

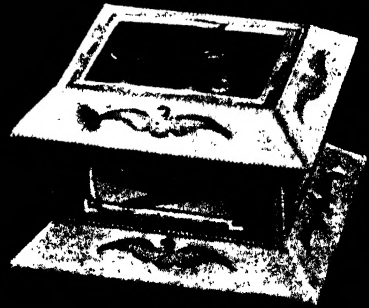
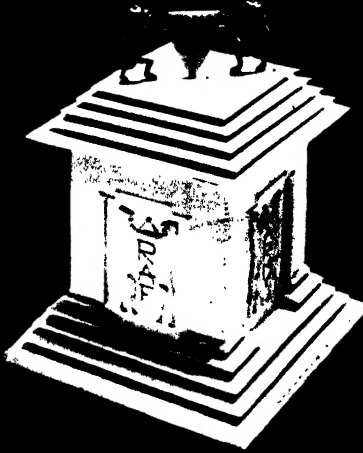
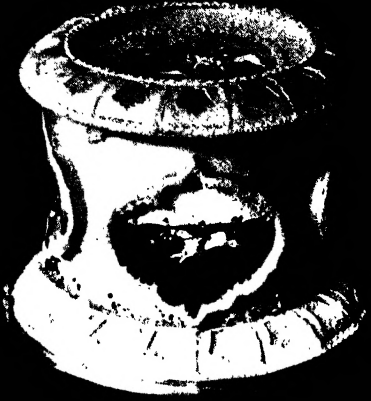
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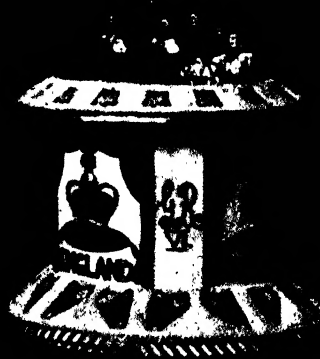
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CAKE MANUFACTURE



EXHIBITION CAKES
Made by STUDENTS of the
NATIONAL BAKERY SCHOOL



CAKE MANUFACTURE

BY

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*This book is produced in complete
conformity with the authorized
economy standards*

PREFACE

SEVERAL excellent books have appeared dealing with confectionery raw materials ; likewise, there are recipe books sufficient to satisfy the requirements of the trade. In presenting this book, it has been the aim of the authors to give such data as will enable the reader to obtain a good working knowledge of the materials and processes they are employing in everyday practice. Emphasis is laid upon the necessity for the production of articles of the highest degree of uniformity and quality ; consequently, special attention is devoted to the methods used for evaluating raw materials and for the technical control of processes, and, also, it is shown how the various methods of preparation of the raw materials may influence the finished product.

It has not been the intention of the authors to prepare a recipe book, but rather to deal with fundamentals, so that with this knowledge recipes can be built up as occasion demands. However, summaries of standard recipes have been introduced, and these will act as a guide to the student.

The book will be found to cover the range of work required for students qualifying for the National Diploma Examination and the City and Guilds of London Examination in Confectionery, Final Grade.

The authors' thanks are due to the following firms who have so kindly provided data and illustrations, rendering it possible to produce some entirely new features : Messrs. Artofex and Co., Ltd., London ; Baker Perkins Ltd., Peterborough ; Wm. Gardner and Sons (Gloucester) Ltd. ; J. Harrison Carter Ltd., Dunstable ; The Morton Machine Company, Wishaw ; The Peerless Electrical Manufacturing Company Ltd. ; C. O. Ericson Engineering Company.

In conclusion, the authors wish to express their gratitude to those who have generously given their assistance, advice and criticism, and especially to Mr. J. T. Parker of the National Bakery School, and to Mr. H. P. Buttrick, A.I.C., for his valuable collaboration in the preparation of the chapter on aeration.

E. B. B.
J. S.

WOODFORD,
August, 1930.

PREFACE TO SECOND EDITION

IN this new edition the authors have included much new matter which has been proved to be of great importance of recent years, and which will prove to be of still greater importance when normal trading conditions can once again be resumed.

As a publication being produced in war-time, it would be incomplete without some reference to war-time commodities and alteration of procedure. A war-time recipe book would, no doubt, appeal to many, but as the supplies of commodities and their availability are changing month by month no fixed recipes can be used. Changes in formula must constantly be made to meet the changing conditions, and it is hoped that from this book guidance will be obtained, particularly if it is read in conjunction with current trade journals.

New chapters on Chocolate, Jam and Jellies, the development of High-Ratio Cakes and War-Time Confectionery Problems have been included. All other sections have been revised and enlarged. Much original research work carried out by the authors and other workers has been included in the text.

The authors' thanks are due to the following, who have given so freely of their advice and help in the revision of the script: Mr. A. Hawley; Mr. H. P. Buttrick, A.I.C.; Mr. A. S. Houghton, M.Sc.; Mr. J. W. Sawtell; Mr. John Pelkman; Dr. Drake-Law and Messrs. Bush & Co., Ltd. In addition, thanks are due to Messrs. Hedley & Co., Ltd., and Messrs. Hobart Manufacturing Co., Ltd., Pelkman Bros. Ltd., Messrs. Bellamy & Co., Ltd., General Electric Co., Ltd., for illustrations for this work.

E. B. B.
J. S.

WOODFORD,
April, 1943.

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CHAPTER I

INTRODUCTORY

FLOUR confectionery—a branch of the baking industry—has developed with great rapidity, and as a result it has become increasingly necessary for all those engaged in the industry, in whatever branch, to have a good working knowledge not only of the materials they are using and of all the processes they are employing, but of all those details so necessary for the production of a regular article of the highest quality.

Science has been a most important factor in bringing about this change, making it possible for large-scale production of most of the ordinary articles of confectionery to be carried out with ease. Further, with the great progress which has been made in the preparation of the raw materials, and especially of the wide range of products which have in many cases replaced the older staple products, it is very necessary that those who are called upon to use them should know exactly what they are using, how these products function when used in different ways, and the results which can be obtained.

For those who are purchasing the raw materials it is important that they should know first of all of what the real product consists, in order that the value of a substance as a substitute can be truly assessed.

There are many substances sold as substitutes which cannot be truly called such ; they are rather to be considered as products of an alternative nature, and by their use more regular products can be obtained. There are others, the number of which is increasing, which are really substitutes, and some are very poor ones indeed.

When raw materials have to be purchased, it is found that there are so many brands of the same product and so many varieties with a wide range of prices that too much knowledge cannot be gained by those who are going to employ them to advantage in their manufactures.

To all those who are entering the confectionery trade, the best advice that can be given is to gain a knowledge of chemistry and physics, for the fundamental principles of both have a very wide application to all matters connected with the bakehouse.

Science underlies the whole working of a bakery. Method, we are

Cake Manufacture

told, is essential, and method is nothing more than working in a scientific way ; for scientific working is systematic working, and the earliest lessons in the laboratory teach one this. Accuracy in weighing materials and prevention of waste are also taught. Science is the great foundation on which the whole superstructure of a successful career is built, yet this is not sufficiently realised. Further, a scientific training results in an adaptable mind, capable of analysing new ideas and eager to test them out ; a willingness to undertake experimental work, so necessary in the development of new methods and new plant ; a courage to face a situation when it arises, and not be content until a successful issue results.

It is not the intention of the writers of this work to deal with any general principles of science, but the matter set out will be grasped much more fully by those possessing a general scientific training.

The training of a first-class confectioner depends on gaining this general scientific knowledge, but today he must also have a sound knowledge of design and modelling, for however gifted a man may be in craftsmanship, that gift will be developed and amplified by proper guidance and study such as a course in these ancillary subjects will provide.

CHAPTER II

FLOUR USED IN CONFECTIONERY

CONFECTIONERS do not always give sufficient attention to the question of choosing the types of flour best adapted to the various goods to be made ; consequently, poor results frequently follow from using the wrong type of flour.

Flour is the final product of milling a mixture of wheats, or single wheats, cleaned, conditioned, and mixed to form a grist which will yield flours suitable for the various requirements of the confectioner.

The quality of the flour depends on the quality of the wheat used in the grist, and also on the method of milling and the length of extraction. There are usually three grades of flour from each grist, known as First Patents, Second Patents, and Straight Run flour. For confectionery purposes, three distinct types of flour should be available. First, a strong flour milled from a mixture of wheats in which spring wheats predominate, such as is employed for the making of bread. Second, a medium flour milled from a mixture of winter wheats, such as American winters and Argentine wheats. Third, a soft flour milled from English, French or German, and weak Australian wheats.

Flour is a mixture of substances, and the following table gives an idea of the composition of the various types of flour required by the confectioner for general purposes :

<i>Constituents</i>	<i>Strong Flour</i>	<i>Medium Flour</i>	<i>Soft Flour</i>
	%	%	%
Carbohydrates - - - -	72·41	73·64	74·85
Moisture - - - - -	13·55	13·78	13·98
Proteins (gluten, soluble proteins) -	12·50	10·76	8·86
Cellulose - - - - -	0·21	0·42	0·55
Fats - - - - -	0·67	0·69	0·89
Mineral salts - - - - -	0·66	0·71	0·87
	100·00	100·00	100·00

Properties of Flour.—The various properties of flour of importance to the confectioner are as follows : It should possess a good creamy colour, and not a grey shade. The best grades of flour have the best

Cake Manufacture

colours, and the poorer grades the inferior colours. A flour of good colour is essential for good confectionery work. The water-absorbing power of the flour depends on the quality of the gluten in the flour, and the amount of moisture already present in the flour. The strength of flour is dependent on the quality and quantity of the gluten present in it. This, to a great extent, is a measure of its ability to produce large volume in goods. The purity of flour is its freedom from foreign starches and any other substance that does not exist in the wheat from which it is milled. The softer types of flour always produce better flavoured products than do the stronger types.

Flour to use for Various Goods.—In the making of fermented buns, a strong flour will produce the bulkiest buns. Texture and flavour should be the first consideration in making fermented goods, so that a flour that is suitable for making good bread is generally suitable for buns. With brioche, however, and other rich fermented articles, owing to their richness, bulk is not the first consideration, and since they are not fermented to so great an extent, would be tough if made with too strong a flour. The medium grade would be better for them. In making puff pastry, the character of the flour is of great importance. A top grade American flour would be of no use for this purpose by itself, nor would a soft English wheat flour. Hungarian flour was at one time recommended for this purpose, but the top grade English milled flour or the strong type indicated here is about the best available for puff pastry. Unless the gluten of the flour is strong and extensible, it will break when the paste is given its various turns. On the other hand, if the gluten is too strong, the paste will be tough to handle and the goods made would have a drawn and contracted appearance when baked.

A medium type of flour is best for all kinds of scones and aerated buns, since the resulting appearance and texture of the finished articles are better than would be obtained by using a strong flour.

Small chemically aerated cakes, such as lunch, madeira, and queen cakes, also require the use of a medium type of flour in order to obtain satisfactory texture and appearance. A stronger flour would yield products of a tough and drawn nature. In making slab cakes and pound cakes of the best quality, soft flours should be used in order to get the best texture and flavour. If the flour is too strong, the appearance is spoiled by toughening and the texture is irregular; the cakes eat dry and harsh and more eggs are required to moisten the batter, thus resulting in a more expensive cake of poorer quality. In making cherry slab, a medium flour can be used in order to hold

Flour used in Confectionery

the cherries in position. The cherries will sink to the bottom if the flour is too soft or the mixture too light.

In the cheaper class of slab cakes a medium strong flour can be used, since these flours absorb more liquid and are aerated by baking powder instead of eggs.

For all rich cakes such as Wedding, Christmas, Birthday, Simnel, or Tennis cakes a mixture of soft and medium flour should always be used to get the best results. With stronger types of flour the cakes are toughened and come out with a rounded top instead of a flat top.

When making short paste goods a soft flour should be employed, because a strong flour readily toughens when it is handled. It must be remembered that a short paste is to be made, not a tough paste. In some cases it is recommended to add a proportion of cornflour in short paste in order that the paste may eat shorter by decreasing the proportion of gluten in the flour. This is unnecessary if the correct flour is chosen.

For sponge goods of all descriptions a soft flour should be used, and here again in some sponge goods a proportion of cornflour is sometimes added to make the flour softer and produce articles of a better texture. This also is unnecessary if the correct type of flour is selected.

Sufficient has been said to indicate the necessity for selecting the correct type of flour. It should always be remembered that texture and flavour are more desirable than bulk in confectionery products. The various types of flour available should be carefully studied, and then the particular one chosen should be used to the best advantage. It should be remembered that on all occasions flour should be sifted before adding to the batch, whether there are any chemicals in it or not, because it is easier to mix the flour with the other ingredients when it has been sifted, thus eliminating the danger of spoiling the batters. Sifting also aerates the flour.

Summarising :

(1) **Strong Flours.**—First and Second Patents, Straight Run grades from wheats with strong glutens.

(2) **Medium Flours.**—Mixtures of strong flours with weaker flours, English, Australian or Indian, American and Canadian winter wheat flours.

(3) **Soft Flours.**—English wheat flours, weak Australian and certain winter wheat flours, French and German flours.

Cake Flours.—Attention to the production of special cake flours was first directed in America when the milling industry investigated the various factors in flour quality which contributed to the special

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qualities required and obtained in flours used for producing the special types of American cakes, notably the Angel Cakes.

Winter wheats are used which possess a low gluten content of good quality, since good gas retention is most important if good volume is to be obtained. The quantity of protein should be about 8.2%. The acidity of the flour must be raised to a *pH* 5.20, and this is accomplished by the use of bleaching beyond that normally carried out with breadmaking flours. Further, the ash content should be low, since this indicates a short extraction flour which is of vital importance. This should be 0.30% or even less.

The granularity of the flour is also of importance, since it has been found for cake work a flour with all its granules of the same size will make far better cakes than one with granules of different sizes.

Another factor which is considered to play an important part in determining the baking quality of the cake flour is the nature of the soil in which the wheat is grown. This has been shown to be the case in America. The viscosity figure obtained with a flour suspension is also used as a factor in determining the standard of cake flour.

Such flours are most essential in High Ratio cakes, since they alone can carry the high sugar and moisture content used in such formulae.

In this country many millers are producing flour specially for cake making, but there are only very few brands so far which approach the American standard of cake flours.

Cornflour.—Cornflour and maize starch are prepared from the cereal *Zea Mais*, maize or Indian corn. The field maize and the sweet or sugar corn are the two chief species of this plant that are cultivated. There are many varieties of these species grown, but the two chief varieties are known respectively as Flint Maize and Dent Maize.

When the corn is ripe the colour of the grain is a reddish-yellow. It is harvested and allowed to mature. It is then washed and dressed, then milled by grinding to a fine powder, and passed through silk bolting cloths to yield cornflour. Maize or corn starch is extracted by washing and purifying the cornflour. It is often adulterated to cheapen it by mixing with potato starch.

Confectioners are familiar with the use of cornflour in making custards. When the cornflour is mixed with water or milk and heated to over 167° F. it swells and becomes gelatinised, and if sufficient cornflour has been used it will set as a thick gelatinous mass. If boiled with water a fairly clear jelly results, which can be coloured and flavoured to imitate the natural jellies. Cornflour is

Flour used in Confectionery

also used to mix with wheat flour in the making of goods which require a very soft flour and fine texture. It also improves the texture of cheap cakes.

Rice Flour.—Rice flour, ground rice, and rice starch are prepared from the cereal *Oryza sativa*, or ordinary cultivated rice plant, which grows in tropical regions. When the rice grains or berries are ripe, they are harvested and allowed to mature. They are washed and dressed and ground by milling in the same way as maize.

Rice flour is useful to the confectioner for dusting purposes because of its granular nature, and because of its special flavour it is employed in making certain kinds of confectionery, such as rice cakes and buns. It is also used in the making of cheap slab cakes, because then more moisture can be added to the batters, thus helping to keep the finished cake moist. The rice flour gelatinises at 176° F. It is also used for macaroon goods, where it helps to produce an open texture.

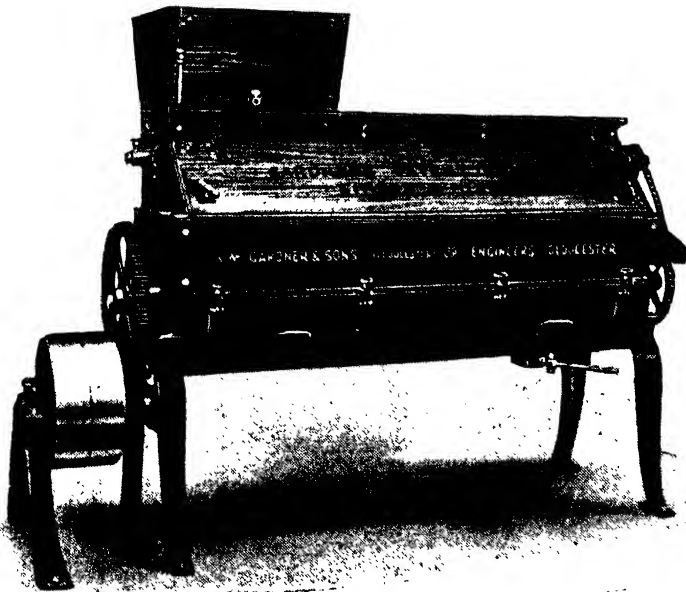


FIG. 1.—FLOUR SIFTING MACHINE.

Flour Blending.—In the manufacture of slab cakes and sponge goods on mass production lines, it is very necessary to have a blend of flours, so that a uniform strength can be maintained from month to month. Similarly, in biscuit factories flour blending plays an

Cake Manufacture

important part, and it is quite common to find six different varieties of flour being used. In order to bring about a thorough blending, suitable plant is required. Fig. 1 shows a sifter suitable for this work. These machines can easily be kept clean and are efficient in their working. Similar plants are also invaluable in the preparation of self-raising flour, but in these modifications must be introduced.

CHAPTER III

MOISTENING AGENTS

Water

FOR all confectionery purposes, when water is used it must be free from suspended matter, colourless and organically pure and not too hard.

Water is seldom used in the manufacture of high-class confectionery, except in the making of pastes, such as cheap short pastes and puff pastes. It is also used in the reconstitution of milk powder and dried eggs. Water is simply a moistening agent, and adds nothing to the food value of the goods.

Milk

Milk is probably the most important moistening agent employed in every bakery, both in bread and confectionery. A knowledge of its composition, food value, and standard of purity, should be of value to those who handle this commodity regularly in baking processes. It is a creamy white emulsion, designed by nature for the complete sustenance of young animals during the first stages of life, when they are unable to obtain food for themselves. Therefore, milk must of necessity contain all the elements necessary for the nutrition of the body. It consists of fats, carbohydrates, nitrogenous matter or proteins, and mineral salts, all either in solution or emulsion in the water. When milk is used in the manufacture of bread or confectionery, something is added which in itself is a perfect food, and so must add to the ultimate food value of the goods made with it. It is necessary to consider the various types of milk that can be used, and what effect they have on the products made with them.

Fresh cow's milk, or the products thereof, is the milk usually used in the bakery.

Composition.—There are considerable variations in the composition of milk as it comes from the cow. These variations are due to various causes, such as the time the cow is milked, the food available (for this affects the fat and protein content especially), the breed of the cows, period of gestation, and the place where they are reared. All these affect the quality and quantity of milk from each cow. A quart of milk contains about $1\frac{3}{4}$ pints of water. The following

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analysis of a sample of milk will give an idea of the amounts of the other constituents present :

Water	-	-	-	-	87.34%	
Butter fat	-	-	-	-	3.95%	
Proteins	{	caseinogen	-	-	3.0%	} Solids (not fats), 8.71
		albumen	-	-	0.45%	
Carbohydrates (milk sugar)	-	-	-	-	4.54%	
Mineral salts (ash)	-	-	-	-	0.72%	
Food value in calories	-	-	-	-	400	per pint.

If the solids (not fats) fall below 8.5% and fats below 3%, it is considered that the milk has been adulterated ; but this is not strictly correct, as is well known to dairymen. Milk is also rich in all the known vitamins (particularly A and B), which are essentials in every food.

The proteins of milk are casein and albumen. Casein is in the milk as very minute particles in the form of a colloidal suspension. When treated with rennet, a ferment secreted by the lining membrane of the cow's stomach, it clots or turns into curds, and becomes more digestible. Milk fat, the most important constituent of butter, is present as minute globules emulsified with the other constituents. On standing, some of the fat settles out, and, as cream, can be skimmed off.

Milk sugar, or lactose, has the same chemical composition as ordinary cane sugar ($C_{12}H_{22}O_{11}$), but is not nearly so sweet, nor is it fermentable by yeast, only yeasts containing the enzyme lactase or certain torula can ferment it to produce CO_2 and alcohol. The lactic acid bacteria present in milk feed on this sugar of the milk, converting the lactose into lactic acid. When the amount of the lactic acid reaches a certain point, the casein is precipitated as a curd. Other bacteria are also present in the milk, which help to turn it sour, although their effect is very small as compared with lactic acid bacteria. As a result, when milk is soured, acetic, butyric, and succinic acids are produced in small quantities. These bacteria are not active at a low temperature. Below 50° F. they do not multiply rapidly. At ordinary temperatures they double themselves every twenty minutes.

The mineral salts in milk are needed by the body for bone formation. They consist of phosphates of lime and potash. The human body requires nitrogenous matters (proteins), fats or oils, carbohydrates (sugars), mineral matters, water, and vitamins to carry on the functions of life.

Grades of Milk.—Milk turns sour easily owing to the bacteria feeding on the sugar of the milk, and so producing lactic acid, which

Moistening Agents

being a weak acid causes the casein to become precipitated with a curdling effect. No milk is absolutely sterile, and producers try to limit the rate of growth of the bacteria, so that the milk will keep longer before souring. Thirty years ago it was difficult in towns to buy milk which would keep fresh beyond a day. Now it is possible to buy milk that will keep fresh for three or four days, even in hot summer weather. Strict precautions are taken on farms to limit the amount of bacteria in the milk, and also to cool it down to below 50° F. as soon as it is produced.

The best certified milk, which is produced under hygienic conditions, and will keep fresh for three days in warm weather, is taken only from tubercular-free cows. It is bottled and sealed on the farms with as little handling as possible. The next grade is about as good, and is in the same category as the best ; but instead of bottling the milk on the farm, it is taken to depots, where it is bottled. A third grade of milk, which is produced under the most hygienic conditions and bottled at depots, is taken from cows which are not certified free from tuberculosis.

Pasteurised Milk.—Milk that has to be kept for a period is pasteurised. This is effected by heating it to a temperature of 145° to 150° F., holding it at this temperature half an hour, and then passing it over a cooler to cool it down quickly to 40° F. The milk is usually heated in bulk, although it may be heated in bottles and then cooled down. The effect of this is not to kill off the bacteria, but to arrest their development.

When normal conditions return—that is, when milk regains normal temperature—the spores commence to develop. If pasteurised milk is kept at a temperature of 40° F., it will keep fresh for a long period.

Sterilisation of milk was the attempt to destroy bacteria present in the milk by boiling. This coagulated the proteins and left them precipitated, and by altering the composition of the milk entirely, conferred on it an objectionable cooked flavour. The proteins of milk coagulate at temperatures over 158° F.

Uses of Milk.—Fresh milk is not usually employed as the total liquor in breadmaking because of the binding action of the casein, but provided sufficient milk is used, to allow for the total solids present, then very high class milk bread can be produced. For this purpose from 19 to 20 gallons per sack is necessary. Fermentation will proceed in a normal manner. Such milk bread is usually made by confectioners in small fancy shapes or as milk cobs.

Unless such a quantity is used, the bread produced would have a bound like appearance and be very close in texture.

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Generally, however, when fresh milk is used, it is customary to dilute it with an equal volume of water, and such a milk mixture will produce very good bread. It improves the flavour, texture and colour of the bread, provided fermentation is allowed to proceed correctly. The fat introduced with the milk gives that silky crumb so much desired in good bread. Such bread would be acceptable as milk bread.

Milk, when used in cakes and aerated goods, gives excellent results. The fat of milk confers richness. The sugar in milk is not nearly so sweet as cane sugar, yet it imparts a certain amount of sweetness and bloom to confectionery. The proteins has some effect in keeping baked goods moist and mellow. The mineral salts give added food value—an important asset. Milk is used in many batter mixings for the sake of cheapness, and to free the batter. It is used in fermented and chemically aerated goods to improve flavour and texture. In cheap slabs, when used in conjunction with nut oils and glycerine, it gives an even texture and assists in keeping the slabs moist. It is also employed in egg and cornflour custards, and in the preparation of many other foodstuffs.

Separated or skimmed milk gives the same results as new milk, less the richness caused by the absence of the butter fat. When the fat is separated off the milk, the composition varies a little. The following is an average composition of separated milk :

Water	-	-	-	-	-	90.7%
Fats	-	-	-	-	-	0.3%
Proteins	-	-	-	-	-	3.7%
Sugars	-	-	-	-	-	4.6%
Mineral salts	-	-	-	-	-	0.7%
						9.0% solids not fats
Food value in calories	-	-	-	-	-	200 per pint

It is interesting to know how much fat is added to cakes with each gallon of milk. This is easily calculated, provided the percentage of fat in the milk is known. The amount of fat added to cakes with each gallon of milk when the percentage is 3.95 of fat is calculated as follows :

$$\begin{aligned}
 & 1 \text{ gal. water weighs } 10 \text{ lbs.} \\
 & 1 \text{ gal. milk, sp. gr. } 1.032, \text{ weighs } 10.32 \text{ lbs.} \\
 & 100 \text{ lbs. milk contain } 3.95 \text{ lbs. of butter fat.} \\
 \therefore & 1 \text{ lb. milk contains } \frac{3.95}{100} \text{ lbs. of butter fat.} \\
 \therefore & 1 \text{ gal. milk contains } \frac{3.95 \times 10.32}{100} \text{ lbs. of butter fat.} \\
 \text{or } & \frac{3.95 \times 10.32 \times 16}{100} \text{ ozs. of butter fat} = 6.52 \text{ ozs. of fat.}
 \end{aligned}$$

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A milk containing more or less fat will yield more or less butter. Milk derives its colour from the globules of fat present. Thus one can readily distinguish new milk from that which has been deprived of its fat.

Milk Powders

There are many milk powders on the market which differ from one another chiefly in the percentage of fat they contain. There are various processes for reducing milk to the dry state, but the same principle is adopted in each—viz., the evaporation of the moisture at a temperature below the coagulating point of the nitrogenous matter. Spray dried powders are always to be recommended since they reconstitute perfectly, whereas roller dried powders do not reconstitute but give a residue. In spray driers the milk is sprayed under pressure into a drying plant with a temperature of about 115° to 120° F. Hot rollers are used for roller dried powders when the water evaporates off, leaving powdered milk. The temperature of the milk must not exceed 95° F. or the flavour will be spoilt.

A genuine full cream milk powder should have approximately the following composition. The composition of half cream milk powder is given for comparison :

	<i>Full Cream</i>	<i>Half Cream</i>
	%	%
Moisture	2.5	2.5
Fat	27.3	16.5
Proteins	26.6	30.3
Lactose	37.6	43.8
Mineral salts	6.0	6.9
	<hr/> 100.0	<hr/> 100.0

Full Cream Milk Powder, upon reconstitution with warm water in the proportion of 1 lb. of powder to 8 lbs. of water, should yield a fluid with nearly the same composition as ordinary milk, and gives practically the same results in use. Its main advantage is cheapness, and it is easily made up in quantities sufficient for each day's work. Full cream milk powder should only be bought in small quantities and kept in a cool store, since it has a tendency to go rancid because of its high fat content. For this reason only the best grades should be purchased, and those with a low moisture content, since they will keep for a much longer period.

Separated Milk Powder is probably better for use in confectionery.

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It is also better for use than full cream milk powder in the manufacture of reconstituted cream, as it gives a more satisfactory cream. This is probably due to the high proportion of casein present which functions as the stabilizing agent. In this variety the fat is separated from the milk before the water is evaporated off. The following is an analysis of a well-known brand :

Moisture	-	-	-	-	-	-	-	-	3.0%
Fat	-	-	-	-	-	-	-	-	0.8%
Proteins	-	-	-	-	-	-	-	-	35.5%
Lactose	-	-	-	-	-	-	-	-	52.8%
Mineral matter (ash)	-	-	-	-	-	-	-	-	7.9%

Separated milk powder is reconstituted by mixing 1 lb. of powder with 1 gallon of warm water. A paste is made with some of the water, and then the remainder is added and whisked well to mix. It is cheap, always handy to make up in any desired quantities, will keep fresh for quite a considerable period, and in practice gives excellent results. It should be reconstituted some hours before required for use, in order to get the best results.

Condensed Milks

Condensed milks are hardly ever employed in this country, owing to the handiness and ever-increasing use of milk powders. Whole or skimmed milk and sweetened or unsweetened milks can be purchased. These milks are concentrated in vacuum pans to a syrup at a temperature well below the coagulating point of the proteins (158° F.); sugar may then be added to preserve them in quantities up to 25% of the weight of condensed milk. The milk as a syrup is put into sterile tins and hermetically sealed.

The law prescribes that the fat content of condensed milk should not be less than 10% and non-fatty solids 25%. If it is separated milk, this must be stated on the label. Each brand of condensed milk usually has the directions on the label explaining how to reconstitute it as whole milk.

Buttermilk

In many places fresh buttermilk is used in the manufacture of aerated goods in place of reconstituted milk. It is the waste product obtained in churning the butter from soured milk. Milk is allowed to become sour, then it is poured into a churning machine and churned. The butter separates out, and what is left is known as sour

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or buttermilk. It contains approximately 90% moisture and 10% milk solids—*i.e.*, traces of fat, proteins, milk sugar, mineral salts, and lactic acid. The longer it is kept the more lactic acid it will contain, usually about 0.8 to 1%.

Owing to the presence of this lactic acid in the milk it is not always necessary to use the same proportion of cream of tartar as is the case when moistening aerated goods with sweet milk. The lactic acid of the milk has a neutralising effect on bicarbonate of soda. The usual proportions are three parts of cream of tartar to two parts of bicarbonate of soda when using buttermilk, instead of four parts of cream of tartar to two parts of bicarbonate of soda which are the quantities generally used with fresh or reconstituted milk. The lactic acid of the buttermilk also has an important physical action on the gluten of the flour, and so matures it. The protein also plays an important part in the production of good volume and keeping qualities. Thus scones and aerated goods are obtained with a greater volume and are softer and moister than those made with ordinary milk. With a sample of buttermilk possessing an acidity of 0.8 to 1%, sufficient aeration, in soda breads, can be obtained by using buttermilk and soda, the latter at the rate of 2½ ounces per stone (14 lbs.) of flour. Such soda bread will have excellent keeping qualities.

Dried powdered buttermilk is now being produced especially for use as a bread improver.

Slab Milk

A new product is now available for the use of chocolate manufacturers known as slab milk, which has the following composition. It is made in the three forms—full cream, half cream, and separated :

	<i>Full Cream</i>	<i>Half Cream</i>	<i>Separated</i>
	%	%	%
Moisture - - -	10	10	10
Fat - - -	12	6	0.5
Protein - - -	12	15	16.5
Lactose - - -	18	21	24
Cane sugar - - -	45	45	45
Ash - - -	3	3	4
Total - - -	100	100	100

It can be used wherever sweetened condensed milk has been used previously, with the advantage that it will keep almost indefinitely.

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Whey Powder

Whey can be dried to produce a powder which can be used in confectionery, but the product obtained from reconstituting is a watery looking fluid and is not very satisfactory.

A modified milk powder derived from whey is marketed under the name of "Cruskmore" and this can be used to replace either full cream or skim milk powder. It reconstitutes to produce a liquid resembling skim milk in appearance. It possesses the property of increasing the volume of goods in which it is used, and preventing rapid staling.

In slab cakes it gives increased volume and good cutting qualities and a reduction in the sugar content of the cakes can be effected by its use. It has no binding action when used either in fermented goods or cakes.

CHAPTER IV

EGGS AND THEIR USES

EGGs constitute one of the most important of the raw ingredients used in the manufacture of confectionery, because they are used to some extent in the majority of articles made. In fact, many of the goods could not be made without them. Eggs in themselves are easily digested foodstuffs if not too highly cooked. There are many methods of using them to give an extra food value to confectionery products.

Sources of Supply.—All varieties of birds' eggs can be used for cooking, as their chemical composition is nearly always alike, although they differ in flavour, but the chief sources of our supplies are hens, ducks, geese, turkeys, and various water fowls. English new-laid eggs are the best to use, but the supply is limited, so they are imported from Ireland, Sweden, Denmark, Siberia, Italy, Canada, New Zealand, Australia, Egypt, China, and elsewhere.

Functions of Eggs.—Eggs when used in confectionery perform many important functions. First, because of the amount of moisture they contain, they act as moistening agents. Secondly, by reason of a property they possess of film formation, whereby they can take up large quantities of air when they are whisked, they act as excellent aerating agents. Thirdly, their chemical composition is such that they act as enriching agents in the goods made. Fourthly they are valuable as emulsifying agents and function as such in cake batters. They not only increase the food value, but they also impart a better flavour, a better colour, and a better appearance. These are all qualities which are of the greatest importance in confectionery.

Eggs vary in weight from $1\frac{1}{2}$ to $2\frac{1}{4}$ ozs. each, but the average weight of a full-sized hen's egg is 2 ozs., or 8 eggs weigh 1 lb., except Egyptian eggs, which average 12 to the pound. There are three different parts of the egg to consider : (1) the shell, (2) white or jelly-like albumen, (3) yellow coloured yolk. These parts bear about the following proportion to each other :

Shell and membrane	-	-	12%	or in weight	7 grms.
Albumen or whites	-	-	58	,, ,, ,,	32 ,,
Yolks	-	-	30	,, ,, ,,	17 ,,
				<hr style="width: 50%; margin: 0 auto;"/>	
				100%	<hr style="width: 50%; margin: 0 auto;"/> 56 grms.
					(or 2 ozs., approx.)

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These are only approximate weights, and may differ slightly according to the size of the eggs. When the eggs are smaller than this the whites are usually weak and watery, and the eggs are dearer to use, owing to the extra weight of the shell compared with the usable ingredients. It may be convenient here also to give the approximate measure of the various portions of the eggs :

- 12 eggs equal 1 pint eggs.
- 20 egg whites equal 1 pint whites.
- 32 to 36 egg yolks equal 1 pint yolks.

An egg contains in primitive form all the blood, bone, muscle, and, in fact, all that goes to make up the young chick. The chemical nature of the chief constituents is nitrogenous in character, for such constituents are required to build up the muscles. Then there are mineral salts for bone formation, and also a supply of fats for the production of heat. The following is an average chemical composition of the edible portion of hens' eggs which shows how the constituents are distributed :

<i>Constituents</i>	<i>Whole Egg minus shell</i>	<i>Albumen or Whites</i>	<i>Yolks</i>
	%	%	%
Moisture - - - -	73·65	86·55	50·44
Proteins - - - -	12·55	12·65	16·05
Fats - - - -	12·15	0·25	32·14
Mineral salts - - -	1·10	0·55	0·82
Organic (non-nitrogenous) -	0·55	—	0·55
	100·00	100·00	100·00
Food value in calories per lb.	720	250	1,700

The following points can be seen from this table :

1. The high moisture content of the whites and yolks.
2. The relatively high fat content of the yolks.
3. The high food value of the yolks compared with that of the whites.

Egg Shells.—The egg shells consist largely of phosphate and calcium carbonate deposited upon a thin membrane which encloses the liquid portion. It is about 11% of the whole egg.

Whites of Eggs.—The egg white, or albumen, consists chiefly of water, in which are dissolved a complex mixture of proteins, such as albumen, globulins, etc., and about ½% of mineral salts. This liquid portion is enclosed in firm fibrous material, which forms

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membranous cells throughout the mass. The membrane is insoluble in water and in dilute acid and alkali solutions. The albumen is miscible in water. The firmer or more jelly-like the whites are, the better they are for confectioners' purposes. It is the presence in the whites of this membranous matter which makes them so useful to confectioners. When egg whites are whisked they give rise to an assemblage of small air cells. This is because the membranous matter provides a structure on which the protein solution can form thin cells in which air is entangled. Anything that tends to destroy this fibrous structure will render the production of a stiff foam impossible. Traces of egg yolks, oily substances, or flour, or dilution of any kind break the filmy cells as fast as they are formed when whites are whisked. Whites which have been separated from yolks and kept for a few days in a cool place will whisk up more rapidly than whites which have been newly separated. The improvement in whipping power is probably due to a change in pH value, possibly brought about by enzyme action. Such whites may have a pH of 6. Fresh egg white is alkaline (pH 8.6-9.0), but after standing for a day or two, it will change in pH, according to temperature of storage. A little sugar added during whisking will aid foam formation, because it forms a syrup with some of the moisture present. The stability of sugar white foam is largely influenced by the pH of the whites. The lower the pH, the more stable the foam. Weak and watery whites are deficient in membranous matter, and are difficult to whisk up. They may be toughened slightly during whisking by the addition of a weak acid solution, but care must be taken not to add too much, since whites are coagulated by a slight excess of acid. Weak acids, such as acetic, lactic, and tartaric, possess the power of coagulating egg whites, so acids should be used sparingly. They are also coagulated under the influence of heat, coagulation commencing about 146° F., and being completed at 160° F. When coagulated the albumen is no longer miscible in water and so loses its power of holding air and being whisked up to a stiff foam.

Egg whites are chiefly used as aerating and moistening agents by the confectioner. The chief goods made with whites are cold and boiled meringues, macaroons and dessert biscuits, and royal icing and certain types of cakes. Whites used alone must be whisked into a stiff froth by entangling air bubbles until a stiff foam is formed. In the oven the air dilates or expands until the sides of the cell walls have been coagulated by the heat. Thus the goods are aerated. This coagulation under heat is a peculiar characteristic of egg albumen. No other foam producing body possesses this charac-

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teristic, but would collapse as the enmeshed gases (air, CO₂, etc.) expanded and distended the cells beyond the breaking point.

Egg whites from duck, geese, and water-fowl eggs are more difficult to whisk up than whites from hens' eggs, because the former contain anatin. Egg whites with the shells are also used for clarifying or making clear syrups and jellies, because of their coagulating properties, whereby the heat of the boiling syrup, etc. causes formation of a tough scum in which impurities are satisfactorily entangled.

Egg Yolks.—The chemical composition of the yolks is more complex than that of the whites. The yolk is the substance provided by nature to feed the chick during its period of development, and so there are more solids present than in whites. There are present the proteins nuclein and vitellin, and certain phosphorised fatty proteins, the main one being *lecithin*, which is an important emulsifying agent. There is a white solid alcohol, *cholesterol*, and a non-nitrogenous body, *cerebrin*. These are important food substances for the building up of the nervous tissues of the body. The yolks contain about 30% of fats, which are identical with those occurring in animal bodies—namely, olein and stearin, with small quantities of palmitin and other fatty glycerides. There is about 1% of mineral salts in the yolks and another important substance, *lutein*, a yellow colouring matter which contains iron in organic combination which is easily assimilated, and thus adds to the food value of the yolks. It is present to the extent of about $\frac{1}{2}$ %, and to this is due the distinctive colour of eggs or goods made with eggs. The coagulation of yolks takes place at a higher temperature than that of the whites. They commence to coagulate at about 160° F., and are completely coagulated at 178° F.

The yolk of an egg is more valuable as a foodstuff than the white, not only from an energy standpoint but also in that it contains certain vitamins, but commercially it has not the same value. The latter commands a higher value on account of its aerating properties. Yolks cannot be beaten stiff like the whites, owing to the presence of so much fatty matter. They can, however, be whisked to retain a certain amount of air cells, because of the presence of small quantities of albumen.

Yolks produce colour, flavour, richness, and shorten the goods in which they are used, and because of their emulsifying properties help to keep cakes moist and mellow. But the best results are obtained by using the whole eggs, when the combined benefits of moistening and aeration are obtained. Yolks are used alone to give colour, flavour, and enrichment in some classes of goods, and, together with milk, function as a moistening and emulsifying agent.

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Use of Eggs.—Whole eggs are capable of aerating their own weight of flour, and on this is based the correct aeration of cakes. If a greater weight of flour than eggs is used, in a cake batter, then some other form of aeration must be employed to aerate the extra flour.

When breaking shell eggs it is necessary to take care that musty eggs do not gain access. Each egg, when broken, should be smelt, since one musty egg would spoil a whole sackful of flour, and there is no means of hiding or evading the consequences of using such an egg.

In the making of sponge goods, eggs are whisked up with sugar until light. The whisking of the eggs is accomplished easily if no grease or flour is present with the sugar, especially when heated to 75° F. over a bain-marie. When heating the eggs, care must be taken to prevent them becoming too hot. They should only be heated until lukewarm.

In cake making, after creaming up butter and sugar, the eggs should not be added too quickly or in too large quantities. Every addition of eggs should be thoroughly creamed in, or the cakes will have a close texture and will be heavy. If they are added in large quantities the batter will curdle. Two at a time to each pound of fat are quite sufficient. The eggs should be heated to the same temperature as the batter, 75° F., otherwise curdling may occur.

Preservation of Eggs.—The shell of an egg is porous, and consequently permits of a passage of air and putrifying organisms. In course of time this brings about evaporation of the moisture in the egg and permits bacterial decomposition of the protein compounds present. The various methods of preserving eggs in their shells have for their object the closing of the pores, and the prevention of decomposition. There are two methods of detecting whether an egg is stale or not. One is to place the egg between the eye and a bright light and look through the egg. The egg is fresh if it appears perfectly clear and transparent, with only a faint indication of an air chamber at the end. An egg that is beginning to go bad will show a cloudy appearance, and a dark opaque mass is shown in an extremely bad egg.

Another method of testing whether an egg is fresh or not is to place it in a 10% salt solution—that is, 4 ozs. of salt in a quart of water at 75° F. A fresh egg will sink in this solution. The older it is the lighter it becomes, and consequently it will float. Decomposition is attended by gas production, and this makes a bad egg lighter than one that is good. This is about the best test for fresh eggs. Another test sometimes employed for a few eggs is the old

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test of holding the larger end of the egg against the tongue, when a good egg will feel warm.

Quite a number of processes have been devised for preserving eggs either in the shells or without shells. Some of the imported eggs are known as chilled eggs. The eggs are kept at a low temperature, just above freezing point. This will keep them fresh for quite a long time, but owing to the porous nature of the shells they lose weight as evaporation takes place. This difficulty is overcome by covering them with a protective fluid, which closes the pores of the shells and keeps the eggs free from the action of air for a time. A 10% solution of silicate of soda, commonly known as water glass, is probably the best for this purpose. Storage in lime water is nearly as good. The fresh eggs are packed in stoneware jars, and the solution poured over them so as to cover them completely. If water glass is used, the eggs will be kept fresh for about twelve months, provided there are no bad eggs among the batch.

Frozen Eggs.—The modern method of preserving eggs is to remove the eggs from their shells and mix them well together, and preserve them in sealed containers of various sizes by freezing and keeping them frozen until required for use. The eggs are about as good to use when they are thawed as fresh eggs, provided they were good when broken and also provided they have been defrosted properly.

Defrosting Eggs.—To defrost these eggs the containers should be placed under running water, and the cold water should be allowed to circulate around the container until all the frost has been removed. The container should then be opened and the contents placed on a tray and well stirred together. The eggs should be allowed to lie until they gradually acquire the same temperature as the bakehouse. Then they are ready for use, and must be used as quickly as convenient. These eggs will not keep very long after they are defrosted. Some confectioners who use frozen eggs obtain them on the day previous to that on which they will be required for use and leave them in the bakery until the frost has all gone. This method of defrosting is quite satisfactory, provided no artificial heat is used to take out the frost. Some people make the mistake of applying heat to the containers, and then condemn the eggs, whereas it is their own bad practice that is at fault. If it is not possible to use all the eggs on one day, then the quantity which is left over should be placed in the refrigerator until the following day, or they can be mixed with a definite quantity of sugar. At least 4 ozs. of sugar should be added to each pound of eggs to keep them sound until the

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following day. The sugar thus added must be allowed for in the mixings in which they are ultimately used.

The whites and yolks are often separated and placed in containers and frozen separately. The whites command a higher price than the yolks. When defrosted they are handy for use, and will whisk up just as readily as whites freshly separated from the eggs. The yolks are used largely by biscuit manufacturers and in large slab cake factories.

Liquid eggs preserved with a suitable preservative, such as boric acid, were largely used for a number of years, but statutory regulations now forbid the use of eggs containing certain preservatives.

Sugar Preserved Eggs.—Sugar preserved eggs when obtainable can be used for almost all kinds of goods. These eggs have usually 25% of their moisture evaporated and 25% of sugar added to take its place. When using these eggs, allowances must be made for the sugar contained in them and a proportion of water must be added to reconstitute them ready for use as ordinary eggs. Thus, if it is desired to use 4 lbs. of these eggs one must add 1 lb. of water to the 4 lbs., resulting in 4 lbs. of eggs and 1 lb. of sugar.

Another modern method of preserving eggs is to evaporate the egg yolks to a thick syrup, adding a proportion of glycerine before concentration. The function of the glycerine is to assist uniform drying and to provide mechanical support to the oil globules as their surrounding fluid shrinks under the evaporation process. Thus, no over-desiccated fragments of egg are formed, and the whole mass is uniformly smooth, while the oil globules are not disrupted. Without glycerine, shrinkage of the surrounding fluid causes collapse of the oil globules. Certain colloid substances will act in the same manner, and these can certainly not be regarded as "preservatives" (in the usual sense of the word). To reconstitute such a concentrated yolk, use 2 parts water to every 7 parts of the concentrated yolk. However, the commercial practice is for certain large manufacturers to buy all the concentrated yolk imported, and to mix with appropriate quantities of water and of crystal albumen to produce a "double-strength" egg. Such a double egg would require its own weight of water for reconstitution, and if properly manufactured, will be quite as satisfactory as are other forms of eggs for making sponge cakes. The double-strength egg, as described above, will keep in a cool place for several weeks, and does not require actual cold storage. The pH of such egg is usually corrected to normal.

Dried or Desiccated Eggs.—Desiccated whole eggs, whites, or yolks are also largely in use in the manufacture of confectionery. These

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are prepared by evaporating the water from the liquid eggs at a temperature below their coagulation point, temperatures below 125° F. usually being employed. Various methods are used to reduce the eggs to a dry state ; one method is to force them under pressure in the form of a spray into a chamber, the temperature of which is kept below 125° F. This procedure dries the egg quickly, which then falls to the floor as a powder. Another method is to spread the eggs as a film on roller, at a temperature of 125°. This gives a rich yellow solid which readily powders, but which does not reconstitute as well as the spray dried eggs.

Whole egg powder is reconstituted by soaking 5½ parts of the powder in 14½ parts of tepid water, and mixing well together with a whisk and stirring occasionally for one to three hours. These eggs are ready for use after about one hour's soaking. Some of these are satisfactory in the making of cakes, but will not whisk up sufficiently light to make normal sponge cakes unless whisked at a temperature of 100° F. when good sponges are obtained. Other varieties possess little aerating power and can only be used when a modified baking technique is employed.

Dried Albumen is prepared in two ways, one by the so-called fermentation process, the other by the straight drying process. In the fermentation process the whites are placed in large wooden barrels having a capacity of 4000 lbs. and left for three to four days. During this time a scum forms on the top, which is removed at the end of the time. After the requisite time the whites are placed on trays and dried at a temperature below 125° F. when the product known as crystal albumen is obtained.

During the fermentation process certain chemical changes occur including a shift of the pH from the alkaline to the acid region. In natural egg whites the protein ion is negatively charged, and forms albuminates of the various bases (Ca, Na, etc.). When fermentation has proceeded to below the iso-electric point, the protein ion becomes positively charged, and acts as a basic radical, forming albumen lactate, acetate, etc. This very materially affects the baking qualities of the finished product, yielding an albumen of much greater strength.

In the straight process a dried albumen is produced which can only be kept satisfactorily in cold storage. This does not form such a good foam when reconstituted and whipped, and so possesses inferior baking qualities.

The whites, when dried separately from the yolks, are reconstituted by adding seven parts of water to one part of dried albumen,

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and mixing well, then stirring occasionally for three or four hours before use. This gives a product similar to ordinary egg whites, and can be used in the same manner, but requires more whisking to make a light meringue. It is very useful for making royal icing and macaroons.

A spray dried yolk powder can be produced having a moisture content of slightly less than 5%. Like the whole egg powders, such sprayed yolks do not disperse freely in water, and are not suitable for making sponge cakes.

They are reconstituted by adding an equal weight of water to them.

Dried eggs are not of the same value to the confectioner as frozen or shell eggs. The products are often not so well aerated as when shell eggs are used, although good cake can be made.

The following table gives the average chemical composition of dried eggs products :

<i>Constituents</i>	<i>Whole Egg</i>	<i>Whites</i>	<i>Yolks</i>
	%	%	%
Moisture	6.45	14 to 17	5.05
Proteins	47.85	78.84	33.95
Fats	40.45	Traces	54.26
Mineral salts	4.15	4.65	3.65
Undetermined	1.10	0.14	3.09
	100.00		100.00

Sponge Products with Dried Egg

After much experimental work in various places it has now been found possible to make good sponges and swiss roll with reconstituted dried egg.

When no other type of eggs were available but dried egg for sponge making, various methods were tried to get them to foam and so give light sponge products. To overcome the difficulty of lack of foaming qualities some people tried making a meringue with sugar, water and gelatine or isinglass, in order to introduce through the medium of a meringue, the air that is normally entangled during the whisking stage. The addition of boiling syrups with increased acidity has also been used, but these methods while giving fairly good results are not practicable for large scale commercial production since they require more labour.

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The Hedley Research Bakery introduced a new method in May 1942. In this method about 25% of the total flour is added to the reconstituted dried egg and sugar in the first stage of sponge making. The mixing is then whisked for twenty minutes on fast speed, by which time the sponge should have whipped up to a foam similar to that of frozen egg. When this stage is reached the remainder of the flour in which baking powder has been sifted is added in the normal way. Each stage of this new method is given with the formulas.

The result of this unorthodox method is to produce sponge products which have tenderness, shortness, lightness and volume comparable with sponge products made with frozen egg.

SPONGE CAKES AND SANDWICHES

<i>Ingredients</i>	1	2	
Reconstituted egg	- 2 pints	2 pints	} Mix and whisk for 20 mins. on fast speed.
Sugar	- 2 lbs.	3 lbs.	
Flour	- $\frac{3}{4}$ lb.	$\frac{1}{2}$ lb.	} Add and mix in to sponge as desired.
Milk or Substitute	- —	$\frac{1}{4}$ lb.	
Colour and flavour as desired.			
Scone Flour	- 1 $\frac{1}{4}$ lbs.	2 $\frac{1}{2}$ lbs.	Sift and mix in lightly.

Drop out sponges and sandwiches in usual manner. Bake at 400° F.

SWISS ROLL

Reconstituted egg	- 2 pints	} Whisk together for 20 mins. on fast speed.
Sugar	- 2 lbs.	
Flour	- $\frac{3}{4}$ lb.	} Add and mix into sponge.
Milk or substitute	- 9 oz.	
Colour and essence as desired		
1 $\frac{1}{4}$ lbs. Scone Flour.		Sift and mix in lightly to sponge.

Spread out as usual on baking sheets using about 2 $\frac{1}{2}$ lbs. per sheet. Bake at 450° F.

Egg Substitutes.—Many powders are provided on the market as substitutes for eggs. These so-called egg powders bear no relation whatever to eggs except in colour. They are composed mainly of Soya flour and cornflour, or other starches, with an addition of baking powder and colouring matter, and milk powder or some milk product together with some albuminous matter. They provide aeration but do not perform the same functions as eggs.

There are albuminous powders obtainable as substitutes for whites of eggs. These contain considerable portions of protein matter, being prepared from gelatine, gum, blood albumen, and casein. They are greyish-looking powders sold under various trade

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names. When dissolved in water and whisked they hold a certain amount of air, but not always to the same extent as egg whites. They fail to aerate the goods to the same lightness as egg whites, because the cells tend to burst when heated. The result is the products either fail to rise sufficiently, or if they rise lightly they may collapse again before cooking is finished.

Some of these substitutes are very suitable for the making of royal icing; owing to the absence of membranous matter they yield a whiter icing. The membranous matter in egg whites tends to make the icing greasy.

Eggs are usually the sole aerating agents in all types of sponges. The following table of recipes will give the reader an idea of the uses to which they may be put in making these articles, and also how the yolks may be used as a substitute for butter in the making of gateaux:

Name of Goods	Whole Eggs	Yolks	Sugar	Flour	Butter	Milk	Baking Powder
Light Genoese	1 ½ pints	—	1 lb.	1 lb.	½ lb. or 10 ozs.	—	—
Light Genoese	1 ½ "	½ pint	1 "	1 ½ lbs.	½ or ½ lb.	—	—
Light Genoese	1 ½ gills	1 "	1 ½ lbs.	1 lb. 2 ozs.	6 or 8 ozs.	—	—
Butter sandwiches	1 pint	1 "	1 lb.	1 lb.	½ lb.	—	—
Butter sandwiches	½ "	½ pint	1 "	1 "	½ "	—	—
Swiss rolls	1 "	—	14 ozs.	12 ozs.	—	—	—
Butter cream rolls	1 "	—	12 "	10 "	—	—	—
Cheap Swiss rolls	1 "	—	1 lb. 10 ozs.	1 lb. 14 ozs.	—	1 pint	1 ½ ozs.
Othellos	1 "	—	6 or 8 ozs.	8 ozs.	—	—	—
Sponge buns and sandwiches	1 "	—	1 lb.	1 lb.	—	—	—
Cheap sponge buns	1 "	—	1 lb. 5 ozs.	1 lb. 11 ozs.	1 oz. glycerine	1 gill	½ oz.
Cheap sponge sandwiches	1 "	—	1 lb. 8 ozs.	1 lb. 9 ozs.	1 oz. "	½ pint	1 "
Cheap sponge sandwiches	1 "	—	1 lb. 12 ozs.	2 lbs.	1 ½ ozs. "	½ "	1 ½ "

The usual method of obtaining the aeration in the above goods consists in heating the eggs and sugar together over a bain-marie. The temperature of the mixture should be about 75° F. The whisking is done by machine until the batter is light—that is, when the impressions made by the whisk take a few seconds to flow level. Time taken should be about seven minutes. The flour should be carefully sifted. When baking powder is used it is sifted with the flour. The flour is carefully mixed in when the batter is light, until it is cleared. Where butter is added, it is added in a liquid state while clearing the batter; care must be taken not to mix in too soon or too much, otherwise the batter will become heavy owing to the breakage of air cells, and the cakes will bake out leathery.

Where milk or water is used, it is beaten up along with the eggs and sugar, then the flour is mixed through until clear.

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Flavours and colours may be added to the batter before adding the flour, in order to produce any desired variety of flavoured and coloured cake.

When large machine whisking is carried out, no water-jacket is used—otherwise the method of procedure is the same. The Morton Pressure Whisk has revolutionised the manufacture of sponges and has made modifications of method and recipes essential.

Fruit juices and jams may also be added to sponges during whisking to obtain very light well flavoured sponge goods, but allowance must be made for the sugar in these products.

CHAPTER V

BAKING FATS

FATS are the primary enriching agents used in flour confectionery, and those which are used must be of a digestible nature. For this reason only the vegetable and animal fats are suitable, since hydrocarbon oils and fats cannot be digested in the human system. If any such were used, violent indigestion would be caused. The names oils and fats embrace a very wide range of substances, and because of the important part they play in bakery operations it is essential to know not only their relative digestive properties, but also something of their chemical and physical properties.

Strictly speaking, there is no chemical difference between a fat and an oil. If a substance of this class is liquid at the ordinary temperature (15° C.) it is termed an *oil*, whilst if it is solid under the same conditions it is termed a *fat*.

Bakers' oils and fats are generally colourless or pale yellow, and possess one property which is familiar to all, and that is their greasiness, which is somewhat different to the greasiness of other oils in a way which cannot be defined easily. To the majority of people an oil or fat is a substance which, when smeared on paper or any surface, makes a greasy mark difficult to remove. This idea of greasiness does not help at all in differentiating between the different types of oils and fats. In order to do this it is necessary to turn to the chemical viewpoint, which states that all vegetable oils and fats are mixtures of glycerides, a glyceride being a substance which breaks down under certain conditions to produce glycerine and a fatty acid. In this the vegetable oils and fats differ from mineral and essential oils. Another difference from mineral oils is saponification on treatment with Caustic Soda.



This change can be brought about in many ways. Chemically fats consist of carbon, hydrogen, and oxygen.

In order to understand the varying physical properties of fats, especially concerning their solidity or hardness, it is important to know something of the glycerides which are present in fats. The five most commonly occurring are :

Cake Manufacture

Olein	}	Liquid at ordinary temperatures.
Lauricin		
Myristin		
Palmitin		
Stearin	}	Solid " "

The first three are liquids, whilst the fifth is a waxy substance and the fourth is of an intermediate consistency. From this it will be clear that the firmness of a fat depends on the proportion of stearin present; the greater the amount present, the firmer the fat. This has been taken advantage of in the production of the wide range of hydrogenated fats and cake margarines now produced for the convenience of handling by the confectioner. These five are known as "fixed fats", because they do not evaporate or lose weight when distilled with water. Animal fats are generally solid; mutton fat contains a high percentage of stearin, so is very firm; beef fat contains considerable quantities of olein and myristin, and so is much less firm and approximates more to the consistency of butter. Butter, margarine, and neutral fats are a mixture of these five glycerides in varying proportion. In butter an important constituent is butyric. Most of the fats which are obtained from vegetables are fluid and oily at ordinary temperatures, whilst at lower temperatures they attain a solid consistency. For example, in cold weather cotton-seed oil will solidify, as also will olive oil and many other vegetable oils.

Vegetable oils can be classified on their capacity for drying—that is, their capability of producing a hard film when exposed to the air as a thin layer.

1. Non-drying oils.
2. Semi-drying oils.
3. Drying oils.

The best-known non-drying oil is olive oil, whilst others which are almost completely in this category, but are generally classed as semi-drying, are cotton-seed oil, sesame oil, arachis oil, all of which are good cooking oils and are used in margarine manufacture.

Drying oils are required by the painter, and linseed oil is the best, this being an oil which dries very rapidly. Such an oil would not be satisfactory as a food.

It is obvious that for foodstuffs a non-drying oil is the ideal, and only those which approximate to this are suitable, especially from the view-point of digestibility.

There are some vegetable fats which find use in confectionery either for direct incorporation in products or for manufacturing fats.

Baking Fats

Such fats are palm-nut oil, coconut oil, cocoa butter, and shea-nut butter.

Now turning to the animal world, it is found that the fats available can be divided into four classes, but here the source of the fat is the consideration, not some physical property.

1. Solid body fats.
2. Animal oils.
3. Milk fats.
4. Fish and marine animal oils.

The most important of the first class is lard, whilst suet or beef fat is equally important for certain products. Of the second class, there is one oil, *lard oil*, which is well known. This is the more liquid portion of lard, and is prepared by expressing it out of the lard, when lard stearine is left behind. Of the third class, butter is the most important, and it differs from all other fats because of the presence of certain volatile fatty acids to which the flavour is due—a fact of great importance when its identification is in question. In the fourth class there are many fish oils used today in margarine manufacture—salmon oil, herring oil, whale oil, and others which are deodorised. When margarine is made with such oils, there is always a danger of a fishy odour being imparted to the finished products.

Practical Application of Oils and Fats

The generally accepted view of the influence of fats and oils in bread and confectionery is that the fat effects a mechanical hindrance on the flour particles, and so prevents their cohesion, and if sufficiently large quantities are used eventually produce a dough possessing no cohesion. One school of thought considers that no chemical change takes place, since the fat, being insoluble in water, is not absorbed by the flour, but is merely mixed among it in such a way that it causes a separation of the flour particles. As a result, the elasticity of the dough produced from the flour in which fat or oil has been mixed is different from that of a dough containing no added fat, and the quality known as *shortness* is conferred on the products. When used in small quantities, oils and fats actually seem to cause a modification in the nature of the gluten of the flour through some possible protective colloidal action. When larger quantities are used, there results a more complete dispersion of the fats and oils in the mixings and the formation of emulsions.

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Properties of Oils and Fats

Most fats and oils are either colourless or possess a pale yellow tint. They are insoluble in and immiscible with water, but are readily soluble in each other and so can be mixed in varying proportions, and should be without taste or odour. Any flavour or odour they possess points to imperfect refining, or partial decomposition due to rancidity setting in. If any flavour is present it is generally an indication of the source of the fat, and today is a sign of inferior quality. Fats are soluble in certain solvents, such as ether and benzene, some of which are used for their extraction from the raw materials in the manufacture of cheap fats. All fats have a definite melting point and solidifying point, which differ with each fat. The specific gravity of most fats is from 0.91 to 0.97. There are many constants which have to be observed by the manufacturer if he desires to produce a regular product. Rancidity has also to be guarded against, and in order to do this the oils and fats must be properly refined and stored afterwards. Rancidity develops in the presence of air, light and moisture, so that the best place to store fats is a dark room which, however, must be kept scrupulously clean.

With rancidity an unpleasant flavour develops, due to decomposition of the glycerides. The cause of rancidity is gradually being solved. There are two main theories, one being that the process is one of oxidation, the other that it is caused by bacterial action.

A. There are two stages of decomposition when the oxidation theory is considered.

1. Hydrolysis of glycerides to form free fatty acids and glycerol.
2. Oxidation of acids and glycerol; this is formed on interaction of the oxidation products, the resulting compounds being responsible for the unpleasant taste and odour of rancid fat.

B. Rancidity is also considered to be produced by the action of zymogen, which in the presence of warmth and moisture produces lipases, thus forming fatty acids.

Fats for cooking purposes, such as frying doughnuts, should stand heating to a temperature of at least 400° F. without undergoing decomposition. Inferior fats will decompose below this temperature and cause noxious smells.

Uses of Fats in Confectionery

Fats are used in confectionery for a variety of reasons. They are first used as shortening agents, and the quality and body of the fat

Baking Fats

used determine the quality of the confectionery. The fats assist in giving cakes their flavour, texture, moistness, and good appearance. When body is mentioned with regard to a fat, it is presumed that the fat has good creaming properties, and will retain or entangle the air when creamed up with sugar and eggs. Some fats cream up easily, but have little body, because they cannot entangle the air to give the necessary aeration in cakes. Other fats are difficult to cream up because they contain too much of the hard solid fat stearin or are crystalline in structure as in lard. In this case it would be impossible to get good texture in the products.

The fats used for any special types of goods should be chosen by their quality, freedom from moisture, and according to the purpose for which they are to be used.

Butter is the fat that fulfils most of the requirements of the confectioner ; there is no other fat which can impart the same flavour and quality to products.

Hydrocarbon fats of a tallowy nature have been known to be used in pastry margarines. When the goods were consumed, a considerable outbreak of indigestion occurred which was traceable to this. There are many fats sold for the production of puff pastry, the main virtue of which is to produce an even lift in the products by being able to produce thin films in the paste. Such fats contain a high stearin content, with the result, instead of an easily digested product being produced, one very difficult to digest is obtained, because of the layers of fat in the paste. The use of these products is to be deprecated, since, as in so many other branches, the appearance and ease of production by semi-skilled operatives are being considered, to the detriment of the eating qualities.

Butter

This fat consists chiefly of the fat of milk, and necessarily must also contain curd, milk sugar, and mineral salts. It is obtained through churning the ripened cream of cow's milk. The churning process causes the fatty globules to coalesce and form granules. When the butter has formed, it is well worked together with wooden spatulas to remove the buttermilk and make it into a homogeneous mass. A little salt and colouring matter may be added to the butter during working in order to preserve it and impart a better appearance. It should not be touched by hand during churning or packing, otherwise it may become contaminated with bacteria and lose its keeping qualities.

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Butter can be classified into various grades. When grading, most points are given to flavour ; then come body, texture, and amount of contained moisture. Colour is also considered, the percentage of salt, and lastly the general appearance. If the grade of butter is known, one can be well assured as to the quality.

No matter how carefully butter is made, it contains a great deal more than pure fat. Too much curd in the butter shows that it has been badly manufactured, and if there is an excess of proteins these quickly change and impart an unpleasant and cheesy taste. Salt is added as a preservative and for flavour, but too much should be avoided. Excess moisture in butter should be squeezed out before use. It is fat in butter which is of the greatest value to a confectioner, and the more readily that a butter will cream the more valuable it will be for cakemaking.

TYPICAL ANALYSIS OF BUTTER

<i>Composition</i>	<i>English</i>	<i>Danish</i>	<i>Siberian</i>	<i>Australian</i>	<i>New Zealand</i>
	%	%	%	%	%
Fats . . .	82.15	83.45	86.25	84.50	85.80
Moisture . . .	14.25	13.40	10.85	12.85	10.80
Curd or casein . . .	1.55	1.25	1.25	1.25	1.20
Salt . . .	2.05	1.90	1.65	1.40	2.20

The glycerides in butter are the five already mentioned, and are present in varying proportions, along with nearly 6% volatile fats such as butyric and its allied substances.

Some butters are defined as weak and others as strong. When using them, it is easy to tell the difference. Siberian butter is a tough waxy butter of good flavour, and is excellent for making good puff pastry. This strong waxy butter makes the paste lighter, and both lightness and flavour are retained. With a softer butter, this would not be the case ; the paste would not rise so well and the oil might run out when the pastries are baked.

In making cakes, butter is generally creamed—that is to say, the butter is usually beaten until it is of the consistency of cream. This act of creaming consists in breaking down the butter into an emulsion of water in oil. It creams easily owing to the absence of granules, and it will retain the air thereby incorporated better than other fats.

The reason why butter is superior in flavour to any other fat is

Baking Fats

due to the presence of volatile fats which it contains. This has its drawback, however, because when butter is kept under unfavourable conditions it soon becomes rancid and at the same time decomposition of the fat proceeds.

Uses of Butter.—If too much salt is present in the butter it is usual to wash it out first in pure cold water, and then beat the butter well to get rid of excess water. Butter gives to the goods a better flavour, a more even texture, and a lighter cake of good appearance than most other fats. It should be employed in the making of all high-class cakes where the above qualities are essential. It is also employed in the making of lemon cheese curds, butter creams, and in toffee making. Wherever quality and good flavour are required as the first consideration in any type of confectionery, there butter should be employed.

Lard

Lard is also a very important fat used in confectionery. For a long time it was the only substitute used for butter. Lard may be defined as the fat separated for use as food from the fatty tissues of pigs. The lard is rendered by first mincing the tissues or crushing between rollers, and then subjecting to a dry heat until the fat runs out of the cells (in the case of home-rendered lard). The temperature used is just sufficient to melt the fat (about 110° F.). If too high a temperature is used the colour of the fat is spoiled, and a bad flavour is imparted which cannot be remedied by refining. This process is adopted frequently for rendering fat which is used in the preparation of margarine. Owing to the low temperature at which it is rendered, it may have a certain enzymic activity. This accounts for the fact that neutral lard will go rancid more readily than lard rendered by steam.

The other method of rendering fat is to subject the mass to high pressure steam to expel the fat from the ruptured fat cells.

Classification.—The great bulk of the lard used in commerce is imported from America, and according to the Chicago Board of Trade is classified into the following grades :

(1) *Neutral Lard No. 1*, which consists of leaf fat rendered below 110° F.

(2) *Neutral Lard No. 2*, which consists of fat derived from the back of the pig.

(3) *Leaf Lard*, obtained by subjecting the residue of No. 1 to high-pressure steam.

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(4) *Choice Kettle-Rendered Lard*, obtained by rendering the residue of No. 2 in high-pressure steam kettles, hence the name.

(5) *Prime Steam Lard* is the portion rendered by steam from the trimmings and other fatty parts of the animals.

Greases and inferior fats are obtained from entrails, feet, and scraps. American lard is usually of a softer nature than European lard. This is due to the differences in the animal and to the different type of food consumed.

Composition and Properties.—Pure lard has a firm consistency and granular texture, and is perfectly white in colour and should have an agreeable flavour. The lower qualities have a somewhat insipid flavour. Lard is composed chiefly of the three common glycerides—olein, palmitin, and stearin, olein being the predominant glyceride. There are also certain unsaturated compounds resembling those of linseed oil, together with nitrogenous compounds, mineral salts, and moisture. It contains 92 to 95% fatty glycerides. Fresh lard, especially if it has been rendered from the pigs while still warm, should be practically neutral (not more than 0.5% free fatty acids), but upon exposure to the air gradually becomes acid in reaction.

When lard has been rendered out it should be run into sterile containers, and not touched by hand or exposed to the air, and should be kept in a cold place until ready for use.

Food Value and Use.—Lard is a fat possessing a high food value. It is easily absorbed and digested by the human digestive system, and so is an important heat-producing food. It is used in confectionery as a shortening agent in the making of short pastes for pies, etc., because of its excellent flavour and shortening properties and relatively high melting point. When used in conjunction with butter in the proportion of 75% butter to 25% lard, it gives a crispness and shortness to pastries which is not obtainable by using butter alone. It is also employed as a cooking fat for both boiling and frying purposes. It is useful for greasing utensils for cakes which must have an even surface and good appearance. Pure lard will not cream up well by itself because of its crystalline nature, which form long coarse crystals with a chisel shaped edge. These pack together like felt, and so cannot be creamed satisfactorily.

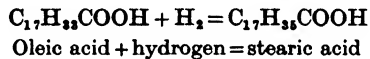
Lard Compounds.—Lard is often adulterated by the addition of cheaper fats, such as cotton-seed, soya-bean, and nut oils, beef fats, and fish oils. Lard compounds are intimate mixtures of vegetable and animal fats bleached as white as possible. Some of these compounds have a consistency and appearance closely resembling lard, especially if made from tallow beef fat and well-refined nut oils.

Baking Fats

These lard compounds are practically free from acids, mineral salts, and nitrogenous matter. That is to say, they consist almost entirely of fatty glycerides, or are 100% fats.

Compound Fats or Vegetable Butters

Lard and lard compounds have been largely displaced in modern times by compound fats made from refined coconut oil, palm-nut oil, cotton-seed oil, and other vegetable oils. These are good cooking fats sold under a variety of names. It is only within recent years that the problem of converting fluid oils into solid fats has been solved. This has been accomplished by the catalytic hydrogenation process, which consists of treating oils with hydrogen in the presence of finely powdered nickel or platinum as the catalyst at a suitable temperature. The catalyst does not take any part in the chemical reaction of the hydrogen and oil, but it causes the two to unite, so that it is now possible to obtain fats of any desired consistency. For instance, in the case of oleic acid the absorption of hydrogen may be represented as follows :



Other fatty glycerides can be changed in the same way, the degree of hardening depending on the duration of the hydrogenation process. By this process any liquid fat can be changed at will to the consistency of butter or lard, or tallow beef fat. Consequently, oils which formerly had not a wide application in foods are easily converted into fats, and so their use is extended very considerably.

Shea butter is now finding extensive use in baking and pastry fats, because of its emulsive properties.

Vegetable Oils

Vegetable oils are mostly obtained by extraction in hydraulic presses, whilst small amounts are obtained by extraction with volatile solvents. When pressure is used, there are four distinct operations :

(1) The seed is crushed or ground in special roller-reduction mills, so as to break the oil cells.

(2) The ground seed is heated so as to facilitate the flow of oil and to coagulate the albumen. This is done in what is called a heating kettle.

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(3) The product is now gently pressed in a moulding machine to prepare it for the hydraulic press.

(4) The seed is conveyed to hydraulic presses and the oil expressed.

The different vegetable seeds used for the production of oil require rather different treatments, but here we shall only deal with those used in the trade.

Cotton Seed.—For edible purposes this is generally prepared by decorticating the cotton seed. The kernel of the seed is surrounded by husks, which contain strong, deep brown colouring matter and little or no oil. Thus the following advantages are derived : (1) The oil is of a better colour ; (2) the press cake is of a better quality ; (3) the material treated being richer in oil than the whole seed, a greater amount of oil can be obtained in a given time.

The oil is refined by various processes and marketed in various forms, generally as a colourless oil. Steam is used to deodorise the oils and to coagulate the protein matter, and treatment with fuller's earth, decolorising carbon, etc., improves the appearance.

Arachis, or Pea-nut Oil.—This is produced in a similar way to cotton-seed oil, and is marketed as high-class vegetable oil. It has a pale yellow colour, and will solidify at temperatures below 40° F. The second grade is largely used in margarine manufacture, the first grade being used as a cheap substitute for olive oil. A colourless variety of the oil is obtainable.

Sesame Oil is used for foodstuffs and in margarine manufacture.

Cocoa Butter is the fat obtained from the cocoa bean, and is used in the manufacture of chocolate. It melts at about 90° F.

Coconut and Palm-nut Oils and Ground-nut Oils are also used in the manufacture of edible oils.

Coconut oil solidifies at 69° F. It is a soft, white, butter-like mass at ordinary temperatures, with an agreeable odour and flavour. Many of the well-known brands of compound fat consists simply of this coconut oil. The chemical constants of this oil are closer in relation to butter than any other fat, and it is very difficult to detect when used to adulterate butter. It is much used in the manufacture of margarine.

Palm-nut Oil is also used in making margarine and vegetable butters, and sometimes as a cocoa butter substitute.

Coconut oil and palm-nut oil can be subjected to hydraulic pressure to separate the stearin from the olein. The longer the fats remain under pressure, the higher the melting point of the residue will be.

There are many other oils which can be obtained from vegetable

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sources, and after refining are good for human consumption. When hardened sufficiently to make into fats, they are good substitutes for butter in the making of cheap cakes. These hydrogenated fats are 100% fats. They are usually excellent for creaming purposes, being easier to cream up than butter. If compound fat is used to replace part or all of the butter in a mixing, then one must remember that compound is 100% fat, whereas butter is only 84% fat; therefore, in order to maintain the balance in the mixture only 14 ozs. of compound should be used to replace 1 lb. butter. Compound fat cannot be expected to give the flavour of good butter. When that is wanted, it is advisable to use a proportion of butter in the cakes. Compound fat, when used in small proportions along with butter in cakes, helps to impart an excellent texture and better keeping qualities.

Lard Oil.—When lard is slightly heated and then subjected to hydraulic pressure, it is possible to separate out what is known as lard stearine, which is used in the manufacture of margarine. The oil, forming about 60% of the whole and consisting mostly of olein, has a soft, pleasant taste, and is a good edible oil; it is sometimes used in place of or as an adulterant of olive oil.

Beef Fats.—Beef fats are rendered down in the same manner as hogs' fat. The first rendering gives hard fat known as *premier jus*, which is used largely in making margarine. When the *premier jus* is placed in bags, heated, and subjected to hydraulic pressure, the softer fat, or oleo oil, runs out and what is known as *stearine* remains. The former is a soft fat with a low melting point; the latter is a hard, firm, white fat with a high melting point. Both are used in the manufacture of various types of margarine. The fatty glycerides in beef fat are mostly stearin, palmitin, and olein. Therefore, in the separation of *oleo oil* and *stearine* from the *premier jus*, the oleo oil is largely composed of olein and palmitin, whereas the stearine is largely composed of the glyceride stearin.

Margarine

Margarine has largely taken the place of butter in many bakeries where the cheap varieties of cake are made. The oils or fats used in the making of margarine are obtained from either animal or vegetable or marine sources. The various fats that may be used are neutral lard, *premier jus*, oleo oil, pea-nut oil, coconut oil, palm-kernel oil, fish roe, whale and other oils.

The fats must first be thoroughly refined; if not, the margarine would soon become rancid and would not be good to eat.

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Fish oils, in addition to deodorising, must be hydrogenated to make them suitable for the manufacture of margarine.

After refining, the oils are blended so that the finished margarine will have a definite melting point. If it is cake margarine that is being made, the melting point will approximate to that of good butter; if pastry margarine, the melting point will be considerably higher, and fats with a higher melting point will be used. Many of the pastry margarines are far too tough. This has resulted from a desire on the manufacturer's part to guarantee an even "lift" in the oven, irrespective of craftsmanship. It is, in fact, a way of covering up bad craftsmanship, and is to be deplored on that account, for a good craftsman can make satisfactory pastry even with cake margarines.

The oils—generally 1 ton to 30 gallons of milk—are blended at a suitable temperature with separated milk which has been ripened, and the mixture is transferred to a churn, where an intimate admixture or emulsification of fats and milk takes place. Lecithin, a phosphorised fatty protein, occurring in egg yolks—for example—and now extracted from Soya beans, is used to complete the emulsion when egg yolks are not used in the best margarines. Water emulsions are used today and special stabilisers are used for the production of stable emulsions. When churning is completed, the mixture is run slowly over a drum which is ice-cooled or is forced into a stream of ice cold water. The mass solidifies immediately, and is scraped off and delivered into a truck. It is then left for several hours to mature, when it is taken to special kneading machines where the surplus water is removed and the consistency of butter is imparted. It is then coloured and salted, and packed ready for use. Where butter is mixed in the margarine, no more than 10% butter fat must be added. The finished margarine has a satisfactory taste and odour, and a texture like fresh butter, and is practically free from fatty acids. It shows little tendency to become rancid unless kept under unsuitable conditions.

The different fats that go to make up the margarine give the different grades supplied. The more stearin it contains the tougher the margarine will be. The difference in the fats used in pastry and cake margarine is shown in the following table :

<i>Pastry Margarine</i>	<i>Cake Margarine</i>
Stearine . . . 30%	Oleo oil . . . 20%
Premier jus . . . 25%	Premier jus . . . 20%
Vegetable oils . . . 45%	Vegetable oils . . . 60%

By the hydrogenation of oils it is now possible (using any propor-

Baking Fats

tion of oils) to get the proper consistency of the fat by hardening the oil to the desired extent. The composition of margarine, when packed, approximates to that of butter.

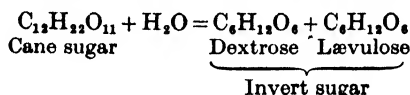
Fats	-	-	-	-	-	-	-	-	82.0 to 84.0%
Moisture	-	-	-	-	-	-	-	-	13.5 to 12.0%
Curd	-	-	-	-	-	-	-	-	1.5 to 1.7%
Salt, etc.	-	-	-	-	-	-	-	-	1.5 to 2.5%

It can be readily seen that there is practically no difference in the chemical composition of margarine and butter, but it should be remembered that margarine often lacks the flavour of butter, and that it often lacks vitamins. There is usually no more than 0.3% of volatile acids present in margarine. Margarine can be used in confectionery to replace butter. It creams up well and gives the cakes a good appearance and texture, but the flavour and keeping qualities are absent. Vitamins A and D are now added to those varieties of margarine sold for domestic consumption.

CHAPTER VI

SUGARS

A NUMBER of sweetening agents are used in the manufacture of confectionery. Most of them are natural substances belonging to a group of chemical compounds known as carbohydrates. The name carbohydrate is given to a large number of neutral bodies that are composed of the elements carbon, hydrogen, and oxygen, the latter two being in the same proportion as in the molecule of water. There are two groups of these carbohydrates used as sweetening agents : (1) The sucroses or disaccharides, the formula for which is written $C_{12}H_{22}O_{11}$. The principal members of this group are cane sugar, beet sugar, maple sugar, and palm sugar. (2) The simple sugars or monosaccharides, the formula for which is written : $C_6H_{12}O_6$. The chief members of this group are dextrose or grape sugar, lævulose or fruit sugar, and invert sugar which is a mixture of dextrose and lævulose. They are found naturally in honey. Commercial dextrose is known as glucose. These two groups of sugars are intimately related, because by a chemical reaction a molecule of water can join up with the sucrose, $C_{12}H_{22}O_{11}$, with the breaking down of the molecule to produce one molecule each of dextrose and lævulose as shown in the following equation :



This reaction is brought about either by prolonged boiling of the sugar with water, or quickly by means of a very dilute acid, such as in fondant making. It is produced naturally by certain enzymes or ferments. Thus by enzymic action the invertase of the yeast breaks up sugar into invert sugar before the zymase of the yeast can produce carbon dioxide gas. Sugars are found naturally in nearly every plant structure—fruits, stems, leaves, and trunks of trees. These sugars are contained in the juices of the plants, and are usually mixed with invert sugars, dextrines, proteins, and other sap constituents, all in aqueous solution. Some of these substances make extraction of the sugars difficult, because they prevent their crystallisation.

Ripe fruits contain sucrose, but when the fruit has become over-ripe dextrose is found in great quantities, due to the inversion of the sucrose by the enzymes of the fruit.

Sugars

Only a few of the sugar-bearing plants are of commercial importance.

The sugar of commerce is obtained mainly from two sources, the sugar cane and the sugar beet. It must be understood that when properly refined all commercial sugars are exactly alike in chemical composition. It is only possible to tell their source when impurities are left in them.

Cane sugar gets its name from the fact that it is obtained from the sugar canes. This plant contains approximately 18% sugar. *Beet sugar* is extracted from the sugar beet, which contains approximately 15% sugar.

Cane sugar is extracted by crushing the canes between powerful sets of rolls after they have been stripped of leaves and cut into suitable lengths. By this means most of the juices are extracted. The remainder of the sugar is extracted by soaking the residual canes in hot water. The juice that is extracted from the plant contains about 75% water, 20% sucrose, 4% organic matter, and 1% mineral matter. This crude juice is collected and freed from organic and nitrogenous matter by heating and treatment with lime, which precipitates phosphoric acid as flocculent calcium phosphate; this adsorbs the colloidal organic matter. Another method is by treatment with sulphur dioxide, which precipitates calcium sulphite. The clarified juice is concentrated by evaporation at reduced pressure and then allowed to crystallise. By means of centrifugals about 90% raw brown or muscovado sugar is obtained. The syrups or molasses separated out are further treated to obtain more sugar of a lower grade. The residue is fermented to produce Jamaica rum. The composition of raw cane sugar may vary considerably, but on the average it may contain about 94% sugar, 2.5% invert sugars, 1% proteins, 0.5% mineral salts, and 2% moisture.

Beet sugar is extracted from sugar beet by washing and pulping. The pulp is mixed with water and the juices are clarified, evaporated in a vacuum pan, and the raw sugar crystallised out from the molasses. The average composition of the raw beet sugar is somewhat similar to that of the raw cane sugar.

Sugar Refining

The raw sugars, whether derived from sugar canes or sugar beets, are generally refined in sugar refineries devoted entirely to this work.

A solution of the sugar is boiled with quicklime, when the impurities float to the top and can be skimmed off. Some of the lime

Cake Manufacture

is dissolved in the juice, and this is precipitated by passing carbon dioxide gas through the juice. This converts the lime into calcium carbonate, which, being insoluble, falls to the bottom and is removed. The juice is then passed through layers of animal charcoal, or a patented substance known as norite, in order to decolourise it. When the syrup has been clarified it is concentrated by boiling in vacuum pans at a low temperature. When it is sufficiently concentrated it is passed into centrifugal pans and whizzed round to separate the crystals from the syrups. This centrifugal pan makes the sugar grow into hard sugar loaves, and the syrups run out through perforations in the well of the pans. The syrups are either treated again by boiling and taking out more impurities and concentrating to get lower grades of sugar, or they are mixed with fresh batches of raw sugar juices and the same process repeated.

There are many modifications of the process which can give different grades of sugars. Thus in some cases the syrups are passed through successive batches, and each successive batch must necessarily have more impurities than the previous, or the syrups can all be kept back and used to produce inferior sugar, and lastly syrups and treacles.

The time and temperature of boiling also affect the sugars to a certain extent. Thus, when making granulated sugar, the solution is boiled to what is known as the "massecuite" stage, so that it has a sharp grain when crystallised out.

After sugar has been refined it is impossible to tell whether it has been derived from the sugar cane or the sugar beet. It should be at least 99% pure sucrose.

The operation of making the crystals of different sizes is done in the vacuum pan. If large crystals are wanted, then large and heavy charges of syrups are placed in the pans at long intervals, so that the crystals can grow during boiling. On the other hand, if fine crystals are wanted the charges of syrup are light and frequent.

The colour of genuine Demerara sugar is due to saccharetin (present in the canes), which is colourless in acids and bright yellow in alkalies. The fact that it is bleached by sulphur dioxide indicates that the colour is not due to caramelisation. Occasionally inferior grades of Demerara are coloured by caramelisation.

Thus in the refining of sugars three or four grades are obtained. The top grades are at least 99% pure sucrose. The second grades are slightly inferior. The third and fourth grades contain a few impurities and have generally a yellow or dark colour, and are sent out to the market as partially refined sugars known as thirds or fourths or pieces.

Milling of Sugars

When sugar has been refined it is ready for milling into the various sizes required in commerce. This is done usually in sugar mills which specialise in this type of work.

Cubes, splits, and nib sugars are prepared from the sugar loaves by cutting the loaves by machinery and dressing it into the sizes wanted.

Granulated sugars are made by passing the syrups, after boiling to a hard grain, into special centrifugals and afterwards washing to clean the crystals. The wet crystals are passed into a revolving cylinder known as a "granulator", in which the material is both dried and granulated. The sugar is then dressed and sieved to give three types of sugar—coffee crystals, granulated sugar, or castor sugar, according to size, the coffee crystals being the largest and the castor the smallest size.

Milled sugars of various sizes are obtained by grinding the cubes or rough sugar crystals of various sizes in fixed drums fitted with mechanical beaters that revolve quickly, causing the crystals to become broken down into smaller pieces. These are all dressed through sieves or dressing reels of various sizes to get the different grades separated out. Thus fine castor sugar, pulverised sugar, and icing sugar, which passes through silks as a fine powder, are obtained.

Fig. 2 shows a small unit suitable for installation in a large bakery or biscuit factory.

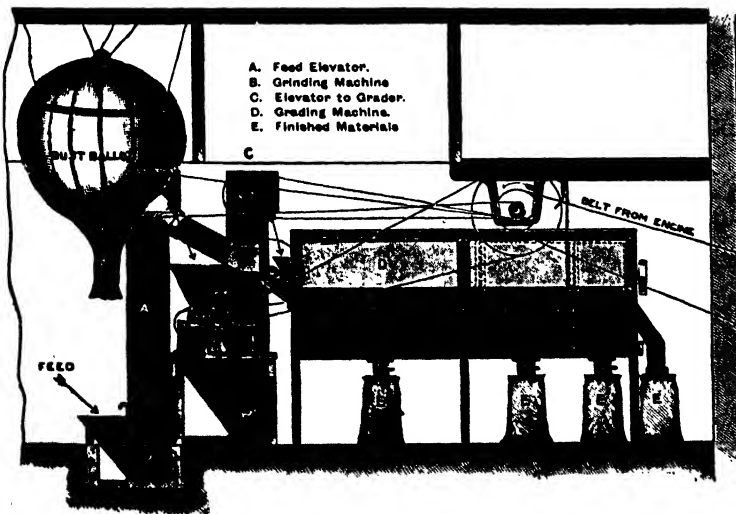


FIG. 2.—SUGAR MILLING PLANT.

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The dry sugar crystals are fed into the elevator. The crystals are then lifted and delivered into the disintegrator (marked B); the ground sugar crystals are then elevated and delivered into the dressing machine (marked D). This machine is clothed with silk, and can be so arranged as to produce all icing, or icing and other grades, castor, pulverised and sherbet.

The Evaluation of Sugars

Good, clear, bright-looking sugar crystals rarely contain any impurities. Dull greyish crystals often contain glucose or invert sugar, and ultramarine ("blue") may have been employed to give a whiter effect. If blue is suspected, it can be detected by dissolving some sugar in water contained in a glass cylinder. Place this on a white surface and allow to settle for a few hours, then look down through the glass. Any blue in the sugar will have settled out to the bottom. The evolution of sulphuretted hydrogen on addition of acid is a confirmatory test.

Sugars containing glucose, when moistened and heated for a few minutes, become more or less sticky. Hold some sugar in the hand for a few minutes; if it contains glucose it will feel sticky.

The ash content of sugar has been shown to influence the volume of cake. A sugar containing 0.45% ash produced a cake with 20% less volume than one containing 0.05% ash.

Good cane sugar should be perfectly soluble in half its own weight of cold water. Such a solution should be free from dirt and other impurities. If it shows a deposit on standing, then the sugar is not pure. If a sugar solution is boiled at ordinary atmospheric pressure water is given off, and, as in all solutions, the temperature does not remain constant. The temperature rises slowly as the moisture is driven off. The solution becomes slightly acid and invert sugar is gradually formed, so that the power of crystallising again on cooling is entirely lost.

If some sugar is dissolved in half its weight of cold water it forms a syrup or a saturated solution, and if more sugar is added this will remain undissolved and can be readily seen as a deposit on the bottom of the vessel. The quantity of sugar required to form a saturated solution is always the same, at the same temperature, and the syrup thus obtained will always have the same density.

When a saturated sugar solution is heated it becomes unsaturated, because sugar is more soluble in hot water than it is in cold water; 1 lb. of sugar will then dissolve in a gill of water. Now if a hot syrup is saturated, then allowed to cool again, it must be evident that

either the excess of added sugar will tend to crystallise out or a syrup will be obtained which contains more sugar than an ordinary saturated solution. With a little care it is quite possible to obtain a hot saturated solution which, when cold, will not recrystallise. It is then said to be *supersaturated*. It is natural for excess of sugar in a supersaturated solution to tend to recrystallise out, and the greater the proportion of sugar in the solution the more likely it is to recrystallise. To prevent it doing so, one must make sure that there are no crystals left undissolved, especially while boiling syrup.

Copper vessels are used to boil sugar solutions, owing to their great conductivity of heat ; also, their smooth surfaces can be readily kept clean and free from crystals. The sides of vessels are washed down to remove crystals, so that all the sugar is dissolved. All the sugar should be dissolved before boiling commences, to prevent graining. During boiling do not stir, as this may make sugar grain, and finally to prevent graining, a proportion of non-crystallisable sugar, such as glucose, should be added. A weak acid, such as cream of tartar, or lemon juice, will have the same effect. The effect of heat on a supersaturated syrup is to make it become runny and less saturated until it boils at 215° F. The longer it is boiled as the water is driven off the higher the temperature rises, and products of a different nature are obtained at different stages of the boiling. There are about ten stages known to the sugar boiler for his various products between 220° and 350° F. Sugar melts at 320° F., without the addition of water, and on cooling sets to a golden-coloured mass, known as barley rock. Above 350° F. the sugar begins to decompose and further heating would leave a mass of carbon only.

Degrees of Boiling Sugar Solutions

When a supersaturated sugar solution boils the temperature rises, due to evaporation of the moisture. It commences to boil at 215° F. The temperature of 225° F. is known as the *Thread degree*, because when it has reached this and cooled, the sugar will be dense enough to form threads if a fork is inserted and pulled out again. This degree is tested by hand by placing the first finger in the boiling syrup and immediately withdrawing and touching the thumb with it ; it should form a thread when cool enough. The syrup itself will set firm when cooled.

230° F. is known as the *Pearl degree*, because, when tested by the fingers at this degree, the sugar forms small globules on both the thumb and finger, resembling a small pearl.

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235° F. is known as the *Blow degree*, because, if a fork is dipped into the syrup at this stage, then withdrawn and allowed to cool, a film of sugar will form which, when blown gently, will stretch. Later on, if the fork is dipped into the sugar at 240° F., the sugar will blow off in feather-like pieces; thus we have what is known as the *Feather degree*.

When the temperature rises above 240° F. the sugar is too dense to allow the use of the fork for testing purposes, and it is usual then to cool the sugar in water by dipping wet fingers quickly into the boiling sugar and immediately immersing in cold water. If the sugar on the fingers forms a soft ball or mass it is at 245° F., or the *Soft Ball degree*. If it forms a hard ball it is at 250° F., or the *Hard Ball degree*. The temperature rises quickly through the succeeding stages, and 280° F. is known as the *Soft Crack degree*, because the sugar is more or less brittle on the outside, but still soft in the centre. When it sets firm and brittle throughout it will have reached the *Hard Crack*, or 315° F. Sugar boiled carefully to this temperature should set firm as a clear, transparent, colourless mass. The sugar changes colour to amber above 320° F., and the more it is boiled the darker it will become, until it is decomposed as a char.

350° F. is known as the *Caramel degree*.

Food Value

Sugars as food by themselves are incapable of supporting life, but because they are soluble and easily digested they are of great importance as foodstuffs. They are not only of use as a food, but when used as a sweetening agent they increase the attractiveness of other foods, and thus aid digestion.

Uses of Sugars

Sugar is usually used to sweeten confectionery products, various types of the latter requiring special types of sugar.

Loaf and cube sugars should be used generally for boiling purposes, such as in the making of fondant, jams, purees, and boiled meringues, because they are usually freer from dirt than other sugars. Sugar nibs are employed to sprinkle on tops of Bath buns and other types of small goods, and are used in the dough, as they do not dissolve easily, and so act as sweetening agents, not being attacked by the inversive enzymes and changed into glucose.

Granulated sugar is used in the making of macaroon goods, because

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of the hard grain and the openness of texture imparted. It is also useful in cheap slabs, where it can be dissolved in the milk. In other products, where eggs are the only moistening agents, it should not be used because some of it remains undissolved, and on cooking shows as dark specks on the outside.

Fine castor sugar is used for nearly all purposes, such as whisking with eggs or creaming with butter or fats, as it is free in the grain and has no dust. It should also be used in the making of meringue products.

Icing sugar is used to make water icings for buns and cakes, also for preparing royal icings for cake decorations. It is also used to make butter creams and gum pastes, and many types of dessert biscuits and for dusting biscuit doughs and marzipan.

Partially refined sugar, such as a light yellow sugar like fourths, can be used in fermented goods, and is often used in Parkin and gingerbread goods.

Dark-coloured sugars, such as Barbadoes or Demerara, are generally used in dark-coloured cakes and puddings, because they help to colour them and give also that special flavour desired in these cakes.

Simple Sugars

The formula for these simple sugars is $C_6H_{12}O_6$. The chief members of this group are dextrose or grape sugar, lævulose or fruit sugar, and invert sugar, which is a mixture of the two.

These sugars are all soluble in water and slightly soluble in alcohol. They are readily fermentable by yeast.

Glucose consists largely of dextrose; honey is mainly invert sugar. It should be clearly understood that the term "glucose" refers to the commercial article, of which dextrose is the main constituent.

Dextrose, or grape sugar, is the chief member of the simple sugars used in confectionery. At one time it was obtained from honey, raisins, sweet cherries, and the expressed juice of grapes. It occurs naturally in these substances, also in various sweet fruits, flowers, and plants, and is often accompanied by an equal amount of lævulose or fruit sugar.

It can be prepared in the pure state by the action of dilute acids and enzymes on the glucosides. It is also prepared by the prolonged action of dilute acids on starches. The liquid obtained from any of these sources is treated with chalk to neutralise the acid. It is then filtered and evaporated to a syrup or else concentrated, so that it will solidify on cooling.

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show no sediment when dissolved in water, contain no acids or iron salts, have a pleasant taste, and contain a large amount of dextrose.

Lævulose or Fructose is the sugar which occurs in flowers and in some fruits. When sucrose is inverted by acids or enzymes, lævulose occurs in the invert sugar in approximately equal quantities with dextrose. It crystallises with difficulty, and so is usually produced in the form of brown syrup, which is about as sweet as sucrose.

Honey has for its chief sweetening constituents dextrose and lævulose. It is a pleasant, slightly acid, sweet-tasting syrup collected chiefly by bees from the nectaries of various flowers. Sucrose is the sugar abstracted from the flowers, and this becomes inverted into the simpler sugars by enzymic action. The flavour of the honey varies according to the source from which it has been abstracted by the bees. It varies considerably in its composition, as the following analysis of pure honey will indicate :

Sucrose	-	-	-	-	-	-	0.5 to 7.6 %
Invert sugar	-	-	-	-	-	-	64.5 to 78.5 %
Proteins	-	-	-	-	-	-	0.18 to 2.00%
Mineral salts	-	-	-	-	-	-	0.05 to 1.2 %
Moisture	-	-	-	-	-	-	12.0 to 31.5 %

Cheap honey is adulterated usually either with glucose or cane sugar syrups. These cheaper honeys may have the same food value as the pure honey, but they have not the same distinctive flavour.

Uses of Honey.—Honey is used in confectionery mostly as a flavouring agent in the making of honey cakes, gateaux, nougat, and chocolate centres. If it was cheap enough it could be used in place of golden syrup and light-coloured sugars as the sweetening agent in cakes.

Invert Sugar is a mixture of the simple sugars, dextrose and lævulose. It occurs in ripe sweet fruits, but is prepared commercially either by enzymic action or by use of a dilute acid on a sugar solution. It is sometimes mixed with glucose, and is used in flour confectionery as a sweetening and moisture retaining agent.

Relative Sweetness of the Sugars

Sweetness is a quality detected by taste, but there is no exact test for it. It depends mostly on the person testing it.

Sugar is generally rated at 100. Sugars rated higher are sweeter than sucrose, and those rated lower are less sweet.

The following is a table of Sugar Sweetness as given by Sale & Skinner of the Bureau of Chemistry :

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Sucrose	-	-	-	-	-	-	-	-	100
Dextrose	-	-	-	-	-	-	-	-	50
Lævulose	-	-	-	-	-	-	-	-	150
Maltose	-	-	-	-	-	-	-	-	50
Invert sugar	-	-	-	-	-	-	-	-	85

Fondant is a mixture of invert sugars prepared from lump sugar, the same chemical reaction taking place as in invert sugar. It is prepared by boiling sugar and water to 240° or 245° F. and adding glucose or a weak acid to hasten the inversion of the sugar or "cut the grain". The quantities usually used are in the following proportions :

12 lbs. sugar.	2 lbs. glucose, or
3 pints water.	¼ oz. cream of tartar.

Glucose is used to prevent too rapid crystallisation of the sugar, but because glucose is practically non-crystallisable too much should not be used. The cream of tartar also has the same effect of preventing sugar from graining during boiling and in changing some of the sugar into invert sugar. Too much should not be used as this would form too much invert sugar and the fondant would be too fluid. Glucose added to fondant cheapens the fondant and toughens it, so that more syrup is required to thin it down when used to cover cakes. Cream of tartar produces a firmer fondant, but not so tough, and one that is more suitable for chocolate creams.

Theoretically fondant is sugar dissolved in water, and after boiling, is recrystallised by mechanical agitation. These crystals in carefully prepared fondant should be so fine as to be scarcely perceptible by the naked eye. It is the fineness of these crystals that gives the gloss to fondant iced cakes. If they are large, the fondant sets with a dull appearance. On a small scale the fondant is made by placing sugar with water in a copper pan on a gas ring and dissolving the sugar slowly, so that all the sugar will be dissolved before it comes to the boil. As soon as it boils, stop stirring and boil quickly to 240° or 245° F., removing any scum that arises to the top. The sides of the pan must be washed down occasionally with water to prevent crystals forming. If crystals did form, or if all the sugar was not dissolved before boiling was commenced, it might well happen that the whole would suddenly set to a hard mass. When the temperature of the boiling syrup has reached 235° F., the glucose, or the cream of tartar dissolved in a little water, is added. On reaching the desired temperature, the syrup is poured on to a moist marble slab between four steel bars (30 inches long and ½ inch thick) forming a square. The syrup is also splashed with cold water and allowed to cool for about

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one hour. When about 100° F. it is creamed together by turning it backwards and forwards until it sets as a hard, firm mass. If this is done before the sugar is cold it will be much easier to crystallise, but the fondant will not be so good, as the crystals will be too large to give a nice gloss on the fondant when it is used. The fondant is then covered over with a damp cloth for half an hour to mature. Then it is rubbed down to take out the hard lumps and stored away in containers until required for use.

Special automatic units comprising sugar boiling pan and a warm agitator are used for making fondant on a commercial scale in which the fondant is produced by mechanical working of the boiled sugar. The process can be made almost continuous.

Syrup is a general term that includes all liquids prepared from sugars, fruit juices, golden syrups, and treacles.

Simple syrups are used for a number of purposes, but the most common uses are for letting down fondant and for crystallising fruits. It is prepared by boiling 3 lbs. sugar, 2 pints water, and $\frac{1}{2}$ lb. glucose; 2 grms. of cream of tartar may be used in place of the glucose in order to prevent the recrystallisation of the sugars. All froth is taken off during boiling, and care is taken to prevent crystals forming on sides of pan. The syrup is strained when cold, and put in bottles ready for use as required.

Golden Syrup and Treacle are the refined or partially refined by-products from the manufacture of sugar. They consist of the uncrystallised sugars and water with varying small quantities of sucrose, proteins, dextrans, and mineral salts. These are used mostly in gingerbread goods.

Glycerine, $C_3H_5(OH)_3$, is used by the confectioner. This is neither a sugar nor a carbohydrate. It is in reality an alcohol of the fatty hydrocarbon class. It is found naturally in all fats in a combined state with various fatty acids.

Pure glycerine is prepared from fats by hydrolysing them with steam under pressure, and as a by-product in soap manufacture. It is a colourless thick syrup very much like glucose in appearance. It has a distinct sweet taste, but gives a dry feeling to the mouth. It has important hygroscopic properties, abstracting moisture from air quite readily. For this reason it is used in confectionery in the making of cheap cakes in order to assist in keeping them moist. The proportion used varies, but it is seldom more than 1 oz. glycerine to each pound of fat employed. However, its value in confectionery is much overrated.

CHAPTER VII

CHEMICAL AERATION

Historical Outline

THE earliest application of chemicals to baking with the object of liberating carbon dioxide for aeration of the dough is uncertain, and it is somewhat difficult to trace the gradual development of chemical aeration.

Carbonates of soda and potash have been known from the very earliest times. The former was obtained from the ashes of sea plants, as well as from those growing near sea shores, and the latter from the ashes of land plants, and went under the name of "potashes", from which a purer form, known as "pearl ashes", was made. Both of these alkalis were used for aerating before bicarbonate of soda, probably in conjunction with sour milk or buttermilk. One special case may be cited, that of real old-fashioned gingerbread, when "pearl ash" dissolved in water was mixed into a firm dough with treacle and flour, then set aside to ripen. This ripening was often allowed to continue for some months. When the dough was eventually baked off, the acid * present in the treacle and flour, and a quantity probably developed during the ripening process, reacted with the carbonate, releasing carbon dioxide gas, which aerated the goods.

There seems little doubt that bicarbonate of soda has been used for 200 years or more, when domestic baking was general, often alone, but probably more frequently in conjunction with buttermilk or sour milk. Lactic acid is present in these liquids, and would react with soda, assisting in the liberation of carbon dioxide. As the amount of acid is not more than 1%, the assistance in aeration cannot have been great, but no doubt reduced the discolouration and alkaline taste.

Just as the domestic baking of bread gradually decreased when this important food was procurable from shops, so, to a large extent, did the making of small goods. When the production of these latter by bakers became more general, it was necessary to find readier means of generating carbon dioxide gas for aeration.

According to Kirkland,¹ no chemicals except pearl ash and alum were used by the baker as aerating agents in or about the year 1830. Alum, although not an acid, reacts with bicarbonate of soda in the heat of the oven, with the evolution of carbon dioxide. Carbonates of magnesia and lime were also employed.

* *National Association Review*, 1929, p. 1598.

Chemical Aeration

Probably the next chemical to be brought into use was the carbonate of ammonia, commonly known as "vol". It was to some extent used in domestic baking, as well as on a larger scale by bakers.

In a work published in Glasgow in 1832,² written by a baker, reference is made to sodium and magnesium carbonates, as well as to the use of bicarbonate of soda and hydrochloric acid; yet in 1836 a patent³ was granted for the use of hydrochloric acid and bicarbonate of soda together as an aerator, and the method adopted is detailed.

In sequence, tartaric acid and cream of tartar followed on the heels of hydrochloric acid, for a well-known, ready-mixed baking powder made from these acid substances was first placed on the market about this time (1830-1840).

In the United States, ready-mixed baking powder, made from similar ingredients to the one mentioned above, was first extensively advertised for sale and generally introduced about 1845-1850. Flaming posters appeared in all the towns calling it "German yeast", or baking powder.

As time went on, the prices of these two materials, tartaric acid and cream of tartar, tended to encourage the search for other suitable acid substances as substitutes, particularly for cream of tartar.

Grant⁴ states that "aeration by chemicals was first tried towards the end of the eighteenth century by means of a mixture of superphosphate of lime and ordinary washing soda that had been dried (dehydrated)". This appears to set the introduction of superphosphate a little too early. Liebig⁵ (1803-1873) originally recommended the treatment of bone with sulphuric acid, and Lawes only obtained his patent for the treatment of mineral phosphates with sulphuric acid in 1842. Manufacture on a large scale was actually commenced in 1845.

In 1856 a patent⁶ was granted for the use of pasty acid calcium phosphate, mixed with farinaceous material and dried, as the acid ingredient of baking powder. Professor E. N. Horsford,⁷ of Cambridge, Mass., in 1861 was the earliest advocate of acid calcium phosphate for aeration, and obtained a patent⁸ for its application in 1864.

Although, as already noted, alum had been used in this country, its general introduction in the United States seems to have taken place about 1880, and in 1892 sodium aluminium sulphate, generally known as "S.A.S.", and which is really a modification of the alum proposition, appeared.⁹ This substance, alone and admixed with acid calcium phosphate, has a large sale in that country, both as a cream powder and also as a ready-mixed baking powder.

It was only natural that other acid salts of phosphoric acid should

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be tried as the source of acid, and in 1888 a patent¹⁰ was granted for the manufacture of mono-potassium phosphate as a cream of tartar substitute. The mono-sodium and mono-ammonium phosphates have also been tried.

The examination of two cream powders is recorded about 1895.¹¹ They consisted of mixtures of the mono-ammonium and mono-calcium phosphates, along with some starch.

The next acid substance to be introduced was acid sodium pyrophosphate. A patent¹² was granted for its manufacture in America in 1901. This material, reduced to cream of tartar strength with starch, was introduced into this country about 1911, and most of the present-day "cream powders" are based on this. This material has a certain distinct disadvantage, which is discussed later, and which militates against its general adoption. In 1927 a patent¹³ was granted for a process of manufacture of acid materials, and it is claimed that by this method mono-sodium phosphate can be made so that it will act with all the advantages of the acid sodium pyrophosphate, but free from the serious drawback of its after-taste in the finished goods.

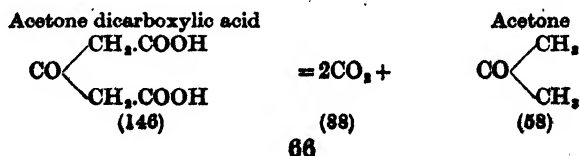
From time to time numerous other acid materials have been tried and in many cases patents taken out. Among them are acid sulphates, glycollic, lactic, citric, adipic, and mucic acids.

During the last war, potato starch impregnated with sufficient hydrochloric acid to yield a powder which could be used in the usual proportions with soda was offered. When fresh it gave moderate satisfaction, but on keeping the starch was hydrolysed to glucose which caused deterioration.

Other organic acids have been suggested to replace cream of tartar, but at the moment they are of no importance.

With the exception of bicarbonate and carbonate of ammonia all aerating chemicals leave a residue in the baked goods. Some of these are considered by certain authorities more or less harmful or at least undesirable, which has led to some controversy. Hence it has been the aim of the experimenters and patentees to introduce materials which leave no chemical residue.

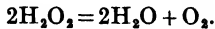
One such product is acetone dicarboxylic acid which, under the action of heat, breaks down into carbon dioxide and acetone :



Chemical Aeration

There is a likelihood of the acetone not being completely expelled from the baked goods and they may thereby be tainted. Also the cost of the material is relatively high. Further its stability under bakehouse conditions is as yet uncertain.

Hydrogen peroxide—30% solution (100 vols) has also been suggested, since the residue left after decomposition is water only :

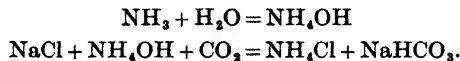


A number of patents have been taken out both in U.S.A. and also in this country for its use in bread and cake manufacture. However, it would appear that a considerable amount of experimental work would be required to be carried out before its adoption could be advocated.

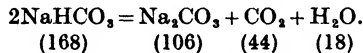
Sodium Bicarbonate, NaHCO_3 .

(Sodium Hydrogen Carbonate, Bicarbonate of Soda, "Salveratus".)

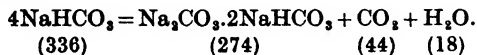
This is manufactured on a large scale by Solvay's ammonia soda process, which consists in passing carbon dioxide under pressure into brine saturated with ammonia gas :



The sparingly soluble sodium bicarbonate is deposited and separated. It appears commercially as a white, crystalline powder of 98 to 100% purity. The solid salt decomposes on gentle ignition to form the normal carbonate ; at the same time carbon dioxide is liberated :



When a solution of sodium bicarbonate is heated, a portion only of its carbon dioxide is given off, and if the solution be allowed to cool, crystals of $\text{Na}_2\text{CO}_3 \cdot 2\text{NaHCO}_3 \cdot 2\text{H}_2\text{O}$ are deposited. The action is represented by :



This is really the reaction that takes place in baking when sodium bicarbonate is used alone, and it is seen that only 25% of the total carbon dioxide is liberated. It is only on prolonged boiling of a solution of the salt that it is completely converted into the normal carbonate.

The alkaline nature of the residue has a marked disagreeable taste, and also causes discolouration of the goods, accompanied by a somewhat unpleasant smell.

When sufficient of any acid is used to decompose it completely, 1 grm. sodium bicarbonate will yield 265 c.c. carbon dioxide at

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0° C. and 760 mm. pressure (N.T.P.), and 362 c.c. at 100° C. and 760 mm. pressure.

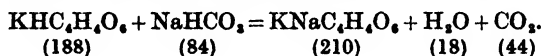
Cream of Tartar

(Potassium Bitartrate, $\text{KHC}_4\text{H}_4\text{O}_6$, Potassium Hydrogen Tartrate.)

Argol, a hard crystalline deposit formed in vats in which wine is fermented, and in bottles of wine, where it is termed "crust", is impure bitartrate of potassium. The salt is present in grape juice, and being insoluble in alcohol and sparingly so in water is precipitated as fermentation proceeds. After crystallising it is called "tartar", and when further purified by the removal of colouring matter and recrystallised becomes "cream of tartar". Argols contain approximately 75% potassium bitartrate.

Cream of tartar has one of the hydrogen atoms of tartaric acid replaced by potassium, and has approximately two-fifths the acidity of tartaric acid, weight for weight. Seeing that half the hydrogen is replaced, it might be imagined that cream of tartar would have half the acidity of tartaric acid, whereas it has only two-fifths, since allowance must be made for the difference in atomic weights of potassium (39) and hydrogen (1).

Potassium bitartrate is only slightly soluble in cold water, but readily so in hot, and on this difference in solubility its value to the baker depends, for when in contact with sodium bicarbonate and water in the cold comparatively little action takes place, whereas in the hot oven, carbon dioxide gas is rapidly evolved.



The residual salt is potassium sodium tartrate, and has an aperient action on the human system. Rochelle salt* is the commercial name for the crystalline salt.

On comparing the equation above with that given for tartaric acid, it will be seen that cream of tartar yields more than double the amount of residual salt for the same amount of carbon dioxide gas evolved.

Generally cream of tartar and sodium bicarbonate are used in the proportions of 2 : 1, but this leaves an excess of alkali in the goods. From the above equation it will readily be seen that 22.4 parts cream of tartar require 10 parts sodium bicarbonate for complete neutralisation.

1 grm. potassium bitartrate with sufficient sodium bicarbonate for complete neutralisation will yield 118.4 c.c. carbon dioxide at

* Seignette of Rochelle named this, so that it is sometimes referred to as "Seignette's salt".

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0° C. and 760 mm. pressure (N.T.P.), and 161·8 c.c. at 100° C. and 760 mm. pressure.

It can now be obtained commercially of 99% purity.

It is evident that since the raw material for this salt, as well as tartaric acid, is really a by-product of the wine industry, the supply will vary from year to year with the grape harvest.

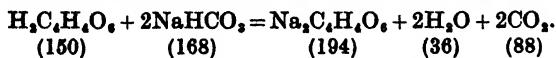
A long and acrimonious controversy has been waged, chiefly in America, between the advocates of tartrates and those of other types of aerators, particularly alum. Scientific opinions have been given in favour of both sides, and appear to be about evenly divided, except that in this country and Australia the presence of alum is looked upon as an adulteration in foodstuffs.

Tartrates appear to have no value as a food, since they do not occur naturally in the human system in any form, and hence are not required to supply any deficiency or to replace wastage.

Tartaric Acid, $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$.

Argol, or crude tartar, was known to the Greeks and Romans. It was not, however, till 1769 that Scheele isolated free tartaric acid from argol, and soon afterwards it was manufactured on the large scale in a similar manner to that employed today. The acid is obtained from either "wine lees" or "argol". Wine lees, consisting largely of grape skins, yeast cells, stalks, etc., is dried to kill bacteria and spores. After milling, it is leached with hot water, filtered, and lime added to neutralise the acid and precipitate calcium tartrate, from which the acid is set free by sulphuric acid, then finally purified by recrystallisation. The lees contain up to 20% tartaric acid in combination as potassium bitartrate. The acid is also prepared by dissolving "tartar", obtained from the first crystallisation of argol (see under Cream of Tartar) in hot water, treating with lime, and proceeding as described above.

Tartaric acid is dibasic, and forms both an acid and also a normal series of salts, called tartrates. It is readily soluble in hot and cold water, reacting immediately in the cold with sodium bicarbonate, liberating carbon dioxide, according to the following equation :



The residual salt, normal sodium tartrate, has a decidedly aperient action, and on this account in certain quarters exception has been taken to the use of tartrates in baking. As the amount present is so small, it is extremely doubtful whether they can really exercise much effect.

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Owing to the ready solubility of this acid, it is not of great interest to bakers today. It finds considerable use, however, in certain classes of biscuit manufacture and in effervescing drinks. It is now obtainable commercially of 99% purity, and practically free from metallic impurities, although in the early days it was often rather heavily contaminated with arsenic and lead. The former was introduced in the sulphuric acid and the latter dissolved from the lead vessels used in concentration and crystallisation.

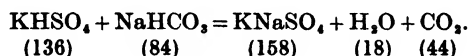
8.9 parts tartaric acid require 10 parts sodium bicarbonate for complete neutralisation.

Calculating from the equation given above, it is found that 1 gram. tartaric acid yields 296.8 c.c. carbon dioxide at 0° C. and 760 mm. pressure (N.T.P.), and 405.5 c.c. at 100° C. and 760 mm. pressure.

Acid Potassium Sulphate, KHSO_4 . (Potassium Bisulphate.)

This is prepared by mixing solutions of pure normal potassium sulphate and pure sulphuric acid in molecular proportions and evaporating to dryness. It has been used to some extent as an aerating agent to replace tartaric acid, which it resembles in speed of reaction, owing to its ready solubility in cold water.

Its reaction with sodium bicarbonate is represented by the following equation :



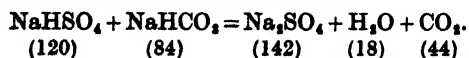
The residual salt is practically tasteless, but has a marked purgative action. For complete neutralisation, 16.2 parts potassium bisulphate require 10 parts sodium bicarbonate.

This salt is now really only of historical interest.

Acid Sodium Sulphate, NaHSO_4 . (Sodium Bisulphate.)

This is prepared similarly to the potassium salt, the solution being evaporated to dryness and then the mass heated to render it anhydrous. The salt is deliquescent, but less soluble in water than the corresponding potassium bisulphate.

The reaction with sodium bicarbonate is :



The residual salt, normal sodium sulphate, when crystallised with

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10 molecules of water, is the well-known Glauber's salt, which is used as a purgative.

14.3 parts sodium bisulphate (anhydrous) require 10 parts sodium bicarbonate for complete neutralisation.

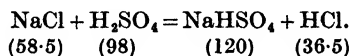
The acid salt, when allowed to crystallise, does so with 1 molecule of water.

Hydrochloric Acid, HCl.

(Hydrogen Chloride, Spirits of Salt, Muriatic Acid.)

This is one of the earliest acids used, in conjunction with sodium bicarbonate, to liberate carbon dioxide for aerating purposes.

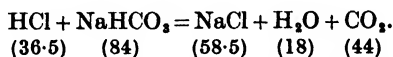
It is obtained on the large scale as a by-product in the manufacture of sodium carbonate (Na_2CO_3) from salt (NaCl). In the first stage of the process, salt is treated with sulphuric acid and then heated. The reaction is :



The hydrochloric acid gas which is evolved is made to pass up stone towers packed with lumps of coke or brick, down which trickles a stream of water. The gas is dissolved and the acid solution is collected at the bottom. Only after thorough purification is it ready for bakers' use.

The pure acid is on the market as a colourless liquid having a density of 1.15 to 1.16, containing 30 to 31% hydrogen chloride. It forms white fumes in contact with moist air, and is highly corrosive in action, requiring great care in handling, so as not to spill any on the person or clothes.

The following equation represents its reaction with sodium bicarbonate :



From which it is seen that, taking 30 as the percentage of hydrogen chloride, 14.5 parts acid (S.G. 1.15) require 10 parts sodium bicarbonate for complete neutralisation. The residue left in the goods is sodium chloride—*i.e.*, common salt, which is a necessary constituent of food.

Hydrochloric acid and sodium bicarbonate have sometimes been employed in the manufacture of wholemeal bread.

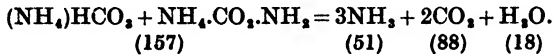
Ammonium Carbonate

(" Volatile " or " Vol ".)

The commercial salt consists of a mixture of ammonium hydrogen carbonate and ammonium carbamate, having the composition

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$(\text{NH}_4)\text{HCO}_3 + \text{NH}_4\text{CO}_2\text{NH}_2$. It is obtained by first subliming a mixture of 2 parts calcium carbonate (chalk) with 1 part ammonium chloride (sal-ammoniac), or with ammonium sulphate. The product, with the addition of some water, is then resublimed, when it is obtained in white, semi-transparent masses, having a strongly ammoniacal smell and a pungent caustic taste. Exposure to the air results in slow volatilisation. On heating an aqueous solution, the salt is completely decomposed into ammonia gas, carbon dioxide, and water :



This is also the reaction taking place in the oven when "vol" is used as an aerating agent. All the products are gaseous and volatile, hence its common name, and no residual salt is left behind in the goods. When freshly baked, the goods smell and taste of ammonia, but these disappear on cooling. Its chief use is for small porous articles, such as biscuits, which permit of the escape of the gases.

It is a white crystalline solid. The grade normally used for food-stuff purposes is described as "Ammonium Carbonate Powder ground from B.P. Lump Carbonate." This grade contains 30 to 31.5% ammonia (NH_3) and 53.5 to 54.5% carbon dioxide (CO_2).

Ammonium carbonate is very volatile and smells strongly of ammonia. In order to prevent loss of ammonia, it must be stored in airtight containers in a cool place.

1 grm. of ammonium carbonate when decomposed, as shown by the equation above, yields the following amounts of gas :

Ammonia (NH_3) -	-	-	-	420.2	c.c. at 0° C. and 760 mm. pressure.
Carbon dioxide (CO_2) -	-	-	-	283.6	" " " " "
Total -	-	-	-	703.8	" " " " "
Ammonia (NH_3) -	-	-	-	574.1	" 100° C. " " "
Carbon dioxide (CO_2) -	-	-	-	387.5	" " " " "
Total -	-	-	-	961.6	" " " " "

Ammonium Bicarbonate

Ammonium Bicarbonate, which is represented by the formula NH_4HCO_3 , is a white crystalline solid. The grade supplied for food-stuff purposes is a fine crystalline powder which satisfies the requirements of the British Pharmacopoeia. It contains 21.4 to 21.6%

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ammonia (NH₃) and 54.25 to 55.85% carbon dioxide (CO₂). It therefore contains considerably less ammonia and slightly more carbon dioxide than the ammonium carbonate.

Since the raising action of the two compounds is mainly dependent on the carbon dioxide liberated by heat, the bicarbonate can replace an equal weight of the carbonate, and it has been shown to result in an improvement in the quality of the baked goods, and in the retention of less ammonia.

The bicarbonate dissociates much less readily than the carbonate at ordinary temperatures, and it therefore has a much less pronounced ammoniacal smell. It should be stored in its original containers in a cool place.

Ammonium bicarbonate, like the carbonate, yields on volatilization only a small amount of non-volatile residue, which is normally less than 0.004%. Its use in baking therefore does not give rise to any appreciable quantity of non-volatile substance in the baked products.

The Alums

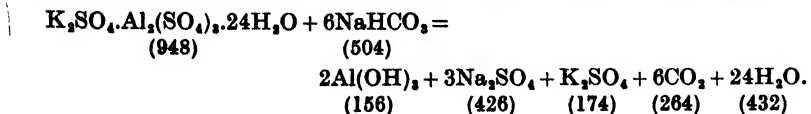
The term "alum" is a generic one applied primarily to a group of double salts of aluminium sulphate, with the sulphates of the alkali metals, which crystallise with 24 molecules of water. This name is now also used for double salts, other than the above, which crystallise in a similar form with 24 molecules of water.

The alums that have been used for baking are :

Potash alum (or simply alum) -	$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$.
Soda alum - - - - -	$Na_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$.
Ammonia alum - - - - -	$(NH_4)_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$.

Under this head sodium aluminium sulphate (S.A.S.) should be included, as it is really soda alum deprived of its water of crystallisation—*i.e.*, dehydrated—although it is contended by the manufacturers that it is something very different.

The alums do not react with sodium bicarbonate in the cold, but in the heat of the oven, although they are not acids in the ordinary acceptation of that term. The following is the action taking place :



The insoluble aluminium hydroxide is highly undesirable in food, although here again widely divergent views have been expressed by authorities. In this country, however, the presence of aluminium in

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foods, other than that present naturally, is regarded in the nature of adulteration, although in the United States such an aerator is permitted. Sometimes it is used alone, as well as in combination with acid calcium phosphate.

It is of interest historically as being one of the first materials used to liberate carbon dioxide from sodium bicarbonate.

The Phosphoric Acids and Phosphates

Phosphorus is widely distributed throughout Nature, chiefly in combination with calcium and oxygen, as tricalcium phosphate, $\text{Ca}_3(\text{PO}_4)_2$, which is the raw material from which the acids and their salts are produced. This element in combination also forms an essential constituent of all animal and vegetable life.

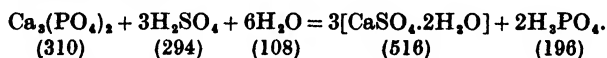
The Phosphoric Acids.—There are three of these—viz. :

Orthophosphoric	-	-	-	-	-	-	H_3PO_4 .
Pyrophosphoric	-	-	-	-	-	-	$\text{H}_4\text{P}_2\text{O}_7$.
Metaphosphoric	-	-	-	-	-	-	HPO_3 .

Orthophosphoric acid is tribasic—*i.e.*, it forms series of salts containing one, two, and three equivalents of a base per equivalent of acid. In the case of sodium, these salts are :

Monosodium orthophosphate	-	-	-	$\text{NaH}_2\text{PO}_4 \cdot \text{H}_2\text{O}$.
Disodium orthophosphate	-	-	-	$\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$.
Trisodium orthophosphate	-	-	-	$\text{Na}_3\text{PO}_4 \cdot 12\text{H}_2\text{O}$.

The acid is manufactured from phosphate rock or bone ash, both of which consist principally of tricalcium phosphate $\text{Ca}_3(\text{PO}_4)_2$, by intimately mixing the finely ground material with sufficient moderately dilute sulphuric acid to convert all the calcium into sulphate, as shown in the equation :



The mass, after standing some time, is taken up with water, the insoluble matter removed by filtration, and the clear filtrate concentrated to a syrupy liquid, in which form it appears on the market. Orthophosphoric acid is usually called simply phosphoric acid, but in the other two cases the prefixes are always used to denote the differences.

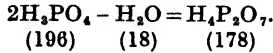
Pyrophosphoric acid is tetrabasic and yields series of four salts, although only two need be mentioned—viz. :

Disodium pyrophosphate	-	-	-	$\text{Na}_2\text{H}_2\text{P}_2\text{O}_7 \cdot \text{H}_2\text{O}$.
Tetrasodium pyrophosphate	-	-	-	$\text{Na}_4\text{P}_2\text{O}_7 \cdot 10\text{H}_2\text{O}$.

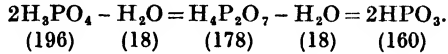
The acid is prepared by heating orthophosphoric acid to 250°C .,

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when 2 molecules of acid lose 1 molecule of water, as shown in the following equation :



Metaphosphoric acid is monobasic, having only one replaceable hydrogen atom in the molecule. It is obtained by heating either ortho- or pyrophosphoric acid to a red heat, whereby water of combination is driven off, as shown below :



The acids themselves are not employed as aerating agents, although orthophosphoric acid admixed with starch as an absorbent has been suggested. The use of acid phosphates as the source of acid for this purpose is of comparatively recent date. They have undoubtedly grown in favour, partly on account of their relatively low cost and partly because compounds of phosphorus are an important constituent of the human diet, being necessary for the building up of bone and tissue. There is, however, considerable divergence of opinion as to whether the phosphorus should be in organic or inorganic combination for easy assimilation ; but probably both forms are equally essential, and by the use of suitable phosphatic cream powders a necessary food, and one that is natural, is supplied to the human system.

Calcium Phosphates or Orthophosphates

The three calcium ortho salts are :

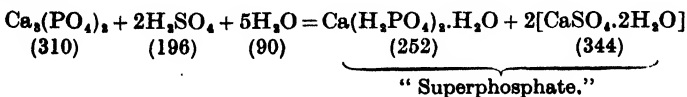
Monocalcium phosphate	-	-	-	-	Ca(H ₂ PO ₄) ₂ .H ₂ O.
Dicalcium phosphate	-	-	-	-	CaHPO ₄ .
Tricalcium phosphate	-	-	-	-	Ca ₃ (PO ₄) ₂ .

The two latter are insoluble in water.

Monocalcium Phosphate, Ca(H₂PO₄)₂.H₂O.

(Calcium Biphosphate, Acid Calcium Phosphate [A.C.P.].)

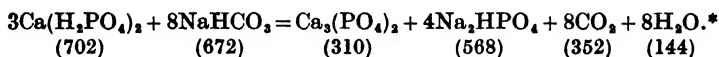
This salt in its impure form, admixed with calcium sulphate, is the "superphosphate" of commerce, which finds extensive use in agriculture as a fertiliser. It is manufactured by the same method as phosphoric acid, except that less sulphuric acid is employed. The reaction is :



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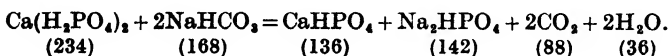
The pure salt for food purposes is made from pure phosphoric acid. High-grade hydrated lime, $\text{Ca}(\text{OH})_2$, or pure dicalcium phosphate and phosphoric acid are vigorously mixed in sufficient quantities to convert all the lime into monocalcium phosphate. Free phosphoric acid is to be avoided, since it increases the difficulty of handling in the final stages of manufacture, as well as detracting from its keeping properties. The mass, after standing some time, sets solid, is broken up, then spread out to complete the reaction and dry. After being coarsely ground, the drying is completed under vacuum before being finely milled. Acid calcium phosphate is now generally offered as being of 80% strength, being reduced to this value by the addition of the necessary amount of pure dicalcium phosphate.

Widely differing views are held as to the reactions taking place between acid calcium phosphate and sodium bicarbonate during baking. Hart¹⁴ writes the reaction as :

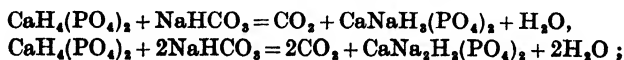


Monocalcium phosphate crystallises with 1 molecule of water, although it is not shown in the above equation ; but, after making allowance for this, it is found that 100 parts pure monocalcium phosphate, $\text{Ca}(\text{H}_2\text{PO}_4)_2 \cdot \text{H}_2\text{O}$, react completely with 88.89 parts sodium bicarbonate, and it is on the basis of this equation that the value of 80% is adjusted by the addition of dicalcium phosphate as a diluent. This salt also aids stability.

Jago¹⁵ and Leach¹⁶ consider that the reaction does not proceed so far, and give the equation as :

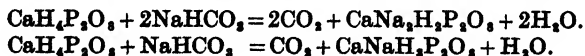


Actually Jago¹⁷ gives the two following equations :



but goes on to remark that the proportions of the latter are correct for aeration, which corresponds with 13.9 parts of the pure acid salt to 10 parts sodium bicarbonate.

Kent-Jones¹⁸ states that acid calcium phosphate reacts with sodium bicarbonate in the way shown by the two equations below:



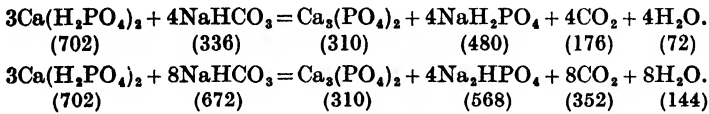
* Students are advised to regard this as the equation which represents the reactions of A.C.P.

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Presumably, from this writer's point of view, both reactions proceed simultaneously.

There do not seem to be any grounds for showing the products of the reactions as compound salts of calcium and sodium ; in fact, it seems entirely wrong, since in chemical reactions, whenever it is possible for a body to be formed which is insoluble, and hence precipitated, or is gaseous, and therefore volatile, these bodies are produced, and so removed from the sphere of action.

Patten¹⁹ considers that one or both of the following reactions take place, depending upon the proportion of sodium bicarbonate used :



Other investigators²⁰ have concluded, as the result of painstaking researches, that if a considerable excess of sodium bicarbonate is present, tricalcium and disodium phosphates are formed ; otherwise some dicalcium phosphate is produced at the expense of an equivalent amount of tricalcium phosphate.

It seems probable that the reaction between acid calcium phosphate and sodium bicarbonate which takes place under actual baking conditions is represented by some combination of the equation as favoured by Hart, and that by Jago and Leach, but just what that combination may be is difficult to define, since no really satisfactory method for the determination of the neutralising value of acid calcium phosphate to correspond with its baking value has as yet been found. Each method so far advocated is empirical, and certain very definite details have to be closely adhered to in order to obtain duplicate concordant results, which are on the high side, requiring correspondingly large amounts of sodium bicarbonate and leaving an excess of alkalinity in the finished goods.

In the case of a powder containing monosodium phosphate or acid sodium pyrophosphate, or both, together with acid calcium phosphate, the reactions are complex and cannot be expressed in equations.

For some time after acid calcium phosphate came on to the market, and, indeed, until comparatively recently, varying strengths and qualities were offered, and some were far from satisfactory. Calcium sulphate was used as a diluent until a maximum of 10% was fixed. The present-day quality is generally excellent, a high-grade acid calcium phosphate having a composition within the following limits :

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Free phosphoric acid	-	-	-	-	Nil.
Monocalcium phosphate	-	-	-	-	85.5 to 90%.
Dicalcium phosphate	-	-	-	-	7.5 to 8.0%.
Calcium phosphate	-	-	-	-	0.1 to 1.0%.
Iron and aluminium phosphates	-	-	-	-	0.1 to 1.5%.
Moisture and insoluble matter	-	-	-	-	1.0 to 1.5%.
Arsenic and lead	-	-	-	-	Under legal limits.
Fluorine and chlorine	-	-	-	-	Traces.

The chief uses of this material now are as a flour improver and as the acid ingredient in "self-raising" flour. As a flour improver, acid calcium phosphate has a definite action on the gluten of flour, in that it tightens or toughens it, hence its action in tending to make a weak flour behave as a stronger one. It is also effective in the elimination of rope in bread.

Acid calcium phosphate begins to react with sodium bicarbonate slowly in the cold, and the reaction increases with rise in temperature. For this reason the best results are obtained by baking almost immediately after mixing. The dicalcium phosphate present in the acid phosphate also reacts at higher temperatures and prolongs aeration.

This material often produces black specks on the surface of goods, due to impurities.

NEW GRADE OF ACID CALCIUM PHOSPHATE FOR USE IN BAKING

Coated Anhydrous Monocalcium Phosphate

A recently developed autogenously coated crystalline anhydrous monocalcium phosphate has attained a high place as a baking acid in the self-raising flour industry and as a constituent of baking powders.

This special type of anhydrous monocalcium phosphate, developed by Schlaeger and Knox,²¹ is made by reacting lime with a strong phosphoric acid containing minor amounts of certain metal compounds at a sufficiently high temperature to prevent the formation of any substantial amount of hydrated monocalcium phosphate, and at a temperature low enough to prevent the formation of any appreciable amount of pyrophosphate. Generally 140° to 175° C. is employed. The reaction is carried out in a batch mixer equipped with an efficient agitator. The resulting product is a dry powder consisting of minute crystals of anhydrous monocalcium phosphate. These minute crystals are then subjected to a temperature of approximately 200° to 220° C. Under this heat treatment the potassium and several other elements appear to combine with the

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calcium phosphate surface of the crystals to form an autogenous, glasslike, substantially water-insoluble coating over the crystals. The exact composition of this glassy coating has not been determined but it does have a great effect on the stability and reaction characteristics of the anhydrous monocalcium phosphate particles.

As a baking acid or acid constituent of baking powder, this new phosphate depends on its ability to resist decomposition in moist atmospheres and on its delayed as well as slow reaction with sodium bicarbonate in dough mixtures. The glassy coating protects the anhydrous phosphate from the action of atmospheric moisture. In wet dough mixtures it permits only a slow penetration of moisture into the interior of the particle and thereby delays its reaction with the soda present.

As an example of this action, the following table shows a direct comparison between the actions of this special anhydrous phosphate and the ordinary hydrated monocalcium phosphate which for many years had been a principal commercial phosphate baking acid. The table shows the amount of carbon dioxide liberated during different time intervals from a mixture of the baking acid and sodium bicarbonate in water at 27° C., the amount of sodium bicarbonate being theoretically sufficient to liberate 200 c.c. of carbon dioxide on completion of the reaction :

% CARBON DIOXIDE LIBERATED

<i>Time, Mins.</i>	<i>Hydrated Monocalcium</i>	<i>Special Anhydrous Monocalcium</i>
1	61.0	7.0
2	63.0	7.5
4	64.0	22.0
6	—	49.0
8	—	60.0
10	—	64.0

The data shows that with ordinary monocalcium phosphate the reaction with soda is about 60% complete within 1 minute, whereas with the special coated anhydrous phosphate the reaction is less than 10% complete in 2 minutes and not over 50% complete in 6 minutes. When translated to baking practice, this information means that the chemically aerated doughs can be mixed, moulded, and cut out, and placed in the oven before any appreciable loss of the leavening gas takes place.

Cake Manufacture

Experimental scones baked under uniform conditions except for the type of acid show that the volume of the scones made with the special anhydrous phosphate is approximately one third greater than when ordinary monocalcium phosphate is employed.

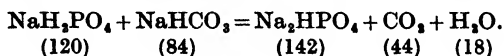
Dicalcium Phosphate, $\text{CaHPO}_4 \cdot 2\text{H}_2\text{O}$.

As already mentioned under Monocalcium Phosphate, this salt is used as a diluent in reducing the pure acid calcium phosphate to 80% strength. It is scarcely affected by cold water. Certain American writers²¹ state that it has a baking value, and when used at a strength of 25 gave satisfactory results, although, of course, the characteristic tightening effect of calcium would be present.

Monosodium Phosphate, $\text{NaH}_2\text{PO}_4 \cdot \text{H}_2\text{O}$.

(Sodium Biphosphate.)

This is manufactured by adding soda ash to a solution of pure phosphoric acid in molecular proportions to produce the salt, evaporating, crystallising, then drying above 100° C. to remove water of crystallisation, and finally grinding. Monosodium phosphate crystallises with 1 molecule of water. This salt is neutral in reaction to methyl orange, but acid to litmus and phenolphthalein. Since the anhydrous salt is deliquescent, great care is necessary in storage. It is readily soluble in cold and hot water, and in solution reacts vigorously with sodium bicarbonate in the cold, according to the equation :



The residual salt is the neutral sodium phosphate of commerce and has a mild, pure, saline taste with a slight aperient action.

Although this was one of the first acid alkali phosphates to be tried as an aerating agent, its ready solubility and deliquescence prevented it from achieving success and caused it to be superseded, particularly by acid sodium pyrophosphate (*q.v.*). A recent patent now enables this acid salt to be manufactured, whereby it is claimed that it is no longer deliquescent, and at the same time is inert in the cold dough, only reacting with the sodium bicarbonate when subjected to the heat of the oven in exactly the same manner as the acid sodium pyro salt, and yet being entirely free from its objectionable taste.

For complete neutralisation, 10 parts sodium bicarbonate require 14.3 parts pure monosodium phosphate (anhydrous). Further,

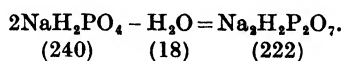
Chemical Aeration

1 grm. of the acid material plus sufficient bicarbonate of soda to leave no excess yields 185.5 c.c. carbon dioxide at 0° C. and 760 mm. pressure (N.T.P.), and 253.45 c.c. at 100° C. and 760 mm. pressure.

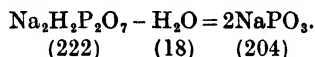
This monosodium phosphate is the active principle in a well-known cream powder, with which there is no objectionable after-taste in the goods.

Acid Sodium Pyrophosphate, $\text{Na}_2\text{H}_2\text{P}_2\text{O}_7 \cdot \text{H}_2\text{O}$.

This is manufactured as the anhydrous variety by heating monosodium phosphate at 200° to 220° C. for six to eight hours, when water is driven off :

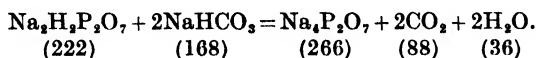


During the period of heating, the temperature must be kept under control in order to prevent dehydration from proceeding too far, for at temperatures exceeding 220° C. further water is gradually expelled until, when 240° C. is reached and this temperature maintained for some time, the following reaction takes place :



The formation of sodium metaphosphate, NaPO_3 , is to be avoided, since this salt is insoluble in water and, further, has no acid properties.

Acid sodium pyrophosphate crystallises from solution with 1 molecule of water. It yields an aqueous solution having a neutral reaction to methyl orange, but acid to litmus and phenolphthalein. The solid is perfectly stable, non-hygroscopic, sparingly soluble in cold water and readily in hot ; hence, so far as its speed of reaction with sodium bicarbonate is concerned, is a very satisfactory “*slow-acting*” baking acid. Its reaction with sodium bicarbonate is expressed thus :



The residual salt, normal sodium pyrophosphate, shows a very distinctly alkaline reaction to phenolphthalein. It has at first a not unpleasant saline taste, but soon causes a tingling, then burning sensation in the mouth and throat. It is the formation of this salt, when this acid material has been used in baking, that causes the peculiar “after-taste”, “bite”, or “burning sensation” in the mouth and throat when the goods are eaten. This, unfortunately, is

Cake Manufacture

the characteristic of many of the cream powders now on the market, because of which cream of tartar still holds its own. This objectionable feature has militated against the more widespread use of this convenient acid substance, as undoubtedly it produces excellent volume and texture, but almost always spoils the flavour. It is interesting to consider the significance of the prefix "pyro", which is derived from the Greek word for "fire", and the reason for this is the high temperature which is required for the conversion from the ortho- to the pyro-condition.

Aqueous solutions of the pyrophosphates are stable even on boiling, but the addition of most acids and continued boiling causes gradual hydrolysis back to the ortho-salt. It has been suggested by certain writers,²² yet with some uncertainty,²³ that the residual salt obtained in actual baking is disodium phosphate. The facts just enumerated preclude such a conclusion, as well as the results obtained by examining the actual extracted residual salt.

The likelihood of the pyro-form of phosphates, as such, being assimilated by the human system seems remote, but possibly a certain portion, at any rate, may be hydrolysed to the ortho-state by the digestive juices, and so eventually be present in a form in which it can be utilised by the human metabolism.

13.2 parts pure acid sodium pyrophosphate (anhydrous) react completely with 10 parts sodium bicarbonate.

1 grm. of the acid sodium pyrophosphate with sufficient sodium bicarbonate for complete neutralisation yields 200.6 c.c. carbon dioxide at 0° C. and 760 mm. pressure (N.T.P.), and 274.0 c.c. at 100° C. and 760 mm. pressure.

Effects of Baking Acids and their Residual Salts on Flour

It is of interest to consider briefly the effect of the acid materials employed in aeration, as well as of the inorganic salts resulting from the interaction of sodium bicarbonate and the various baking acids.

In chemical leavening the gas is supplied from bicarbonate of soda. This gas is released from the soda by reaction with an acid acting substance. The acid must be inactive towards the soda until liquid is added in the making up of the dough or batter otherwise there would be premature loss of gas. In addition to supplying the raising power, chemical aerating materials, after liberating the gas, leave residual salts in the dough that modify the flour proteins and affect the texture, colour and tenderness of the baked products.

Chemical Aeration

Taking weights of tartaric acid and cream of tartar which show an equal acidity by the usual titration methods, it is found that, although handled with all speed and baked off immediately, the former does not give a volume which compares with the latter, although the residual salts differ only slightly. It is probable that in this case the intensity of acidity—*i.e.* hydrogen ion concentration—in the dough has some slight effect on the gluten in the flour, the tartaric acid having a greater hydrogen ion concentration, and so a greater softening effect, whereby the gluten strands break more easily and do not stretch to the same extent as they do when cream of tartar is used, and so a depreciated volume results.

More important, however, seems to be the comparative solubility of these two acids. Tartaric acid is much more readily soluble in the cold dough than is cream of tartar, and as a result greater solution takes place. Hence, some interaction with the bicarbonate takes place and the gas produced dissolves in the liquor of the dough. When the goods are placed in the oven this gas expands, but as it has been produced in the cold it would have a tendency to cause the dough to flatten, so that on expansion in the oven only a steady lift results. This does not produce a bold-looking product, for from all experiments carried out it has been found that a more rapid evolution of gas, under the influence of the heat of the oven, is required, which causes a rapid rise, and so gives bulk to the goods.

With cream of tartar less solution takes place in the cold dough, so that more gas is given off in the oven, as a result of which a somewhat bolder product is obtained.

As already mentioned, acid calcium phosphate has a toughening effect on gluten, which prevents its being stretched so fully on the evolution of the carbon dioxide in baking, and a pinched appearance is evident in goods baked with this material. This pinching effect can to some extent be reduced by the use of a larger amount of liquor than usual in wetting up.

It has also been observed that disodium phosphate has a marked action upon gluten, tending to keep it from forming a tough, firm, compact mass. The action of the pyrophosphate is difficult to define, but the volume obtained with it is hard to surpass. Notable features of the phosphate baking acids are that they give the crumb a good white appearance, not obtained with cream of tartar, which yields a creamy tinge, and also, so far as the sodium salts are concerned, the goods keep moist for a longer period than when tartrates are used.

Cream of tartar and sodium bicarbonate, mixed together in the

Cake Manufacture

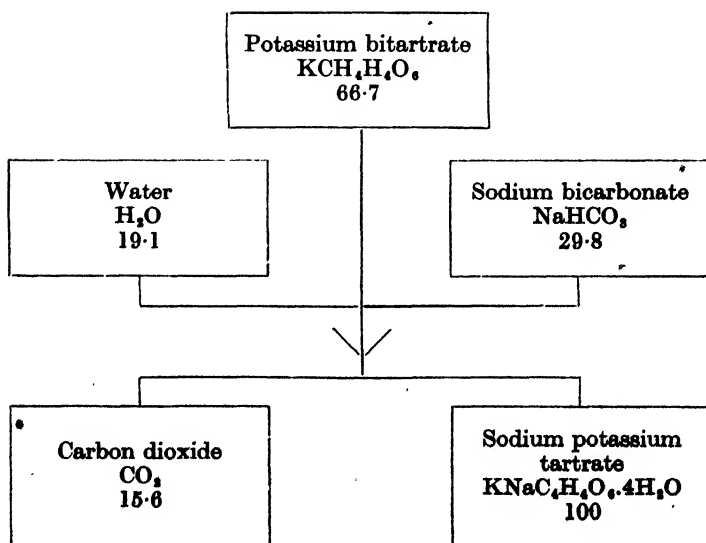
usual proportions of 2 : 1, liberate by the action of the acid on the carbonate 15.6% carbon dioxide—i.e. 66.7 parts of cream of tartar and 33.3 parts sodium bicarbonate yield 15.6 parts (=percentage) carbon dioxide.

Actually the same percentage of carbon dioxide would be obtained using the above quantity of cream of tartar and only 29.8 parts sodium bicarbonate, since it is this latter material which contains the carbon dioxide.

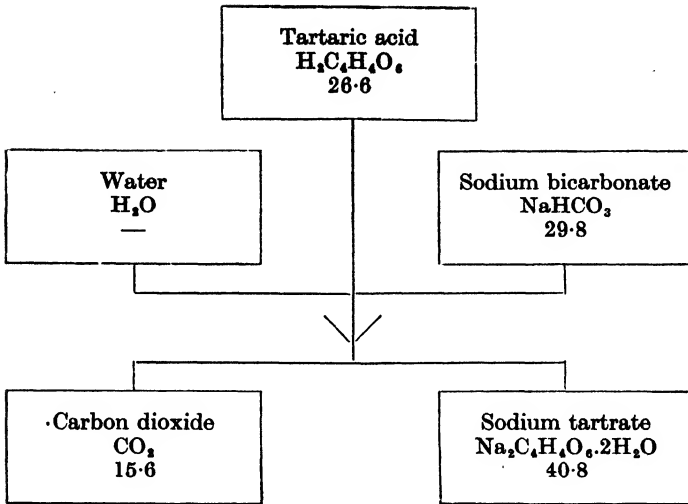
Cream powders are sold guaranteed 100% cream of tartar strength, and as a general rule the neutralising value is higher than that of cream of tartar, and lies somewhere between that figure and the one for complete neutralisation of the sodium bicarbonate, hence the percentage of gas will be proportionately higher.

Taking as a basis the production of 15.6% carbon dioxide, the actions between some of the acid substances and sodium bicarbonate can be represented diagrammatically, showing at the same time the relative amounts of residual salts produced for the same gas evolution. Starch is added in the diagrams of the phosphate baking acids to give the proportions of 2 parts cream powder to 1 part sodium bicarbonate. In each case the bicarbonate is taken as 29.8, as this will yield the 15.6% carbon dioxide, and the amount of acid material shown is just sufficient for complete neutralisation.

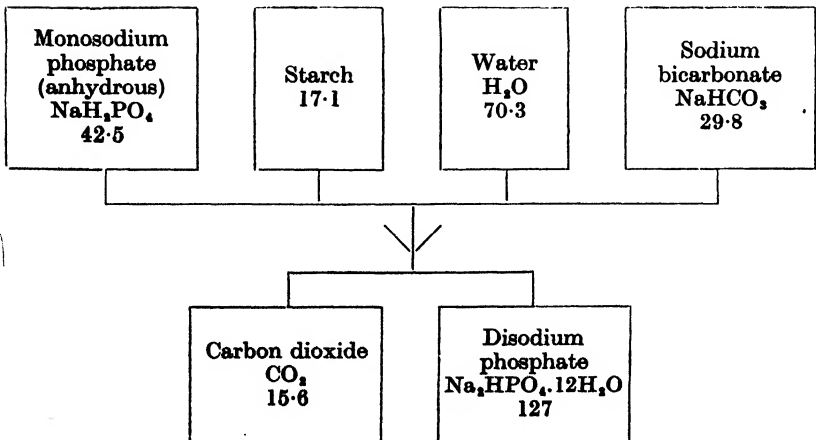
CREAM OF TARTAR.



TARTARIC ACID.

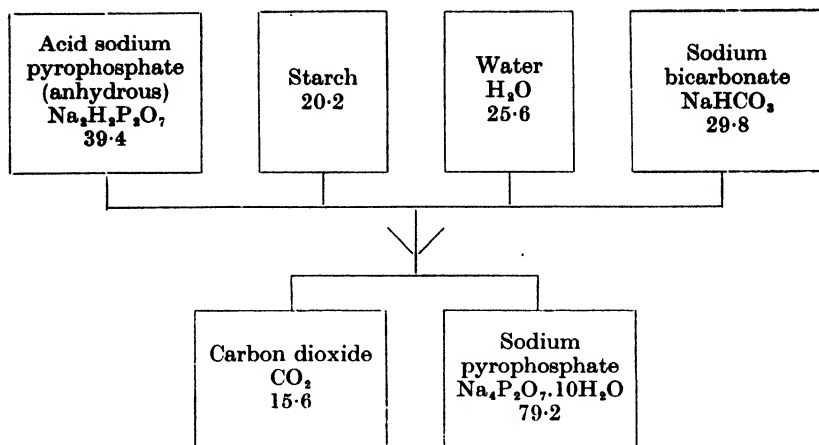


MONOSODIUM PHOSPHATE.



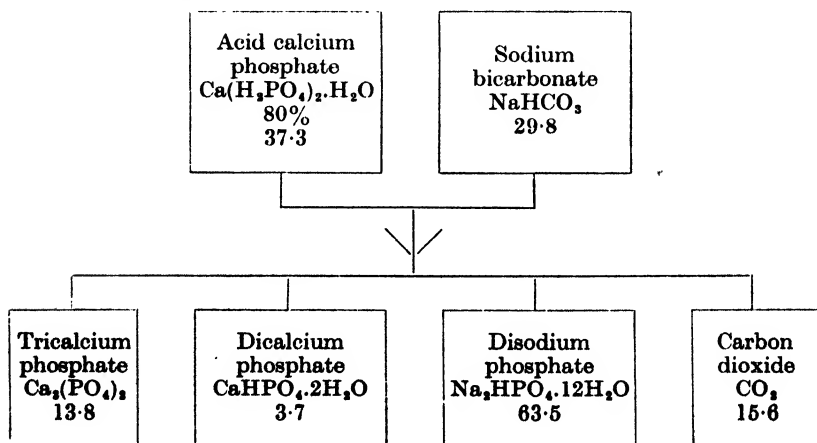
Cake Manufacture

ACID SODIUM PYROPHOSPHATE.



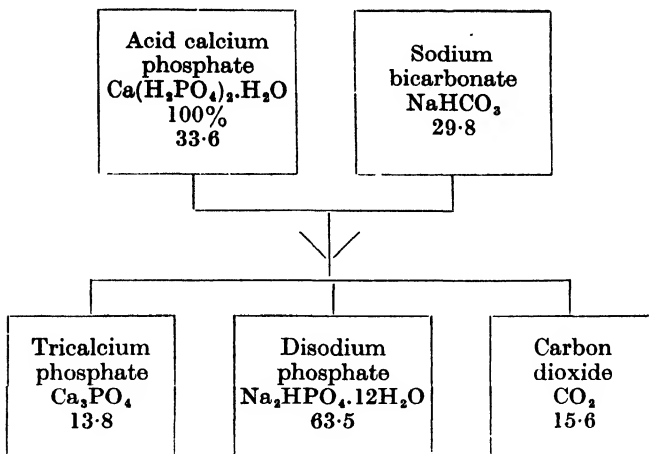
ACID CALCIUM PHOSPHATE.

Diagram A presumes A.C.P. to be 80%, i.e. 90% $\text{Ca}(\text{H}_2\text{PO}_4)_2 \cdot \text{H}_2\text{O}$, the balance consisting of 10% dicalcium phosphate.



Chemical Aeration

Diagram B presumes A.C.P. to be 100%.



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- ²¹ KNOX, W. H., *U.S.P.* 2, 160,700.
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- ²³ WAGGAMAN and EASTERWOOD : *Phosphoric Acid, Phosphates, and Phosphatic Fertilisers* (1927), p. 260.
- ²⁴ *Ibid.*, pp. 265-6.

CHAPTER VIII

ESSENCES AND ESSENTIAL OILS

FOR general use in confectionery products, essences and essential oils are very widely used, and although liqueurs may be necessary in certain of the best quality products, most of the space in this chapter will be devoted to considering those substances which find application in everyday bakehouse practice. Where delicacy of flavour is desired—and this should be the aim of those using flavouring materials—natural fruit juices should be largely employed.

Before proceeding with a detailed study of the various flavouring materials used by the confectioner, a survey of their constitution and composition must first of all be made.

An **Essential Oil** or ethereal oil is defined as an extract prepared from a fruit or plant by expression or distillation in steam. This is usually a fragrant oily fluid. Thus oil of lemon can be obtained by expression from the rind, or it may be obtained by distilling the rind in steam. This second method usually results in oils of poor quality as far as flavour is concerned. Many of these oils contain compounds belonging to the terpene series, such as are found in oil of lemon.

Natural Essences are prepared by macerating natural flavouring materials such as roots, barks, seeds, fruits, etc., in either spirits of wine, iso-propyl alcohol, glycerine glycols or a mixture of two or more of these. Sometimes also essential oils are dissolved in these solvents.

Artificial Essences are prepared by blending various organic compounds in such a way that the product obtained possesses in some degree the natural flavour which it is desired to imitate. These generally lack the subtlety of flavour obtained when natural essences are used.

This type of essence often has the advantage of strength and is more economical in use. Frequently a synthetic essence has an entirely different flavour when used in a fondant cooked at a low temperature as compared with the same essence used in cakes or boiled sugar, which latter products are subjected to higher temperatures. It is therefore important to seek the advice of experts when selecting an essence for any particular purpose.

True Fruit Essences are alcoholic infusions or distillates of fruits and, although comparatively weak in flavour and expensive, yield

Essences and Essential Oils

pleasing results. They are particularly recommended for high-class goods which are not subjected to high temperatures, *e.g.* syrups, fondants, creams, etc.

Fortified or Compounded Essences consist of fruit or vegetable extracts blended with suitable synthetic compounds.

Liqueur is a strong, alcoholic, syrupy fluid obtained by incorporating sugar and alcohol, and flavouring it with spices such as nutmeg, oil of coriander, mace, lemon, and others, the type of spice used determining the type of liqueur.

Essences

Vanilla Extract.—This is probably the most widely used flavour for baking purposes. The best cured Vanilla Beans, from which this extract is prepared, vary from 8 to 25 cm. in length and from 4 to 8 mm. thick. They are of a rich, dark brown to almost black colour with an oily surface, and are often covered with fine frost-like crystals of Vanillin.

The Mexican beans are of the choicest grade and command a high price. The beans, when first gathered, are yellowish-green, fleshy, and without odour, developing their peculiar consistency, colour, and smell by a process of autofermentation. The best method is to sun-dry the beans for a month, alternately pressing them lightly between the folds of blankets; at the end of this time they are said to be "cured". *Vanillin* is the active substance, and this is developed during curing. The quantity varies from 1.5 to 3.5 per cent. in different grades.

The vanillin is readily extracted by alcohol, but such a product would be far too expensive to compete with *synthetic* vanillin, an artificial product produced by oxidising the eugenol of clove oil.

Vanilla Extract Preparation.—This is a dilute alcoholic extract sweetened with sugar; sometimes glycerine is added. The following proportions are used:

- 10 parts vanilla beans (crushed).
- 20 parts granulated sugar.
- 100 parts alcohol and water (1 : 1).

Macerate the pods in half the amount of liquid for twelve hours, then drain off the liquid and set it aside. Transfer the vanilla to a mortar and grind it with the sugar into an intimate powder, after which mix in the remaining liquid. Filter this off by decantation, and wash the residue with alcohol to extract the last traces of essence.

Cake Manufacture

Such an extract contains about 0.2 per cent. of vanillin. The extract not only contains the vanillin, but also small quantities of gums, resins, and esters, which constitute a balsam soluble in alcohol.

Adulterants of Vanilla Extract.—Since vanilla extracts are naturally expensive, adulteration has long been practised. The main adulterant is *coumarin*, an extract of the Tonka bean. Imitation flavours consist of little more than a mixture of coumarin with vanillin in weak alcohol, coloured with caramel or occasionally coal-tar colours. Prune juice has also been used as an adulterant, whilst the exhausted pods are sometimes macerated with hot water and the extract reinforced with coumarin.

Vanillin is manufactured from a variety of raw materials, but one example will suffice. By oxidation of iso-eugenol, a phenolic compound prepared from clove oil, and recrystallisation of the crude product, pure vanillin is obtained. This synthetic vanillin has the same chemical constitution as that which occurs naturally in the vanilla bean, but it does not possess the full bouquet associated with natural vanilla extract. The latter product is, however, too expensive for many flavouring purposes.

Lemon Extracts

Essence of Lemon is usually prepared by extracting the soluble constituents of lemon oil with alcohol, and may also contain a portion of tincture made from the peel.

Lemon Oil.—The flavour of lemon is a popular one, and the oil is produced in large quantities to meet the universal demand. The principal centre of the lemon oil industry was at one time Sicily, but many other countries of the world, notably California, produce this oil to-day.

The oil is obtained by machine expression from the peel of the fruit; and it is composed chiefly of terpenes, with the aldehyde citral as the most important constituent. The content of this substance has been standardised by the British Pharmacopoeia as not being below 4%, but normal oils can contain more than this amount, and in some instances slightly less. California also produces a distilled oil which, however, is lacking in strength in comparison with the expressed oil. Lemon oil must be kept in a cool dark place, otherwise it is liable to deteriorate in quality. The container must be securely corked or stoppered.

Terpeneless Oil.—This is prepared by fractional distillation of the

Essences and Essential Oils

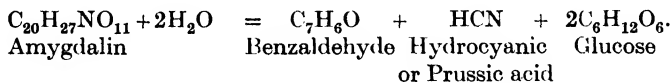
straight oil. The strength can vary from 15 to 25 times that of the original oil, and there is no tendency to go cloudy on standing. The price is correspondingly high. The oil is used in jellies, syrups, etc., where transparency is essential, and a solvent is generally employed.

Sesquiterpeneless Oils are prepared from the terpeneless variety and are used in a similar way, but they possess the advantage of being more soluble in water. They also dissolve more readily in alcohol, so may prove cheaper to use in practice because of the greater ease with which they may be distributed in confectionery products.

Orange Oil.—Orange oil is obtained by expression from the peel of the fruit. There are two types—Sweet and Bitter. Originally the oil was obtained chiefly from Italian sources, but many other countries now produce oil of good quality, South and West Africa, California, Florida, Palestine, Spain and some states of South America. Terpeneless oils are also widely used: they are of considerable flavouring strength.

Orange Extract is the usual flavouring agent produced from Oil of Orange or from orange peel or both, and contains not less than 5% by volume of Oil of Orange.

Almond Oil.—Oil of Bitter Almonds is obtained from *Prunus Amygdalus var amara*, or from peach and apricot kernels. After the fixed oil has been expressed, the resulting cake is mixed with water and allowed to ferment, after which it is distilled. Bitter Almonds contain the glucoside amygdalin, and the ferment, known as emulsin, breaks down this substance, liberating Benzaldehyde and Hydrocyanic acid:



The crude oil is then treated with lime and iron salt to remove the very poisonous hydrocyanic acid and distilled.

The Essential Oil of Almonds so obtained is practically pure benzaldehyde. The oil must be kept in small containers well corked, as it oxidises rapidly, particularly in presence of moisture, to give the flavourless benzoic acid.

Artificial Almond Oil consists of benzaldehyde manufactured from Toluene, a coal-tar product. It has the same chemical constitution as the natural aldehyde, but differing from this frequently contains a trace of chlorine. As a flavouring agent, it is a satisfactory substitute for the natural product.

Cake Manufacture

Almond Essence is generally prepared by making a solution of Oil of Almonds in a suitable solvent.

Peppermint Oil is one of the most important oils used for flavouring sweetmeats. It is distilled from the peppermint plant. There are three chief types of oil in use—English, American and Japanese. The English possesses the finest aroma and bouquet, and is much more expensive than the others. The chief constituent is menthol. Alcoholic solutions are used as commercial essences.

Spice Extracts

To-day there is marketed a number of “liquid spices”, so that it is worth while reviewing these and considering how they are prepared.

Anise Extract is prepared by making an approximately 3% (by volume) alcoholic solution of oil of anise. It is used in sugar-boiling work.

Caraway Extract is prepared by distilling caraway seeds in steam. The resultant oil is dissolved in alcohol and used as an essence for seedless caraway cakes. It is the constituent of Kummel liqueur.

Celery-Seed Extract is prepared from oil of celery seed, and contains not less than 0.3% by volume of the oil.

Cinnamon Extract is prepared from oil of cinnamon, and contains not less than 2% by volume of oil of cinnamon. This contains not less than 65% by weight of cinnamic aldehyde and not more than 10% by weight of eugenol.

Clove Extract is prepared from oil of cloves, and contains not less than 2% by volume of oil of cloves. The chief flavouring constituent is eugenol.

Ginger Extract is prepared from ginger, and contains in each 100 c.c. the alcohol soluble matters from not less than twenty parts of ginger.

Nutmeg Extract is the flavouring extract prepared from oil of nutmeg, and contains not less than 2% by volume.

Imitation Fruit Flavours

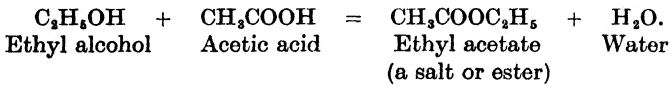
There are many fruits possessing unique flavours which are of a particularly subtle, delicate nature. It is no easy matter to produce a natural flavouring from these, and because of the high prices they command, many artificial essences have been introduced.

The essences already considered in this chapter are all obtained from the essential oil of a fruit or plant, but with many fruits the

Essences and Essential Oils

flavouring is in no way connected with essential oils, but with what are termed *esters*. These are comparatively simple chemical substances, being compounds of various alcohols and acids. In reality they are salts of alcohol and inorganic or organic acids. Just as inorganic acids and alkalies combine to produce salts, so alcohols can combine with organic acids to produce salts which are termed *esters*. These are the basis of the flavourings in many fruits such as strawberry, pear, apricot, pineapple, raspberry, etc.

In order to explain simply the basis of the changes by which esters are produced artificially, the following equation is given :



In the same way we have many other substances such as amyl acetate, which is the predominant ester in pears.

The artificial esters are far more pungent than the delicate natural flavours, so they must be used with great care.

The table on page 94 is given by Leach as typical of the composition of many of these essences :

Besides these artificial flavourings, compounded by careful blending of different esters, there are certain fruit pastes and syrups now on the market which are prepared from the fruit itself. They are sugar-preserved, the sugar being present in sufficient quantity to inhibit fermentation. The quality of these flavours is very good, and in all high-class trades they should be employed.

Fruit Juices and Syrups

When fruits are in season the juices should be utilised, and it is advisable to make fruit syrups for one's own use during the season when fresh fruits are not available. They are simple to make, and the method employed consists in heating the fruit in double-jacketed pans until the juice flows freely. This is carried on for one hour at 190° F. It is allowed to cool and ferment for one or two days, and then the juice is expressed by squeezing. This is followed by sterilising in boiling water by intermittent heating and cooling, skimming off the mucilage which comes to the top. Sugar is now added, and the boiling and skimming are continued until no more scum rises, when the syrup should be transferred to sterilised bottles and sealed up immediately. Sufficient sugar should be added to give at least a 50 per cent. solution—*i.e.* approximately 1 lb. of sugar to each quart of juice.

FRUIT FLAVOURS

<i>Fruit Extract</i>	<i>Chloroform</i>	<i>Nitrous Ether</i>	<i>Aldehyde</i>	<i>Acetic Ether</i>	<i>Formic Ether</i>	<i>Butyric Ether</i>	<i>Valerianic Ether</i>	<i>Benzonic Ether</i>	<i>Geranthylic Ether</i>	<i>Oil of Peppercot</i>	<i>Sebacic Ether</i>	<i>Methyl Salicylic Ether</i>	<i>Amyl Alcohol</i>	<i>Amyl Acetic Ether</i>	<i>Oil of Lemon</i>	<i>Oil of Orange</i>	<i>Saturated Alcoholic Solutions of—</i>				<i>Glycerine</i>	<i>Amyl Butyric Ether</i>	<i>Amyl Valerianic Ether</i>
																	<i>Tartaric Acid</i>	<i>Oxalic Acid</i>	<i>Succinic Acid</i>	<i>Benzoic Acid</i>			
Pineapple	1	—	1	—	1	5	—	—	—	—	—	1	—	3	—	—	—	—	—	—	—	—	—
Strawberry	—	1	—	5	1	5	—	—	—	—	—	1	—	2	—	—	—	—	—	—	10	—	—
Raspberry	—	1	1	5	1	1	—	1	—	—	1	—	—	1	—	—	—	—	—	—	4	1	—
Gooseberry	—	1	1	5	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—
Apple	—	1	2	1	—	—	—	1	—	—	—	—	—	1	1	—	—	—	—	—	10	—	—
Orange	—	1	2	5	1	1	—	1	—	—	—	1	—	2	—	10	—	—	—	—	10	—	—
Pear	—	—	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—
Lemon	—	1	2	10	—	—	—	—	—	—	—	—	—	—	10	—	—	—	—	—	5	—	—
Plum	—	—	5	5	1	2	—	—	—	4	—	—	—	—	—	—	—	—	—	—	8	—	—
Apricot	—	—	—	—	—	10	5	—	1	—	—	2	—	—	—	—	—	—	—	—	4	—	—
Peach	—	—	2	5	5	5	5	—	5	5	1	—	—	—	—	—	—	—	—	—	5	—	—
Currant	—	—	1	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Essences and Essential Oils

Liqueurs

These are strong alcoholic syrups in which have been incorporated certain non-resinous essential oils or other ingredients. Thus cherry liqueurs are made from cherry brandy, cherry fruit juice, alcohol, 60% sugar syrup, and distilled water. Maraschino generally contains rose water, oil of cinnamon, oil of neroli, ethyl acetate, ethyl nitrite, raspberry distillate, wine brandy, bitter almond water, colourless cherry flavour, and sugar. Creme-de-Menthe contains peppermint, balm, sage, cinnamon, orris, ginger, alcohol and sugar, with the addition of green colouring matter. Such a liqueur would be used in quantities of 1 oz. to the gallon.

Curaçoa contains bitter orange oil and other principles.

Benedictine is a blend of nutmeg, peppermint, angelica and hyssop.

For further details the student is recommended to study a suitable reference book.

Coffee Extracts

The roasted coffee beans are ground and infusions made in a pressure vessel for preference, sodium bicarbonate being added sometimes to obtain a full strength extract. Blends of coffee and chicory are also used.

A test for a true coffee extract is to render it alkaline and expose it to the air, when a green colour is produced. An icing or meringue which contains white of eggs should not be flavoured with coffee extract, for on standing the proteins of the albumen will decompose, particularly in the presence of moisture, to give off ammonia. The evolution of the ammonia will gradually turn the products green. If coffee extract must be used, then a little citric or tartaric acid should also be added to neutralise any ammonia which would subsequently be formed.

Butter Flavours.—Diacetyl is used to impart a butter flavour to confectionery, as well as margarine and fats. It is extremely strong, and should be used in the proportion of 1 part in 100,000 parts of any product.

CHAPTER IX

SPICES

SPICES are aromatic vegetable products which are used in powder form to flavour various confections, and, more generally, as a condiment for seasoning food. These powders consist of the vegetable tissue of certain plants which have been dried and ground or pulverised by heavy machinery. The aromas and strong pungent flavours of spices are due to the presence of particular essential oils and glucosides. Owing to their strong odour and flavour they are comparatively easy to adulterate with worthless material, such as the shells and husks of various nuts. The adulterant is seldom harmful in itself, but it reduces considerably the flavouring value of the spices. Another form of adulteration consists in extraction of the essential oils with alcohol to obtain the essence ; then the residue is ground to a powder and sold as spice.

Ginger

Ginger is one of the commonest of spices used. The powder form of ginger is the well-cleaned, dried, and ground root stock of the herb *Zingiber officinale*, which comes from India, but is now cultivated in Jamaica and Nigeria. The root is dug up when the plant is a year old. There are two forms of whole ginger used in confectionery, black ginger and white ginger. Black ginger is stronger in flavour and odour than the white. It is the whole root simply cleaned and boiled after digging to prevent germination, and then dried. White ginger is the core or scraped root, sometimes bleached to make it whiter.

The starch of ginger has a characteristic ellipsoidal shape and is transparent. Thus, it is an easy matter to recognise the presence of any foreign starches when ground ginger is examined under the microscope. Ground ginger is mostly used to flavour ginger cakes and biscuits.

U.S. Standards.—Whilst there are no standards in this country to which many food products must conform, the United States have fixed standards for the majority of them, and the following is that for ginger : Starch, not less than 42% ; crude fibre, not more than 8% ; lime (CaO), not more than 1% ; cold water extract, not less

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than 12% ; total ash, not more than 7% ; ash insoluble in hydrochloric acid, not more than 2% ; ash soluble in cold water, not less than 2%.

Cinnamon

Cinnamon has long been a highly-prized spice. It comes from the bark of a species of laurel trees which are grown in Ceylon. The crops are gathered in May and September, the two-year-old shoots being stripped of their bark. The cinnamon bark comes to the grinding mills in the form of long, cylinder-like rolls, having a pale yellow-brown colour and slightly furrowed outer surfaces. Cinnamon yields on distillation about 1% of essential oil, the chief constituent of which—cinnamic aldehyde—is present to the extent of from 50% to 65%. The oil owes its strong odour and flavour to this substance. Ground cinnamon is either used alone as a flavouring or as an ingredient of mixed spice.

Cassia

Because cinnamon is so expensive, it is now largely substituted by cassia, the bark of a species of laurel trees grown abundantly in India and China. It is somewhat similar in appearance, but coarser than cinnamon in aroma and flavour. The essential oil of cassia is also similar to that of cinnamon, but is not of such a fine flavour. The dried flowers or cassia buds are largely used as an ingredient of mixed spice.

Cloves

Cloves consist of the dried flower-buds of an evergreen belonging to the myrtle family, which grows in Zanzibar and the East Indies. The buds are gathered as soon as they assume a reddish appearance and are nearly ready to open. They are spread out in the sun to dry, and the colour changes to deep brown. Cloves possess a strong, hot flavour, due to a volatile essential oil, of which there is present on an average about 16%. The chief constituent of this oil is the phenol Eugenol, which is present to the extent of about 88%. The limits of the British Pharmacopoeia are from 85 to 90% Eugenol is a starting-point for the manufacture of Synthetic Vanillin used in making artificial Vanilla Essence. Cloves are used in flavouring jellies and for many purposes in the kitchen.

Pimento, or Jamaica Pepper.—Pimento, Allspice or Jamaica Pepper, is the dried fruit of an evergreen belonging to the myrtle

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family which grows in Jamaica. The berries are grey or reddish-brown in appearance and like black-currants in shape and size. They are picked before they are quite ripe, because if allowed to ripen the aroma would be lost, since the flavour is due to the presence of an essential oil in the shell, which is present in the maximum quantity before the berries are ripe. Similarly to clove oil, the chief constituent of this volatile oil is Eugenol, which is present to the extent of from 75 to 85%. The flavour is supposed to suggest a combination of cinnamon, cloves and nutmegs, hence the name allspice.

Nutmegs and Mace.—The nutmeg tree yields a fruit which gives two different flavouring spices, nutmeg and mace. These trees are grown in the Malay Archipelago, also the East and West Indies. The fruit resembles a peach in size, and when ripe the fleshy portion is split open, the mace removed and dried in the sun, changing to a buff colour. Mace has essentially the same flavour as nutmeg, and is used as an ingredient of mixed spice. The seed at the centre of the fruit is also removed and dried. The hard, grey, shining coat—or testa—is stripped off, leaving the commercial nutmeg. Nutmegs contain 30% to 40% of fixed fatty oil and about 7% to 10% of volatile oil. It is this oil of nutmeg that makes the seed valuable as a flavouring agent. Nutmeg is used for flavouring foods, and also by the confectioner for flavouring custards, wedding and ginger cakes. It should be known that excess of nutmeg acts as a narcotic, and fatal results may follow.

Pepper

Pepper, either black or white, is obtained from peppercorns, the fruit of a climbing shrub called *Piper nigrum*, grown in the East and West Indies. They are small, round, reddish berries growing in clusters of about thirty to a stalk. After treatment they have the appearance of small, black pills. The fruit is picked before ripening and dried, and ground to make black pepper. For white pepper the fruit is allowed to ripen, then dried, and after soaking in water the outer shell is rubbed off. The result of this treatment is that white pepper is milder in flavour than black pepper.

The flavour of pepper is due to a crystalline alkaloid substance known as piperine, also to a volatile oil and oleo resin in the berries. It is used as a seasoning for meats.

Spices have practically no food value in themselves; they are added to foods as a stimulant for the appetite, and thus aid the digestion of food.

Mixed Spice

Mixed spice is compounded from spices, and usually contains a large proportion of rice flour and sometimes sugar. The spices employed are cinnamon, cassia, caraway, ginger, coriander, cloves, mace, and nutmeg in varying proportions, with cinnamon predominating.

Recipes for Mixed Spice.

	(1)	(2)
Rice flour - - - - -	25%	—
Cinnamon - - - - -	28%	32%
Caraway - - - - -	25%	—
Coriander - - - - -	3%	32%
Ground ginger - - - - -	3%	16%
Mace - - - - -	11%	—
Nutmeg - - - - -	5%	16%
Pepper - - - - -	—	4%
	100	100

No. 1 is a type sold by grocers to the householders. No. 2 is a type of mixed spice that the confectioner can make up for use in various goods which call for a good mixed spice.

Aromatic Seeds

These are not used in confectionery to a great extent in the whole unground state. Coriander and caraway seeds are the two principal seeds concerned.

Coriander seeds.—Coriander is the fruit of *Coriandrum sativum*, which grows in Italy, the Mediterranean area, Russia, Great Britain and India. It is globular in shape, yellowish-brown in colour, hollow in the centre and therefore is easily crushed. It has a mild characteristic flavour, and is used for flavouring ginger cake, honey cakes and jellies.

Caraway seeds.—These are the commonest seeds used in confectionery. They come from the plant *Carum carvi*, which is a native of Europe. The seeds are about $\frac{1}{4}$ inch long, and are curved slightly and nearly black. They have a strong, pungent, stimulating flavour. The carminative properties are due to an essential oil, of which the ketone, carvone, constitutes about 60%. The alcoholic extract is often adopted as the flavouring in place of the seeds.

CHAPTER X

COLOURING MATTERS

THE function of colours in confectionery is most important, for it is essential that first of all they should be harmless, and, secondly, please the eye. It will be noticed that precedence has been given to the necessity for ensuring purity in food products.

Pleasing the eye precedes pleasing the palate, and to-day it is found that it is by tints rather than colours that this can be achieved. The old desire for definite colours is gradually passing, and with the introduction of tints a much wider range of colours becomes available, which are of a much more pleasing nature. Formerly we depended on natural food colours; to-day, with the production of coal-tar colours, we have a wide range, and from this many can be selected for use in foods because of their non-poisonous nature.

The Principles of Colour Mixing

There are three primary colours: red, yellow, blue. None of these are obtainable by the admixture of any other colours.

Secondary colours are prepared by mixing together two primary colours. The exact shade or colour obtained depends on the proportion in which the primary colours are used; thus one can obtain an exceedingly large number of secondary colours by altering the proportion of the constituent primaries: red and yellow give orange shades; red and blue, purple shades; yellow and blue, green shades.

Tertiary colours are mixtures of primary and secondary colours, or of two secondary colours; it is obvious that an infinite variety of shades is obtainable.

Natural Colours.—Colouring matters available for use in confectionery are of two kinds, natural and artificial. Most of the natural colours are obtained from plants, but their use is limited. Many have been superseded by artificial products because of the reliability, purity, and brightness of tone of the latter. Most of the artificial colours are synthetically produced from coal-tar products.

The natural colours are generally obtained direct from their sources by the confectioner himself—for example, the colouring matter from fruits for use in jellies and ices, the yellow colour of saffron and egg yolks for cakes, the red colour from beet, the green

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colour from spinach, and the blues and violets from indigo carmine. There is one animal colour, cochineal, still widely used.

Cochineal is the dried female insect *Dactylopius coccus*, which is cultivated on various species of the cactus *Nopalea* growing in Mexico, Canary Islands and Guatemala. The insects are brushed off the plants and killed either by sulphur fumes or charcoal, or by hot water or stove heat. There are two varieties of cochineal, "silver-grain" and "black-grain": the former consisting of insects which have been killed without heat, and the latter by hot water or stove heat.

Cochineal liquid is prepared by grinding cochineal (1 pound to 3 quarts of water—approximately a 15% extract) and immersing in boiling water, maintaining it at the simmer for some time. A dull-coloured solution is now obtained, to which 1 pound of alum and lime water is added. This acts as a mordant and fixes the colour. The product is then ground up in a pestle and mortar and left to simmer. Cochineal should yield not more than 7% of ash. When stirred with water there should be no sediment of talc or lead or barium sulphate or carbonate. These chemicals were formerly used to "weight" or adulterate cochineal, but are now rarely encountered.

The colouring constituent consists of carminic acid. Acids change a decoction of cochineal to a yellowish-red colour, whilst alkalis give a violet colour.

Liquid carmine goes through the same processes as cochineal, but *carmine* is the aluminium lake of the pure colouring principle of cochineal.

Saffron.—Of the yellow colours, saffron alone is largely used, and this especially in the West of England. Here it is popular not only as a colouring matter, but because of its flavour, which is undoubtedly highly esteemed by those accustomed to it. Saffron is obtained from the stigmata of the *Crocus sativus*. Saffron is imported from abroad, especially from Avignon in France, and Spain. When steeped in water and alcohol it produces an orange-red fluid. It must be used in a fresh state, as it decomposes rapidly. Saffron has a rather pleasant odour, but bitter taste, and a high colour strength, so that dilute solutions only are employed.

Spinach.—This is the main green colour, and is produced from the ordinary spinach, chlorophyll being the colouring matter. By the use of yellow dyes, apple green colours can be obtained from it. Chlorophyll is now being extracted from lucerne on a considerable scale.

Artificial Colours.—When artificial food colours were first intro-

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duced, the two most important points in their favour were a bright shade and easy solubility in water. Besides possessing these properties, it is now found necessary that they should possess the following in addition : they should

- (1) be easily soluble in water,
- (2) produce a bright shade,
- (3) be fast to the action of sulphur dioxide,
- (4) withstand the action of high temperatures,
- (5) be fast to sunlight,
- (6) be unaffected by baking powder,
- (7) be harmless.

This last factor has been introduced into recent legislation of 1925, but the great difficulty is in deciding which are likely to be harmless. Several colours formerly used have been banned, but the range still available is very wide. The position with regard to artificial colours has been dealt with very fully by Dr. H. Drake-Law in a lecture delivered before the National Bakery Students' Society in December, 1927, so the following abstract of his paper will be given :

The most difficult properties to secure are fastness to sulphur dioxide and high temperatures. Sulphur dioxide is present as a preservative and bleaching agent in many raw materials, and it has the power either of changing the shade or of completely decolourising many of the aniline dyes. Most colours are affected in this manner, but fortunately the change takes place slowly in the case of those which are used by confectioners. Amaranth, one of the best and fastest raspberry shades, will, when mixed with glucose in a concentration of 1 in 25,000, fade completely in four weeks, the sulphur dioxide content being 300 parts per million. A colour concentration of 1 in 10,000 will change from a deep raspberry tint to a strawberry red in the same period. The alteration is then complete, and prolonged standing produces no further fading. The action is less pronounced with fondant sugar, as the sulphur dioxide contents are smaller. The change is strictly proportional to the amount of sulphur dioxide present. The obvious remedy for the above transformation is to employ more colour than is originally needed, especially in the case of biscuit and cake icings, which may be stored over several months.

A few colours are stable to sulphur dioxide, and the most notable of these are Rhodamine and Erythrosine. Preparations from these two colours are sold under such names as French cream pink, perfection pink, geranium pink, and the like. They are offered to bakers under various disguises and in great dilution, the latter being

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probably due to the high price of the undiluted products. Erythro-sine is to be preferred on account of its harmlessness. It is actually beneficial to health, as it contains a high percentage of iodine. This colour closely resembles cochineal in general properties, and is precipitated in the same way. It gives a bright shade of pink in aqueous solution, but is of no value as a pigment, and is inferior to carmine in this respect. Rhodamine gives an even brighter shade of pink in icing sugar, and it is stable to acids. It is therefore largely used in sugar work. This colour is highly fluorescent in aqueous solution, and is useless therefore for colouring jellies and other transparent goods.

Other colours fairly fast to sulphur dioxide are :

Tartrazine	-	-	-	-	Lemon yellow
Orange G	-	-	-	-	Orange
Auramine	-	-	-	-	Primrose yellow (basic colour)
Ponceau 3 R	-	-	-	-	Strawberry
Carmoisine	-	-	-	-	Raspberry

Baking.—Many colours are spoilt under baking conditions. This is not due entirely to high temperature, but is influenced by the various raw materials used. The most potent factor of all is the baking powder, which is a mixture of sodium bicarbonate and a solid acid. The latter may be tartaric acid, cream of tartar, and calcium phosphate, or sodium pyrophosphate, but in most cases the final product of reaction is alkaline—that is, if an excess of sodium bicarbonate has been employed. The alkaline nature of these mixtures, combined with high temperatures, has either a notable destructive action on many colours, or completely changes their shade. This is especially the case with chocolate shades. The problem is still further complicated by the fact that no single brown colour is an exact shade match for natural chocolate, and mixtures of three or four ingredients have to be used, all of which must stand up to baking conditions. The same problem occurs in the case of egg yellow, where similar stability is required. Egg colours are also mixtures, but are of a similar type. They are nearly always composed of Tartrazine and Orange 1, or Tartrazine and Orange 2.

Some of the colours fast to baking are :

Tartrazine.	Amaranth.
Orange 1.	Carmoisine.
Orange 2.	Ponceau.

Ponceau, Orange 1 and 2 are fast in an acid medium, but not in an alkaline one.

Fastness to sunlight is not of great importance to the baker, as

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his products are generally consumed in a fresh condition. Long exposure to sunlight may occur in biscuit and cake icings, but in these cases the colours mentioned in the previous lists will serve, as they are fast to light.

Types Used.—The greatest difficulty with which bakers have to contend is the securing of correct information with regard to the raw materials used in their trade. Many of these raw products are not by any means accurately named or are only vaguely described. This is especially the case with colours, which are invariably listed under some descriptive or proprietary title without reference to official registers. Names such as raspberry red, egg yellow, cream pink, and the like are misleading in the above respect.

A second and even more subtle difficulty is that of colour strength. Most confectioners' colours are supplied in powder form, but are diluted with salt or dextrine. The value of the colour is proportional to the strength, and this fact must be kept strictly in mind when comparing prices.

The colours which bakers most need are those which imitate natural products, such as fruits, eggs, and chocolate. The choice in this country is left largely to the blender, although there are certain guiding influences. There is no schedule of permitted colours in Great Britain, although most of our colonies and the United States are quite definite in this respect. The United States, for example, has issued a list of colours which may be used in foodstuffs in that country. This procedure has also been followed in most other English-speaking countries, with the exception of South Africa. Many exporters in this country now confine themselves to the United States schedule for all their trade in order to avoid duplication, and some of the smaller users are now following this example.

The colours in the permitted list are :

Red shades :	Tartrazine.
Ponceau 3 R.	Yellow A.B.
Amaranth.	Yellow O.B.
Erythrosine.	Sunset yellow F.C.F.
Ponceau S.X.	Green shades :
Oil red X.O.	Guinea Green B.
Orange shade :	Light green S.F. yellowish.
Orange 1.	Fast green F.C.F.
Orange S.S.	Blue shades :
Yellow shades :	Indigo carmine.
Naphthol yellow S.	Brilliant blue F.C.F.

The above list is sufficient for most bakers, and need not be

augmented. Egg yellow, for example, may be made up of Tartrazine and Orange 1. The best egg substitutes are compounded with Orange 1, although many blenders use the cheaper Orange 2.

Use of Colours

For general purposes colours should be purchased in powder form, and used as required for the making of liquid colour.

For this purpose a 1% solution in ordinary tap water, or preferably distilled water, is required, whilst if stronger solutions are needed for any particular work they can readily be produced; for delicate tinting it is often advisable to make more dilute solutions, so that a delicate colour is obtained without any risk of streaks.

By proper addition to fondant or icings, many nice shades of colour can be obtained for decorative purposes. The colours should not appear dull; they should be bright, but not glaring. Delicate shades only should be used, as highly coloured goods do not look appetising. Deep greens and blues should be avoided.

Colours are deceptive in artificial light and for this reason they should be added to fondant and icings in daylight. They are added drop by drop—preferably from a dropping bottle—to a given weight of sugar until the particular shade required is obtained. If a record is kept of the number of drops required for a definite amount of sugar, then it is possible to get the same shades in artificial light by adding the recorded number of drops to the given weight of sugar. Cheap vivid colours should be avoided, as it is possible they will dry out in strange and unexpected shades.

Flavourings should be added to suit colours.

White is flavoured with vanilla, maraschino, or rose water.

Pink carmine is flavoured with raspberry or strawberry essence, noyau, or rose water.

Lemon yellow is flavoured with lemon or pineapple.

Orange colour, obtained by mixing carmine and yellow, is flavoured with orange or curaçoa.

Pale green is flavoured with orange flower water, kirsh water, noyau, almond essence, or peppermint.

Tartrazine is the most important yellow colour, as it imparts a bright lemon yellow to food products and is fast to light, acids, high temperatures, and sulphur dioxide. It is used in lemonades, boiled sweets, jellies, chocolate centres, lemon cheese, etc. With Orange 1 it produces a bright custard or cake yellow.

Naphthol Yellow S.—This is similar to tartrazine, but gives a some-

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what greener shade of yellow. It is not so fast to light, but is mixed with Orange 1 to produce egg colours.

Orange 1.—This is chiefly used for the production of egg yellows in conjunction with Tartrazine and Naphthol Yellow S. It is a very satisfactory colour for jellies, cakes, boiled sweets, but is not suitable for beverages, as it fades in the presence of light.

Amaranth.—This is a deep raspberry red shade, readily soluble in cold water. It is fast to light, high temperatures, and acids, but not to sulphur dioxide. It may be used for jams, sausages, and cooked meats, but it must be remembered that in these products sulphur dioxide is always present, so a stronger solution of colour is necessary. For syrups, drinks, and aerated waters it is satisfactory, and it is used with Tartrazine for producing orange shades.

Ponceau 3 R.—This is similar to Amaranth, but is faster to sulphur dioxide. It will not stand up indefinitely in this respect, and begins to fade in potted meats after about two months.

A 5% solution is the strongest possible solution which can be made.

Erythrosine.—This is the brightest pink on the American list, and is absolutely fast to SO_2 . It finds an important application in the manufacture of crystallised cherries, meats, and fish pastes.

It is only very slightly soluble in acids, and so gives only pale colours in boiled sweets; for this reason it is not satisfactory in jams and jellies, but gives pleasing tints in blancmange powders, creams, icings, and all products where acids are not present.

Indigo Carmine.—This is not very satisfactory in sugar boiling. It is used mainly to produce chocolate colour, greens and violets for colouring sugar icings.

Yellow O.B. and Yellow A.B.—These are oil-soluble colours, possessing great fastness, and are employed for tinting margarine and fats.

Testing of Colours

When colours of an unknown strength or of a suspected inferior variety have been purchased, the testing of these for colour strength is no easy matter, but the following method may be recommended :

Make up a 1% solution of the colour by dissolving 1 grm. in 100 m.l. of water. Now take some untreated flour and make it into a scald with boiling water. Into a basin place 50 grms. of this scalded flour and stir in 1 m.l. of the colour solution. Note the colour against the standard colour, and if of an inferior tinting power add further

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quantities of the colour solution until the correct tint is obtained. From this the relative strength can be calculated.

Finally, it is interesting to note that it has been estimated that the expenditure of £1 sterling for colours is equivalent to a turnover of from £500 to £1,000 worth of fancies—a very small amount in view of its great importance.

American Colour Regulations

Under these regulations (1939) any coloured food product manufactured for use in the U.S.A. must contain certified batch colours. These colours may be manufactured in the U.S.A. or in this country, samples from each batch to be sent to the U.S.A. for certification.

The range of colours has been given the title “ F. D. & C. Colours ”. These are of high strength and extreme purity.

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Marzipan

Marzipan has been in use for a long time by confectioners. It is bought by the confectioner in the form of a paste, which contains sugar and ground almonds in varying proportions, according to the grade and the price paid for it. Some confectioners try to make their own marzipan out of ground almonds and sugar, but the results are mainly disappointing.

In making large quantities of marzipan some heavy machinery is necessary, such as an almond blanching plant and almond grinding machinery with granite rollers ; also double-jacketed steam boilers and stirrers.

The almonds are first of all blanched in the usual way, then they are steeped in cold water. After steeping, they are chopped and put through the grinding machine three or four times. Each time the rollers are set closer. No syrup or egg whites are required to make the paste smooth, as the almonds should have soaked up sufficient water for pounding to prevent them becoming oily. After the almonds are ground to a smooth paste, a nearly equal quantity of icing or pulverised sugar is added, and the mix is transferred to the steam cooker, when it is brought to the boil and maintained under these conditions until it reaches the required consistency. The whole is kept continuously stirred to prevent the paste from sticking to the pan and so becoming burnt. When it shows no tendency to stick to the pan, it is ready. The marzipan is then stored in air-tight containers ready for use.

Extra sugar, colours, and flavours may be added to it as desired. This is sometimes done in the factory, but more often by the confectioner himself. Up to 1 lb. of icing sugar to each pound of marzipan may be used for covering cakes. A little stock syrup may be added to moisten the paste if required.

Uses of Marzipan.—Properly made marzipan should be as smooth and plastic as potter's clay, and is very useful for many purposes. It can be used with advantage in all classes of cakes, if mixed in during the creaming process—in the proportion of 2 or 3 ozs. to each pound of fat employed. This not only helps to flavour the cakes, but assists in keeping them moist for a longer period, because of the natural oil in the almonds.

Nuts in Confectionery

TABLE OF RECIPES FOR ALMOND GOODS

<i>Name of Product</i>	<i>Ground Almonds</i>	<i>Sugar</i>	<i>Egg Whites</i>	<i>Rice Flour</i>
Almond macaroons -	1 lb.	2 lbs.	Fully $\frac{1}{2}$ pint	3 or 4 ozs.
Almond macaroons -	1 ,,	$1\frac{1}{2}$,,	Bare $\frac{1}{2}$,,	2 ozs.
Congress or almond tarts - - -	1 ,,	2 ,,	$\frac{3}{4}$ pint	4 ,,
Parisian routs -	1 ,,	1 lb.	$1\frac{1}{2}$ gills	—
Ratafias - - -	1 ,,	$1\frac{1}{2}$ lbs.	$\frac{1}{2}$ pint	—
Dessert biscuits -	1 ,,	$1\frac{1}{4}$,,	$1\frac{1}{2}$ gills	1 oz.
Dutch macaroons -	1 ,,	$2\frac{1}{2}$ or 3 lbs.	3 gills	—
Almond paste -	1 ,,	$1\frac{1}{2}$ or 2 lbs.	7 egg yolks or 1 gill whole egg	—
Almond slices - -	1 ,,	2 lbs.	$\frac{3}{4}$ pint	2 ozs.
Almond chocolate -	1 ,,	2 lbs. (icing)	$\frac{3}{4}$ pint	4 ozs. unsweetened chocolate or cocoa powder
Boiled almond paste	1 ,,	$1\frac{3}{4}$ lbs.	8 egg yolks	2 ozs. glucose, $\frac{1}{2}$ pint water

The majority of dessert biscuits that can be made with ground almonds can also be made from marzipan by adding extra sugar to the marzipan and softening down to the proper consistency with egg whites.

TABLE OF RECIPES FOR BISCUITS MADE WITH MARZIPAN

<i>Name of Product</i>	<i>Marzipan</i>	<i>Sugar</i>	<i>Ground Rice</i>	<i>Egg Whites</i>
Macaroons - - -	4 lbs.	4 lbs.	$\frac{1}{4}$ lb.	1 pint
Congress tarts -	4 ,,	$5\frac{1}{4}$,,	$\frac{1}{2}$,,	$1\frac{1}{2}$ pints
French routs - -	4 ,,	$2\frac{1}{2}$,,	2 ozs.	$\frac{1}{2}$ pint
Dutch macaroons -	4 ,,	6 ,,	—	$1\frac{1}{2}$ pints
Fancy macaroons -	4 ,,	$2\frac{1}{4}$,,	2 ,,	1 pint
English routs - -	4 ,,	$1\frac{1}{2}$,,	—	2 eggs
Neopolitans - -	4 ,,	3 ,,	2 ,,	$\frac{1}{2}$ pint

The use of marzipan in place of ground almonds in cakes and macaroon goods is a sound commercial proposition.

The method of making up these biscuits from marzipan is very simple. Mix the rice flour into the egg whites. Rub down the marzipan and sugar with a little of the egg whites until smooth,

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then add sufficient whites to get the mixings to the correct consistency.

* For covering gateaux and fancies, marzipan and sugar are mixed together ; flavour and colour are added as desired, the proportions depending on the price to be obtained.

It is also used for modelling flowers, fruits, etc., by adding sugar—say $\frac{1}{2}$ to 1 lb. icing sugar to 1 lb. marzipan. It is then ready for modelling the desired shapes with suitable modelling tools. For flowers a more plastic marzipan can be made by adding a table-spoonful of soaked gum tragacanth to the pound of marzipan and adding sufficient icing sugar to stiffen it, the gum tragacanth having been soaked in water the previous day.

The table of recipes for various almond goods given on page 111 should prove useful in illustrating the manifold applications of almonds in confectionery making.

Coconut *

The coconut is the fruit of the coco-palm. The chief commercial supplies come from India, Ceylon, and the South Sea Islands.

Coconut oil is extracted from the kernels and is used in the manufacture of margarines. The coconut shells are sometimes reduced to a fine powder, and by cautious roasting the colour of ground cloves and nutmegs is matched, with the object of adulterating these spices. By roasting at a higher temperature a charcoal is obtained which, mixed with starchy material, is a close imitation of black pepper.

The fleshy portion of the coconut, after drying, is reduced to various forms adapted to the confectioner, such as shredded, coarse, medium, or fine desiccated coconut.

It is used in various tart fillings or for macaroon goods ; also as a decorative medium, either in the natural state or carefully roasted to a nut-brown colour. It may also be coloured with vegetable colours and employed in the decoration of cakes.

Walnuts

Walnuts are obtained from the walnut tree, a native of Asia ; it is now largely cultivated in the central and southern regions of Europe.

When the walnut oil is extracted and used as a vegetable oil, the

* This is spelt coconut, cokernut, or cocoanut.

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residue is sold as cattle food. Shells are sometimes crushed to a fine powder to serve as an adulterant of spice.

The skins of the walnuts have a strong acrid taste, which is accentuated as the nuts become dry. When dry, the skin is difficult to remove, but boiling in water for a few minutes, then steeping in cold water for half an hour, leaves them easy to peel.

Walnuts are used in making walnut cakes and bread, also for cake decoration and chocolate confectionery.

Brazil Nuts

Brazil nuts are the seeds of large trees growing in forests on the banks of the Amazon and Rio Negro rivers. The embryo, either whole or broken, is used in confectionery.

The nuts are blanched by boiling them for a few minutes, then soaking in cold water, so that the skins are easily removed.

They should only be bought in small quantities, as they readily go rancid and acquire a bad flavour. Not more than one month's supply should be bought at a time.

In chocolate work they are usually applied whole for centres, but if soaked in cold water and crushed, then mixed with an equal weight of sugar and put through granite rollers, they make a nice paste useful for decorative purposes or for cutting out as chocolate centres.

Pistachio Nuts

Pistachio nuts, or green almonds, as they are sometimes called, are cultivated mostly in the Mediterranean region. They are elongated, green nuts about 1 inch in length. The ridge is on the dorsal side, where it is also thickest. The spermoderm is dark purple. The outside of the nut has a brownish appearance, but the kernel inside is green in colour. They have a flavour approximating to Jordan almonds or Brazil nuts. The skin is removed by boiling and rubbing the nut between fingers, as in blanching almonds.

Pistachio nuts, whether brown or chopped, are recognised by the carmine or brown colouring matter on the spermoderm becoming green when treated with an alkali. Almonds and other nuts dyed with coal-tar dyes are sometimes offered as substitutes, owing to the high price of pistachio nuts. They are used for flavouring and decorating high-class confectionery products.

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Hazel Nuts

• Hazel nuts are of some importance in Europe, both as a table nut and for the production of hazel oil. The nut contains about 60% oil.

Ground hazel nuts are prepared from the kernels without removal of the fat, and are used in conjunction with wheat and rye flour in bread making and confectionery. They can also be used in making various types of macaroon goods in place of ground almonds. They go rancid quicker than ground almonds do, so should not be purchased in large quantities. They impart a delicious flavour to confectionery products.

Pine Nuts

Pine nuts are the seed kernels or nuts of various species of pine trees. They are highly prized for their delicate resinous flavour.

Pea-nuts

Pea-nuts, or monkey-nuts, have a bean-like odour and flavour. They contain about 40% of oil, which is employed in making vegetable fats. The ground nuts are sold as a cheap substitute for ground almonds.

When fully roasted, they can be made into a sort of cheap cocoa or chocolate.

Soya Beans

For 5,000 years the soya bean has been a staple article of food with eastern peoples, but it is only within recent years that its importance as a foodstuff has been recognised in this country by our dietetic experts.

The soya bean is classed among the leguminous plants, and exists in some 1,500 varieties. The seeds are shaped either like an ordinary pea or bean, small in size, and of many different colours—yellow, brown, green, and black, and striped or spotted combinations of these colours.

From the nutritional point of view the soya bean is everything that is desirable, containing, as it does, essential nutritive constituents—fat, protein, and carbohydrate—in a readily assimilable form. The oil in the soya bean contains a large amount of lecithin and

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vitamin A, and in this respect resembles butter, making the soya oil a most important human food. This lecithin is identical with that in egg yolk. It is only within the past 20 years that the process of milling the soya has been perfected to produce Soya Flour in a digestible and pleasant flavoured form without detracting from its nutritive value. This flour is said to preserve all the good qualities contained in the bean itself. High grade soya flour is now available for all bakery purposes. It is of a pale yellow colour and has a pleasant almond-like taste.

When used in confectionery and the general production of small goods, soya flour can be used as an addition to, or to replace other ingredients. It helps to make goods more palatable, easier to digest, and to improve their keeping qualities. It is cheap to buy, and helps to reduce costs. It can be used in quantities up to 20 % in cakes and small goods, biscuits, etc. By its use eggs, milk and fat can be reduced if necessary.

The following table shows the approximate composition and food value of the various nuts :

<i>Nuts</i>	<i>Water</i>	<i>Protein</i>	<i>Fat</i>	<i>Carbo- hydrates</i>	<i>Cellu- lose</i>	<i>Mineral Salts</i>	<i>Food Value in Calories per lb.</i>
* Almond -	5.8	20.0	54.9	15.3	2.5	2.0	3030
* Coconut -	14.1	5.7	50.0	27.9	—	1.7	2760
* Dried walnuts	2.5	17.0	66.4	11.0	1.4	1.7	3306
* Brazil nuts -	5.3	17.0	66.8	7.0	—	3.9	3265
* Pistachio nuts	4.2	22.3	54.0	16.3	—	3.2	2995
† Hazel nut -	9.3	13.2	63.2	14.3	—	—	3177
† Pine nuts -	—	31.4	48.0	20.6	—	—	2806
* Pea-nuts -	9.2	23.3	38.6	24.4	2.5	2.0	2560
‡ Soya Flour -	8.33	42.84	20.0	19.35	4.79	4.69	2165

* Leach, *Food Inspection and Analysis*.

† McKillop, *Food Values*.

‡ C. J. Ferrée, *The Soya Bean and the New Soya Flour*.

CHAPTER XII

FRUITS USED IN CONFECTIONERY

UNDER this heading we shall deal with many types of dried and crystallised fruits and flowers which are used in the manufacture of confectionery. Many types of fruit play an important part in the daily processes of the food manufacturer, contributing to the food value as well as the aesthetic attraction of the products. Although the succulent, easily crushed ripe fruits are much used in food manufacture and add to the attractiveness of confectionery products, the dried fruits, for many obvious reasons, are of the greater importance to those who specialise in the manufacture of cakes.

Of all the dried fruits, the product of the vines take first place. The grape vine grows at its best in the regions around the Mediterranean Sea, and wherever else in the world there is a climate of the same type with suitable soil, wintry rains, and sun-baked summers and autumns. The sources of supply are greater to-day, for vines are now grown in Australia, California, South America and South Africa, mostly on hillsides facing the mid-day sun.

Three essential conditions must be fulfilled to enable the vine to produce fruit abundantly and of the greatest perfection. (1) Suitable soil of a calcareous nature, or of gypsum, or even of hippurite limestone, also warm marly or loamy limestone soils. The soil should be of a fatty character containing plenty of potash salts, as these are necessary for the production of sugars. (2) A bounteous water supply is necessary. (3) The climate must be semi-tropical.

Raisins.—Ripe grapes are converted into raisins and sultanas in different ways. In the case of muscatels, the grapes are allowed to hang on the vines for a few weeks after the circulation of the sap has been stopped in the branches by partly twisting and cutting them. This helps to retain as much sap as possible within the grapes and increases the sweetness and food properties of the fruit. The raisins are then treated in a similar manner to sultanas. After drying, the raisins have to be stoned by machinery before the confectioner can use them in his products.

Raisins owe their importance as a food to the fact that they have a high food value, a fine flavour, and also are valuable sweetening agents. They contain approximately 65% sugar, 2% fat, and 2% proteins, and their calorific value is 1300 calories per pound of fruit.

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The raisins from Alicanti, Valencia, Italy, Syria, Australia and South Africa are most popular.

Sultanas.—When the seedless yellow grapes that are to be converted into sultanas are ready, the branches are cut from the vines and gathered together. They are then dipped in quantities into vats of potash lye, flavoured with rosemary or lavender, with a layer of hot olive oil on the surface. This treatment varies in different countries. The main objects of such treatment are to soften the skin of the grapes, to make them bright and clear, and also to sterilise the fruit. Yeast spores are always present on the ripe fruit, and if these were not removed fermentation would set up at a later stage.

After the dipping process, the grapes are dried in open sheds, by placing them on wire or fibre mats or wire frames, each about a foot from the other, so as to allow a free passage of air currents and sunlight. The fruit is turned occasionally, so that all parts are equally exposed to the sun and air. The open sheds in which they are placed protects the drying fruit from the occasional showers of rain. The effect of this drying process is to evaporate the moisture from the fruit and concentrate the sugars and other solids.

The very pale or bleached sultanas are nearly devoid of flavour. These are bleached by exposing the dried fruit to the action of fumes from burning sulphur, *i.e.* of sulphur dioxide gas, which also acts as a preservative.

Sultanas should have a fine flavour and good colour. They are valuable as a sweetening agent and have a high food value. They contain approximately 62 to 65% sugar, 1% fat, and 2% proteins. The calorific value is approximately 1260 calories per pound of fruit. The food value of raisins and sultanas is not sufficiently recognised by many people, but is well known in the countries where they are produced.

Sultanas are obtained from the seedless yellow grapes grown in Smyrna, Persia, Afghanistan, California, South Australia and South Africa.

Currants.—Currants are the dried form of small black grapes originally grown in Greece. There are several varieties of the special vine tree which produce small dark luscious seedless currants. The best quality currant is Eleme, which is a large currant of fleshy character. This variety has a pleasant sweet flavour when dried, but is generally too big for confectionery use. Some well-known brands of currants are Vostizzas, Gulf, Amelias, Patras, Pyrgos and Australian. Vostizzas are generally the best and most expensive.

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The grapes of the currant vines, when seven years old, ripen in the summer. The branches are cut and placed in thin layers on drying mats and turned occasionally. Evaporation of the moisture takes place through the action of the sun. The drying process takes from 10 to 12 days, but deluges of rain often spoil the crop while drying. When dry, they are freed from stalks and stones by hand or machinery, then sifted, packed in quarter cases, and exported ready for sale.

Vostizzas and other high-class currants are generally dried in the shade. This process takes about twice as long, but it gives to the fruit a blue black shade of colour and a better flavour, and a fine silky texture. The shade drying consists in hanging the bunches of grapes on strings and placing them inside wooden huts exposed to the sun. Shade-dried currants can always be recognised by their blue-black colour and silky texture.

Currants, when bought, should be bold and fleshy and clean, and devoid of shrivelled, red and fleshless berries. The red berries spoil the flavour of cakes owing to their extra acidity.

Currants contain approximately 63% sugars, 0.5% fat, and 2% proteins. Their calorific value is not nearly so high as raisins or sultanas, but is approximately 1200 calories per pound of fruit, so they need not be ignored as a supply of potential food with a fair sweetening property.

These dried fruits contain large quantities of true fruit sugars, often seen in crystal form in raisins. Their fine flavour and food value are their main attractions.

Currants and sultanas before use should be lightly washed and dried again and picked over to get rid of the grit, stalks and stones, and any other foreign bodies that should not be present in the fruit. Dirty, unpicked fruit will soon spoil a manufacturer's reputation. Most fruit is cleaned by machinery to-day and afterwards hand-picked to ensure freedom from stones and stalks. Electromagnets are also used to remove any metallic particles or nails.

Figs.—Figs are one of the cheapest of dried fruits, and have not been much used by confectioners in the past, although widely used for dessert. Because of their high sugar content and food value they should be used to conserve sugar supplies. The confectioner and the public have not sufficiently realised the value of this fruit ; its scanty use is to be deplored. War-time conditions, however, have aroused a new interest in them, and they have been more widely used in confectionery and biscuits.

Figs are largely produced in countries bordering on the Mediter-

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ranean Sea. They are wholesome, nourishing, laxative. They are preserved mainly by drying in the sun, although they are occasionally candied or crystallised. Their sugar content is in the region of 60%, and their calorific value is approximately 1150 calories per pound of fruit. They form an entire meal for natives in the east, and in this country could constitute a valuable addition to any product or meal.

Dates.—Dates are abundantly grown in the oases of the Egyptian deserts and similar regions. The most remarkable thing about the date is that it belongs to the same family as the coconut. The palms are the most useful fruit-bearing trees in existence, because their usefulness does not end with the fruit, the sap, leaves, fibre and wood being invaluable for many and widely differing purposes. The date is so different from the coconut that it is difficult to realise their relationship.

As a concentrated form of sugar it is the portable food of millions, and as more or less a luxury it is familiar to every child in this country.

Dates are mostly preserved by drying them by exposure to the sun. Their sugar content is over 60%, and their calorific value is approximately 1300 calories per pound of fruit. That is to say, they have the highest calorific food value of all the dried fruits. They are used by some natives as an entire meal. In this country dates are mostly used as a dessert, but they offer a valuable addition to our food stocks, and when used with other foodstuffs will enhance their palatability and food value. They are particularly popular when used with walnuts in cakes, and in puddings.

Figs, dates and raisins can be used by the confectioner to save sugar. When these are chopped up and soaked for an hour in at least half their weight of boiling water, they absorb the moisture and release their sugars. There is approximately 9 ozs. of invert sugar per pound of fruit, so that when using them to sweeten cake batters allowance can be made for this sweetening material to replace a portion of the sugar. In this way good results can be expected.

Dried Apples, Pears, Apricots, etc.—Large quantities of apples, pears, apricots and many other fruits in the ripened condition, or dried before packing, are exported from most of the temperate and semi-tropical British Colonies, and many other parts of the world, where the temperature, climate and soil are suitable for their production.

Stone fruits such as apricots are deprived of their seed kernels

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before drying. These kernels are used in the preparation of the fixed and essential oil of bitter almonds. Apples, pears, etc., are cored before drying, and are also cut into discs.

By exposing these fruits to the action of the air and sunlight, the ultra-violet rays exert a powerful antiseptic influence and gradually remove the moisture from the fruits. When thoroughly dry the fruit is packed in lined wooden cases and stored in a dry, cool place.

These dried fruits are made usable by soaking them in cold, rather hard, water for a few hours, when a portion of the water is absorbed and the fruit becomes serviceable. The characteristic flavour, aroma, sugar, proteins, and other substances are only slightly impaired by this treatment of these fruits.

Dried apple rings contain about 59% sugar, and their food value is approximately 1130 calories per pound of fruit. Dried apricots contain about 50% sugar, and their food value is nearly 1040 calories per pound of fruit.

Crystallised Fruits.—Fruits can be preserved by other methods besides drying. An addition of sugar to the fruit will act as a preservative. Sugar in small quantities is a food to the yeasts and other micro-organisms which exist as spores on the fruit, but in large quantities—that is above 50%—it prevents the organisms from working. Consequently, if sufficient sugar is added to any fruit it will preserve them from attack. Fruits that have to be crystallised, such as apricots, cherries, plums, and small good-flavoured pears, etc., should be just ripe and in perfect condition. The kernels must be removed from stone fruits by means of a special instrument similar to a hair-pin, or a special kind of steel fork devised for this purpose, so that very little injury is done to the fruit on removal of the stone. The fruit is then cooked to the desired degree of softness in a dilute sugar solution, or in water, but the former is preferable. The fruit is next allowed to drain. A supersaturated sugar solution is boiled up to the desired degree, usually the hard crack, and the prepared fruit is dipped in it, so that a complete coating of sugar covers the fruit. It is then subjected to a dry heat, thus giving it a candied or crystalline appearance.

Glacé cherries are not subjected to crystallisation. These are preserved in a thick syrup or a supersaturated sugar solution. When using glacé cherries for the purpose of making cherry cakes or slabs, the syrup has to be carefully washed out of the cherries, and they are dried before use, to prevent the cherries from sinking to the bottom of the cakes, and disfiguring the cakes.

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Crystallised fruits are mostly used in the decoration of rich fruit and other cakes. The crystalline sugar can be washed off, and the fruits cut up to the desired shapes and placed on the cakes as a decoration. They can then be washed over with a good stock syrup or a gum-arabic solution to enhance the brightness of the fruit.

Candied Peels.—The chief candied or preserved peels used by confectioners are lemon, orange and citron. These are all members of the *Citrus* family. The method of preserving the rinds of these fruits are very similar in each case, although there is some variation in the strength of the sugar solutions employed and the time occupied in the process of preserving citron peel.

Lemon Peel is generally prepared from a special variety of coarse thick-rind lemons. The lemons are cut transversely through the middle and the pulp is extracted. The caps are then placed in a brine solution for several days to take out the undesirable taste and open up the pores of the rinds, so that they will absorb the sugar from the sugar solutions in which they have to be placed. The caps are washed in cold water to get rid of the salt, then they are placed in tanks or tubs containing warm, dilute sugar solutions. A fermentation takes place, and the lemon caps absorb sugar from the solution. The caps are passed successively through other sugar solutions each stronger than the preceding one, until they are thoroughly saturated. They are then placed on draining wires and air dried, then they are ready for sending out to the market as drained caps or for cutting up by machinery into small evenly-sized pieces of fine cut peel, then packed in boxes ready for sale. This is the general method employed in making the best types of cut lemon peel.

The cheaper varieties of lemon peel are made from longitudinal strips, out of which some of the essential oil of lemon has been extracted before preserving as above.

When the whole caps are drained, if it is intended to sell them as candied caps, they are placed on wire trays and subjected to a high temperature for several hours in a drying room or oven. The heating sets or fixes the sugar and hardens the caps. After cooling in a dry, cool room, they are ready for packing in cases for sale. The candied caps have generally a better flavour than the other varieties.

Orange Peel and candied orange caps are prepared in a similar manner to that described above, using thick-rind oranges for this purpose.

Manufacturers, besides selling cut lemon and orange peel as such, also mix the two varieties in roughly equal proportions and sell as

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mixed peel. When purchasing these peels, buyers should see the samples submitted are of good colour and flavour. Cut peels when added to cakes impart an excellent flavour. It should not lose its colour on baking as some of the cheaper peels do.

There is about 66.5% sugar in candied peel, and the approximate food value is 1250 calories per pound.

Citron Peel is also prepared in a similar manner to lemon peel, although there is some variation in the strength of the sugar solutions employed, and the time occupied in the process. The best caps are usually cut longitudinally for whole caps, although they are sometimes cut transversely for those caps that have to be thinly sliced by machinery ready for use on Madeira cakes.

Citron can be bought either as drained citron caps or candied citron caps, or sliced citron, or even as cut citron. The popular use for it is as thin slices for decorating the top of Madeira cakes prior to baking them. This assists in causing a nice crack on this variety of cakes by slightly toughening the cake batter where the peel has been placed. When the slices are cut too thick, it looks ugly, and the weight of it may cause it to sink into the cake and incidentally spoil its appearance. After baking is completed, the citron peel should be washed over with stock syrup to soften it and improve its appearance. The small cuts of citron peel are used in rich cherry and Genoa cakes. The slices may also be employed for decorative purposes on gateaux and other cakes.

Angelica.—Angelica is a perennial umbelliferous plant that is cultivated for its aromatic stem. It also grows wild in many ditches and swampy places in England. The method of preparing as drained angelica or candied angelica is very similar to that employed in candied or drained peels.

The drained or candied stems are used in confectionery mostly as a decorative agent, although it is sometimes used for its aromatic flavour in confections.

Ginger.—Ginger is obtained from the root stock of the herb *Zinziber Officinae*, which is a native of India and China, although now cultivated in America, Australia and Africa. The root is cut up when the plant is a year old. The cut roots are thoroughly cleansed and boiled in a weak sugar solution until soft, then stored in earthenware jars and packed with syrup ready for sale. Crystallised ginger is made by soaking the prepared roots in sugar solutions until saturated, then heating until the sugar crystallises.

Crystallised Flowers.—Lilac, violet and rose petals are the three main forms of crystallised flowers. After the stems and decayed

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petals have been removed, the flowers are placed on tinned wired frames in tiers; underneath each tier is a shallow tray to catch excess syrup. A thin sugar solution is allowed to drip through the tiers of flowers until they are thoroughly saturated. They are then dried by gently heating or exposing to the sunlight.

These crystallised flowers have an excellent flavour and are mostly used as decorative agents on confectionery.

Bottled Fruits.—Bottling is one of the easiest and most simple methods of preserving fruit, and from an economical point of view the most important, since it ensures a supply of fruit when, in the ordinary course of events, fresh fruit is not available. It is generally bottled in vacuum bottles made to withstand the heat of sterilisation, and with glass or metal lids, with a rubber ring to act as a washer between the lid and the bottle, the lids being secured to the bottles with either a spring clip or preferably a screw band. The bottles must be sterilised before the fruit is added to them.

All fruit to be bottled should be quite sound and free from blemish. Gooseberries are bottled when green and under-ripe. Strawberries, raspberries, loganberries, currants, peaches, apricots and cherries should be ripe and quite firm when required for bottling. Plums, greengages and damsons are bottled when nearly ripe. All fruits should be bottled as soon as possible after picking to get the best results.

The fruit is graded before bottling, to sort out the best for this purpose, the fully-ripe and under-ripe and blemished fruit being set aside for jam- and jelly-making purposes. The best fruit is graded into two sizes, large and small, each being bottled separately. The fruit should be washed in cold water and drained under cover. It is then freed from stalks and stems. Gooseberries should be hulled. When the fruit has been prepared and dry, it is carefully packed as tightly as possible without crushing it into the sterilised bottles, filling them quite full. The bottles are sharply tapped to shake the fruit into position. They are then filled up with boiled water. The rubber rings and screwbands or lids and clips are then fitted on to the bottles, and they are sterilised by placing them in a boiler or sterilising pan, so that they are completely covered with water. A gradual increase in temperature is required, so that the heat will penetrate to the centre of the pack. The length of time required for cooking depends chiefly on the nature and hardness of the fruit. The temperature of the pack is raised slowly over a period of 1½ hours to 170° F., and then maintained at that temperature until the fruit is cooked. Soft fruits such as raspberries, loganberries and

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strawberries require 10 to 15 mins. at 165° F. Apples require about 20 mins. at 170° F., pears 30 mins., and apricots 15 mins. Plums, greengages, gooseberries and damsons require about 20 mins. Black currants and red currants require 20 mins. at 180° F. Cherries require 30 mins. at 190° F.

When cooking is completed, the bottles are removed from the steriliser and the screwbands are immediately tightened. Faulty bottles are discarded, the bottles are wiped clean, and when quite cold are stored in a cool dry storehouse, away from the light. If the storeroom is damp the rubber bands become damp, and mould growth sets up around the bands, which would in time force its way into the bottles. The fruit loses its colour if exposed to the light. Fruit bottled in this manner will keep fresh for a considerable period.

Bottled Fruit with Syrup.—In many cases fruit bottled in syrup is preferable to that bottled with water. The strength of the syrup used varies with the type of fruit being bottled. Black currants, cherries, apples and plums require 4 lbs. sugar per gallon of water. Strawberries, raspberries, loganberries and other soft fruits require 5 lbs. sugar per gallon of water. Pears, currants, apricots, damsons and greengages require 6 lbs. sugar per gallon of water. Gooseberries are generally bottled in water, and as a result are very sour. If 2 lbs. sugar per gallon of water is used to cover them, the flavour is very much improved. A stronger solution of sugar than this will cause the gooseberries to shrivel up.

The syrups are made by boiling the sugar and water together, then allowing it to cool, and straining through a jelly bag before using to cover the bottled fruit.

When the fruit has all been bottled and covered with syrup and lids put on, it is sterilised in the sterilising pans by heating to the same temperatures already given, and maintaining these temperatures for the same time as given for the fruits when bottled with water only. Fruits preserved in these ways are excellent for making fruit pies and flans.

Fruit pulp is generally prepared when the fresh fruit is in season by boiling it with or without sugar, in a jacketed pan, such as is used for jam-making. Only whole and sound fruit must be used for fruit pulp. The fruit is boiled gently at first, then more briskly until it is pulped. Generally 2 or 3 grains of salicylic acid or other preservative is added to prevent acid formation. The pulp is then canned or stored in a cool, dry place, ready for use in jam-making, etc., when required.

Canned Fruits.—The canning of fruit is a highly scientific process

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carried out in factories specially designed for this purpose. The principle is much the same as that applied to fruit bottling. The fruit is first washed, then graded into various sizes by machinery, before filling into the cans. All bruised and broken fruit is removed, and any deformed specimens that would look unsightly when the cans are opened, also any over-ripe fruit that might go mushy when cooked, is rejected.

The cans are then filled nearly to the top with hot syrup of the required density. Each type of fruit requires to be cooked in a sugar syrup of a density suitable for that type. The lids are next clinched on to the cans by a rotary clincher. They next go to an exhaust box where a vacuum up to 12 lbs. is applied, and at the same time the temperature is raised. It is important to note that if they are put through the exhauster without lids, the top fruits are bleached; that is why they are first put through the clincher with the lids lightly fixed. The cans are not air-tight at this stage, as it would be no use passing them through an exhauster if they were, but the presence of the lids prevents bleaching, and the raising of the temperature prevents the re-entry of the air when the cans leave the exhauster.

The exhaustion process is necessary on account of the natural evolution of gas which goes on in spite of the most rigorous precautions, to ensure that there are no live organisms in the cans when they leave the factory. If this gas were to be evolved in cans already at atmospheric pressure, swelling would be inevitable and blowing likely. Complete exhaustion is unnecessary, and it is found in practice that the 12 lb. vacuum applied is sufficient. When vacuumising is completed, the cans are sealed by machine which puts a double roll on the lids, making them airtight.

The cans of fruit are next cooked. The optimum temperature and time of cooking have been determined after considerable experimentation. The temperature of cooking lies between 200° F. and 212° F., and in any given instance depends on the type of fruit, as well as the size and ripeness, etc. Strict adherence to the temperature known to be most suitable for any particular fruit is achieved by thermostatic control.

After cooking the cans of fruit are passed through a water spray cooler, and at the same time are subjected to air cooling induced by a draught of high-speed fans.

After quick cooling, the cans are packed ready for dispatch.

The whole process is continuous, and is carried out on the conveyor system.

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Campden Fruit Preserving Solution

As a consequence of the enormous waste which occurs in glut seasons of certain varieties of English fruit, notably plums, various experiments have resulted in the production of a preservative solution which has proved to be a considerable advancement on the usual methods of preserving fruits for later use for cooking or jam-making, *i.e.* pulping, bottling, canning, or methods where sterilisation by the use of heat has been necessary.

This method is designed to supercede the ordinary bottling process at present universal in the home, as well as the usual factory pulping method. Much less time and trouble are required to preserve the fruit adequately, with the additional advantage of dispensing entirely with the use of heat.

The method is simplicity itself. The fruit is gathered, is placed in the storage vessel, the solution diluted and added until it covers the fruit (see directions below), and the vessel sealed.

The fruit in the solution will keep an indefinite period, providing the following directions are strictly adhered to.

Directions.—The contents of the bottle of preservative are sufficient to preserve 28 lbs. of fruit.

Place the fruit—which must be sound and not too ripe—in any glass or stone bottle or jar, which can be sealed with a cork, pack the vessel with fruit until it is nearly full.

Empty the preserving solution into any clean vessel and make up to 2 gallons with cold water. Pour over the fruit until it is entirely covered. Cork the vessel tightly **AT ONCE**. It is desirable to cover the exposed surface of the cork with sealing wax or paraffin wax. Any of the following seals can be used in substitution for the cork to render the vessel airtight: paraffin wax, mutton fat, or any other effective seal.

Important.—Have everything ready, so that the solution shall not be unduly exposed to the air.

How to use fruit.—It is essential that the fruit be cooked before use. It can be stewed and served in the ordinary way, or used for tarts, pies, or in any manner in which fresh fruit is utilised for cooking. The preservative is boiled off during the course of the cooking.

It is not necessary to use the whole of the fruit immediately the seal is broken. It will keep sound for some time.

Precaution.—See that the remaining fruit in the jar is completely covered with the liquid. Re-cork the jar as quickly as possible, and use the remaining fruit approximately within three weeks.

Fruits used in Confectionery

Success depends upon completely following the foregoing directions.

—Fruit preserved with the Campden Fruit Preserving Solution is excellent when made into jam. It follows, therefore, that it is not necessary to make jam only when fresh fruits are in season. Jam can be made at any time of the year.

Always use a proportion of the preserving liquid when cooking the fruit. If used for jam-making, boil the solution down to the weight of water usually added for the different variety of fruits.

NOTE.—The fruit will lose colour, but this will in a large measure return during the cooking process. As a part of the colour of the fruit passes into solution in the liquid, it is well to add a proportion of the liquid corresponding to the amount of fruit used from the jar when cooking.

This method gives excellent results with strawberries, raspberries, plums (all varieties), loganberries, blackberries—in fact, practically every variety of English fruit. The only fruits which have so far yielded less satisfactory results have been gooseberries and black and red currants.

For preserving Fruit Syrups.—Dilute 1 fl. oz. of solution in $\frac{1}{2}$ pint of water. Add 1 fl. oz. of this dilute solution to every pint of syrup to be preserved. Pour into bottles and cork tightly at once.

Dried Apples and Pears.—To prevent browning of apples and pears, particularly before drying, soak the prepared fruit for $\frac{1}{4}$ hour in water containing 1 teaspoonful of this fluid to every quart of water.

The Campden Fruit Preserving Solution is packed and distributed SOLELY by the University of Bristol, Department of Agriculture and Horticulture, Research Station, Long Ashton, Bristol.

Tablets of Potassium Meta-bisulphite for preparing a similar solution are also available.

CHAPTER XIII

JAMS AND JELLIES

THE jam- and jelly-making industry is developing every year, and regular good quality supplies are available at any time for the users of these products. As with all commercial food products, the essential feature of jam production is uniformity. It is quite easy for an amateur to make a boiling of jam which might be considered perfect from every point of view, but it is another matter to reproduce the same results regularly under factory conditions. Some of the difficulties with which the jam manufacturer has to contend are seasonable variations, and changes in the fruit due to conditions of cultivation, harvesting, and storage. Analysis of the fruit does not always give sufficient information to enable a perfect jam to be made at the first trial, therefore an expert jam boiler is still required in the jam factory. Although jam production is a highly scientific process, the art still lingers.

Raw Materials

The raw materials used are of first importance, also experience in choosing and blending fruit is very necessary. The jam manufacturer has four classes of fruit to choose from :

1. Fresh Fruit.
2. Frozen or Chilled Fruit.
3. Canned Fruit or Fruit Pulp.
4. Fruit preserved by Sulphur Dioxide.

These are placed in their order of merit as regards their suitability for jam-making, and while fresh fruit is used to produce the best jams, fruit preserved with sulphur dioxide is the most convenient for handling in the factory. It is for this reason, and also because large stocks of fruit may be preserved in this way for making jam when the fresh fruit is not available, that jams made from preserved pulps occupy a very important place in the industry.

Good, sound fruit should always be used, whether fresh fruit or pulp is being used. It must be sorted into trays before use. When fresh soft fruit has, for some unavoidable reason, to be kept overnight or longer, it is generally covered with water, and a small quantity of preservative is added to it. About 6% sulphurous acid

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or other sulphite per cwt. of fruit is sufficient to prevent the development of yeasts and moulds, which might cause later trouble. When preserved pulps are used, every cask must be examined for signs of fermentation, by removing the head. Fermentation can easily be detected by signs of gassing, or by the return of the natural fruit colour due to the preservative having been lost by evaporation. When frozen fruit is used, it should be allowed to defrost slowly and naturally, but must be used as soon as it has been defrosted.

Various Fruits

Raspberries.—There are various types of raspberries well suited for jam-making, but most of the usual canning varieties, such as Pynes Royal, Lloyd George or Norfolk Giants are the best. Those varieties which show an excessive number of seeds should be avoided. A proportion of Scotch raspberries is always welcome in this jam, because their seeds retain their fresh appearance longer than most English fruits. When all English fruit is used, the jam may take on a stale appearance after a lengthy storage. The fruit should be passed through a fine mesh sieve to remove plugs, stalks and hard berries.

Strawberries.—All strawberries are not really suitable for jam-making, so a large tonnage of pulp is imported, chiefly from Holland and Russia. Some of the imported strawberries arrive in cans, but the bulk of these arrive in casks having been preserved with SO_2 . The best varieties of English strawberries for jam-making are Sterling Castle, Ruskin, Royal Sovereign and Paxtons. Jam-making strawberries should always be firm and free from plugs and stalks, also the fruit should be picked over to remove those with hard black patches. This is a blemish particularly liable to be present with Paxtons. Uniformity in strawberry jam is only attainable by blending different types of strawberries. This helps to compensate for seasonable and other variations. A boiling may be made from equal proportions of Ruskins, Paxtons and Dutch pulp.

Black-Currants.—Most of the canning varieties of black-currants are suitable for this jam. The fruit should not be too ripe, nor too under-ripe; otherwise the jam will contain tough skins and there will be floatings of the fruit to the top of the jars. These are the main difficulties in making black-currant jam. To avoid this trouble, it is necessary to boil the fruit or pulp with water until it is tender, before adding the sugar.

Gooseberries.—These are a good fruit with which to make either jam or jelly. They can be cooked either ripe or under-ripe, but are

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at their best for jam-making before they are fully ripe. There are many types of gooseberries, the small green type being useful for jam-making, also the large red type, while the small red hairy type are most suitable for making gooseberry jelly.

Plums.—The best plum jam is made from the two varieties of egg plums—the Red and the Yellow—and Victorias. Other varieties are used, but are better mixed with one of those mentioned. They should be boiled until tender before the sugar is added. Too many stones are undesirable in plum jam, so about one-third of the fruit pulp is sieved through a coarse mesh sieve to remove the stones, unless a stoneless plum jam is required, then all the stones are removed entirely by sieving all the pulp.

Sugar.—Either cane or beet sugar may be used in jam-making, provided it is a good grade of unblued sugar. It is often used today in the form of a syrup, adding it hot to the boiling fruit.

Liquid glucose or invert sugar may also be used by some manufacturers to help in the inversion of the sugar and prevent it from graining during storage, but not more than 25% of the sugar should be thus replaced.

Pectin.—There is a quantity of natural pectin in all fruits, but some contain more than others, for instance apples, gooseberries and citrus fruits are very rich in pectin, while strawberries are naturally deficient in it. Pectin is one of the main things in the jam which causes it to set firm.

Pectin can be obtained either as a powder or in liquid form, as a 5% solution. It is added to those fruits that are deficient in pectin. Either form can be used. The liquid apple pectin is cheaper than the powdered pectin, and perhaps more convenient for use in the factory. The powdered citrus pectin may be preferred by some, as there is no flavour or odour with it, and it is of uniform setting power.

Apple juice, gooseberry juice and red-currant juice were much used before pectin came into vogue on account of the pectin in these juices, but these are now only used in making mixed fruit jams.

Colouring Matter.—Only permitted fruit colours should be added to jams. They should be used in liquid form, 1 oz. per pint of water. They should be bright and clear and not liable to fade.

Acids.—Tartaric or citric acid may be added to jam to help in setting it and prevent graining of the sugar. A convenient form of either acid is a 50% solution in water, *i.e.* 10 lbs. per gallon of water. Acids are often included in jams to make up for a deficiency of natural acid in the fruit, so as to increase the amount of inversion. The amount of inversion of sugar during boiling is very important

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in preventing granulation. If the percentage of invert sugar is below 25%, acid should be added: 1 oz. per 112 lbs. of jam will be sufficient, but the actual quantity that should be used will depend on the acidity of the fruit, and on the length of the time taken to boil and fill the jam.

Boiling Jams.—It is very important that jams should be boiled correctly, in order to avoid such troubles as fermentation, granulation, bad colour and flavour, mould development, and bad setting. After preparation, the fresh fruit or fruit pulp is weighed out, water as required is added to it, and it is placed in the steam boiler and the steam is turned on. It is generally necessary to boil the fruit for a few minutes, either to soften the fruit or to remove some of the SO_2 . The maximum amount of SO_2 permitted in jam is 40 parts per million. Black currants require more water than other fruits, and also require more boiling at this stage. After a few minutes boiling, the sugar is added, also any required colouring matter and acid. A small amount of butter or nut oil should also be added to prevent frothing and formation of scum. About five minutes before the end of the boiling period, liquid pectin is added, if this is necessary. Pectin should not be added too early, otherwise some of its setting properties may be destroyed owing to the formation of pectic acid. When dried pectin is used, it is generally mixed with five times its weight of sugar, and added before the bulk of the sugar.

The jam-maker uses a thermometer to get it to the correct temperature, but a "drop" test is also employed to make sure the jam will set. After the first boiling of any particular fruit it is then only necessary to use the thermometer to get it to the correct temperature. The temperature at which a boiling of jam is considered to be ready is determined by the concentration of solids precisely when the correct set is obtained, as shown by the "drop" test. There should be about 70% soluble solids when the jam is ready. Those fruits with the higher sugar content, such as strawberries, require a higher finishing temperature than those fruits, such as apples, with a lower sugar content. There is only a matter of a few degrees difference, so that it requires very careful watching. Strawberry jam should finish at 222° to 224° F., whereas apple jam should finish at about 219° to 221° F. Since the finished weight of a boiling is dependent on the time of boiling, this gives an additional check on the correctness of the boil. The maximum tolerance is 1 lb. in 1 cwt. jam. It is generally checked by tipping the jam into a tared cooling pan.

The first boiling of any particular fruit is of necessity in the

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nature of a test boiling, and if the set, the soluble extracts, and the invert sugar are found to be correct, then subsequent boilings should be standardised. Then by adding each ingredient at the correct time, keeping the steam pressure constant, seeing the steam traps functioning properly, and using the correct temperature for the boiling, then the finished weight should be constant. The soluble extract and the amount of invert sugar should not vary if the method of making is standardised.

When the jam is ready it is transferred to coolers, where it is allowed to cool a little before filling into sterile jars. It must not get too cool, as this fosters premature setting and spoils the final set of the jam. If it is filled while too hot, the fruits and stones may show a tendency to float, so that there is an uneven distribution in the jars. There is some diversity of opinion as to what is the best filling temperature, but many manufacturers fill at 180° F. to 200° F. It can either be filled by hand into sterile jars or through a feed tank by machine. When the jars are filled, they should be cooled quickly in order to preserve the colour and prevent further inversion of the sugar.

A round of wax paper is placed on the top of the jam in the jars while it is still hot. This paper should be impervious to moisture, and should be securely sealed to the top of the jars.

Parchment closures for the tops of the jars are only satisfactory if the jam has been correctly boiled and the storage conditions are good. Parchment tops let through both air and water vapour. This latter will be absorbed by the jam in a damp atmosphere, and will be given off if storage conditions are too dry, unless some other form of protection is available. Dampness causes mould and dryness causes crystallisation. The modern method of sealing jars of jam with metal closures is best, as then the external atmospheric conditions do not affect the keeping qualities of the jam. When metal closures are used, it is necessary to make sure that the jam is sterile and that the inside of the caps are also sterile. This can be done by passing them through a steriliser, while shielding the main body of the jars from the heat, in order to avoid discolouration and over-inversion.

Food Manufacturers' Federation Standards for Jam.—The Food Manufacturers' Federation in collaboration with the Society of Public Analysts some years ago laid down certain standards for two grades of jam, labelled respectively "Full Fruit Standard" and "Lower Fruit Standard". Standards for mixed fruit jams are included, the proportion of fruit entering into the mixture being stated.

1. Standards are fixed for first quality ("Full Fruit Standard") and second quality ("Lower Fruit Standard") jams.

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2. The standards are a minimum percentage of soluble solids and a minimum fruit content for each variety of jam.

3. No jams are to be manufactured below the agreed standards.

4. The use of citric, tartaric and malic acids are permissible where necessary, as is also that of permitted artificial colouring matter, without declaration on the label.

5. Added fruit juice or pectin. These may be used without declaration in first quality jams, but their presence in second quality jams must be declared in type of equal size to that employed for the name of the fruit used.

6. In mixed fruit jams the fruit present in least amount must be named last on the label.

Below is a table of F.M.F. Standards (1st Quality) jams :

<i>Variety of Preserve</i>	<i>Minimum quantity of Fruit used per 100 lbs. of finished preserve</i>	<i>Quantity of Sugar used per 100 lbs. of finished preserve</i>
Strawberry - -	42	64.7
Raspberry - -	38	65.5
Black currant - -	30	64.2
Red currant - -	35	64.9
Greengage - -	40	62.9
Victoria plum - -	40	63.5
Green or golden plum	35	64.7
Red plum - -	40	63.3
Blackberry - -	38	65.0

National Mark Standards for jam usually contain more fruit and slightly less sugar per 100 lbs. of finished jam.

The Ministry of Food have recently published provisions relating to Quality Standards of jam manufactured in the United Kingdom, stating the minimum amount of fruit content in both Standard jam and Lower Fruit Standard jam. This is published under the Statutory Rules and Orders, 1941, No. 41. The Jam (Maximum Prices) Order, 1941. Dated January 13, 1941.

The standards given are practically the same as the standards of the Food Manufacturers' Federation.

Recipes for Jam.—There is not much point in giving recipes for all types of jam, as each manufacturer has his own formulae, and has to alter them to suit the available fruit, but it might be useful to consider a few points in the making up of recipes.

The size of the available boilers affect the recipe used, but it is best not to have too large boilers. A quick boiling of the jam gives

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best results, so the ingredients should not fill the pan above the steam jacket level ; but if it falls below this level caramelisation may occur, resulting in a poor coloured jam. When the pan is too full the jam may froth up and boil over. Again, a small boiling will cool quickly.

Another important point to consider is the soluble extract, since the keeping qualities of jam is largely dependent upon the maintenance of a correct percentage of soluble matter. All the ingredients used contribute to the soluble extract, but naturally the sugar and fruit contribute most. When calculating the soluble extract of a recipe, it is usual to take only these two ingredients into account, together with the final weight of the boiling. Where a large amount of pectin is used, allowance should also be made for it. The following table gives the approximate percentage soluble extract of ingredients used in some jams.

Sugar	-	-	-	-	-	-	100%
Glucose	-	-	-	-	-	-	82%
Liquid pectin	-	-	-	-	-	-	12%
Black-currant pulp	-	-	-	-	-	-	11%
Plum pulp	-	-	-	-	-	-	11%
Strawberry pulp	-	-	-	-	-	-	10%
Apple pulp	-	-	-	-	-	-	9%
Red-currant pulp	-	-	-	-	-	-	6%
Raspberry pulp	-	-	-	-	-	-	5%

When calculating the soluble extract of a jam from a given recipe due allowance must be made for any invert sugar formed during boiling. When sugar is inverted the soluble extract is increased by 5%, so if 20% of the sugar in a boiling of jam is inverted, the soluble extract in the jam is increased by 1% for each 100 lbs. of sugar in the recipe.

The soluble extract should not fall below 68%. Around 70% is a good average.

Here are two commercial recipes for jam, showing how the soluble extract is calculated :

RASPBERRY JAM :

49 lbs. raspberry pulp	Extract 5%	- 2.45 lbs.
74 „ sugar	„	- 74.0 „
7 „ pectin	„ 12%	- 0.84 „
17 „ water	Inversion of sugar	
147 „ total weight	20% of 5% of 74	0.74 „
112 „ finished weight	Total extract in jam	78.03 „
35 „ to boil out	Percentage of soluble extract	
	$\frac{78.03 \times 100}{112}$	= 69.6%

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STRAWBERRY JAM :

59 lbs. strawberry pulp	Extract 10%	- 5.9 lbs.
72 „ sugar	„ -	- 72.0 „
8 „ pectin	„ 12%	- 0.96 „
10 „ water	Inversion of sugar	
149 „ total weight	20% of 5% of 72	0.72 „
112 „ finished weight	Total extract in jam 79.58 „	
37 „ to boil out	Percentage of soluble extract	
	$\frac{79.58 \times 100}{112}$	= 71.0%

Fruit and Piping Jellies.—Fruit and piping jellies of various colours and flavours are a very useful commodity for use as fillings or for the decoration of cakes and gateaux.

There are great differences in some of these products, not only in flavour, but in quality and smoothness. Good jelly should be bright and clear, have an attractive colour and flavour, should not be too expensive, and when used should be perfectly smooth, and retain the form in which it has been piped out. These qualities in a confectioner's jelly are obtained in a variety of ways, but the best results are obtained by the use of good materials, boiled in the correct manner and acidified at the right time.

Natural fruit jellies have generally the best colour and flavour, and make excellent fillings, but are sometimes inclined to be short when used as a medium for the decoration of cakes, or else are runny and flow out on the goods, so that they do not retain the form in which they have been piped out. Reinforcing fruit jellies with either liquid or dried pectin has helped the modern manufacturers to produce better jellies without these faults. Some jellies are now produced with dried pectin alone as the jelling agent.

Agar-agar is another reinforcing agent much used in the making of piping or confectioners' jelly. Agar-agar is the dried form of a red seaweed found along the shores of California and Japan. It can either be purchased in powder form or in a dried stringy form. It consists principally of a carbohydrate—Gelose—which is similar in properties to fruit pectin. Agar-agar is insoluble in cold water, but swells and absorbs large quantities of it when soaked for 12 hours. When a solution is boiled gently for 3 to 5 mins., it goes into a colloidal solution that sets firm like a jelly when cool.

Leaf gelatine has also been used as a reinforcing agent in piping jelly. This has only about half the water absorbing power of agar-agar. The jellies made with it are good and clear, and set nicely when the correct quantity has been used.

Natural Fruit Jelly.—Jelly-making is a process of preserving fruit

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juices, which can be carried out by two successive operations. Most soft fruits are fairly suitable for making jelly, except strawberries, since they are lacking in both pectin and acid. Strawberries can only be made into jelly if they are mixed with some other fruit juice strong in pectin, or if the prepared pectin is used with the strawberry juice.

Except in the making of gooseberry and apple jellies, all fruit should be fully ripe, because then the flavour is fully developed, and the yield of juice will be greater.

The fruits should be picked over to take out any unsound and bruised fruit, and then it is washed, the proper proportion of water is added to it, and the whole is brought slowly to the boil and then allowed to simmer until the fruit is quite tender.

Some fruits require only a small quantity of water, because they already contain plenty of juice.

Red-currants, raspberries and loganberries require only 1 gal. water to 21 lbs. fruit.

Black-currants, gooseberries, apples and plums require 1 gal. water to 11 lbs. fruit.

When the fruit is sufficiently soft, the juice is strained or separated from the pulp, by passing it through a jelly bag or a filter press, to obtain the pectinous juice. The pulp may again be boiled with more water to obtain more juice of a lower quality.

The quantity of sugar required to make a jelly from the fruit juice depends to a large extent on the quantity of pectin in the juice. This can be estimated by testing it for quality. Take a spoonful of juice in a cup and add three spoonfuls of methylated spirits, shake together, then carefully decant off the spirits. Pectin is insoluble in alcohol and is thrown out of solution, so that it should settle out as a jelly-like clot at the bottom of the cup. This clot should be examined. If it is fairly solid, the juice is rich in pectin, and 1 lb. 2 ozs. sugar can be used per lb. of juice. If the clot is weak, the juice is only moderately rich in pectin, and 1 lb. sugar should be used per lb. of juice. When little or no pectin is formed, then some other fruit juice rich in pectin should be used with the juice, or a proportion of liquid or dried pectin can be used, and only 1 lb. sugar per lb. of juice.

It is important to have the proportion of sugar in a jelly exactly right. When too much is used the jelly will be too sweet and will not set properly. When too little is used, the jelly will be tough. If the jelly is boiled too long with the sugar it will be ropy and syrupy.

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When boiling the jelly it is necessary first of all to heat the juice until nearly boiling, then add the sugar, and have it all dissolved before the mixture boils. Stirring during boiling spoils the clear colour of the jelly.

Some jellies require only a few minutes' boiling, others may require up to 15 minutes' boiling, to reach the desired degree of jellifying. The thermometer is used and the drop test. About 220–221° F. is generally found about the correct temperature at which the jelly will set when tested.

With experience one soon gets to know when a boiling of jelly has reached its maximum setting point. The over-boiling of a jam or jelly destroys the pectin and acid combination, and gives a sticky syrupy jelly. The sugar content of the jelly should be about 65 to 68% when finished.

Fruit Jelly with Pectin.—It is impossible to make fruit jellies from some of the most popular flavoured fruits, owing to their deficiency of pectin and acid, but this deficiency can be overcome by the use of powdered pectin and acid solution. The standard recipe to use is as follows :

50 lbs. sugar.
50 lbs. fruit juice.
 $\frac{1}{4}$ to $\frac{1}{2}$ lb. pectin.
3 to 6 ozs. acid solution.

The pectin and acid used depends on the available supply in the fruit juice.

Yield about 84 lbs. for 65% soluble solids.

Lower Cost Jelly.

50 lbs. sugar.
42½ lbs. fruit juice.
 $\frac{1}{2}$ lb. pectin.
6 ozs. acid solution.

Yield for 65% sugar jelly 77 lbs.

Method of making jelly with pectin :

Place the fruit juice in the boiler. Mix the powdered pectin in a basin with 5 times its weight of sugar taken from the total sugar to be used. Before heating the juice, sift this sugar pectin mixture over the juice while stirring it in the boiler. Bring the mixture to the boil, add the main portion of sugar, and boil to about 220 to 221° F. Cool the jelly slightly and add the acid, then pour into sterile jars.

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Confectioners' Piping Jelly.—There are a vast number of recipes for making confectioners' piping jelly, either with agar-agar as the main jelling agent, or with powdered or liquid pectin as the jelling agent.

The following recipe can be utilised by those confectioners who wish to make this commodity :

- | | |
|---------------------------------|--|
| 4 ozs. agar-agar | Soaked together for 12 hrs., then brought to the |
| 4 quarts water : | boil and allowed to simmer for 3 mins., and strained through a hair seive into the sugar solution. |
| 20 lbs. sugar | Bring slowly to the boiling point, then boil to |
| 5 pts. water : | 240° F., add the agar-agar solution and boil the mixture to 220° F. |
| 12 lbs. apricot purée : | Heat the apricot purée until boiling, then pass through a fine seive into the boiled solution. Allow the mixture to cool a little. |
| 4 ozs. tartaric acid solution : | Add to the jelly, then pour into sterile jars, cover with waxed discs and tie down with strong greaseproof paper. |

Colour and flavour as required.

The tartaric acid solution is made by dissolving 1 part tartaric acid in 2½ parts water. It is always added to the batch just before colouring and flavouring and pouring.

CHAPTER XIV

CHOCOLATE

IT is only within recent years that confectioners have had to make sure that all chocolate confectionery goods must have a proportion of genuine chocolate in their make-up, otherwise the confectioner displaying chocolate coloured and flavoured gateaux and fancies, etc., which are designated chocolate goods, is liable to prosecution under the Food and Drugs Act (1938). By the invocation of this Act it ensures a general improvement in the quality of chocolate cakes, because an addition of genuine chocolate in place of colour and flavour only must automatically improve the quality, food value and flavour of this type of confectionery. No standards are laid down in this Act, but certain suggested standards have been generally adopted by the Trade and the Public Analysts.

History of Chocolate

Although chocolate manufacture has only been developed in Europe during the last hundred years or so, its great value as a food-stuff has been known for many centuries. There are many books dealing with the history of it and telling of its manufacture, such as : *Cocoa—All About It*, by “Historicus” ; or *Cocoa and Chocolate*, by R. Whympers ; or *Modern Methods of Cocoa and Chocolate Manufacture*, by H. W. Bywaters. All these books give a vast amount of information about it. Here, it is only proposed to give a brief idea of how chocolate manufacture has developed in Europe, and an outline of its food value and uses.

It was first discovered by the Spanish explorers in the early sixteenth century, who found it used very widely in the best circles of Mexican society as a drink called *Chocolatl*. This drink was actually a cross between Cocoa and Chocolate as we now know them, being a very thick chocolate drink. It was prepared by a primitive and laborious process, basically, however, the same as modern chocolate manufacture.

The biological name for it, “*Theobroma Cacao*”, means “The Food of the Gods”, for the Mexicans considered it a divine product. The Spaniards, however, had more practical ideas, and took the recipe back to Spain, where they kept it a close secret, and managed

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to hold the monopoly for over a century, after which it slowly spread to Italy, Holland and France.

Raw cocoa first appeared on the English market in the early eighteenth century, and manufacture was started in the west country, as Bristol was then the principal port for the West Indies. Previous to this, the drink had been imported from Spain as an expensive luxury, costing 10s. per pound, then an exceedingly high price indeed. This drink was apparently known as "Jocolatte". At least that is what Pepys called it when he saw it in 1664.

Chocolate as a Foodstuff

Chocolate was at one time regarded as a luxury, but when it is partaken of in moderation, it becomes a sustaining and useful food which is now regarded as an essential commodity. It is a very pleasant sweetmeat and makes a pleasant addition to other foodstuffs. The War Office now regards it as a necessity, since it is supplied to the army as an emergency ration, thus acknowledging its great food value. One pound of chocolate supplies about 2515 calories.

The average composition of chocolate is approximately as follows :

Proteins	-	-	-	-	-	4.8%
Fats	-	-	-	-	-	32.5%
Carbohydrates	-	-	-	-	-	59.5%
Theobromine	-	-	-	-	-	1-2½%

Theobromine is an alkaloid possessing stimulative properties. Chocolate is rather more expensive than many other foodstuffs, but good chocolate cannot be made cheaply, because the best raw materials must be selected for its production, and elaborate processes are involved in its manufacture to produce the best grades of chocolate.

Manufacture of Chocolate and Cocoa

It is generally known that both chocolate and cocoa are made from the same principal ingredient, the Cacao Bean. Cacao trees grow only in tropical climates, and the fruit is in the form of large pods, similar to a melon, but with slightly more pointed ends. The cacao beans correspond to the seeds of a melon, but are about the size of almonds, and each pod holds 30 to 35 beans. Each tree bears 14 pods, and there are nominally two crops per year, so that each tree produces approximately 3 lbs. of usable beans per annum. The fruit when ready for harvesting is of a rich golden-red colour.

The characteristics of the beans vary very considerably according

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to the district in which they are grown. The Spaniards were not long in finding that cacao trees grew considerably better in central American countries other than Mexico, both north and south of Panama, notably Venezuela, which remains to this day one of the regions where the finest cacao beans are grown. They were also responsible for the transplanting of the cacao trees to the West Indies, which was a very successful experiment. Since then cacao planting has steadily progressed westwards, first to other Atlantic islands, and then finally into West Africa, which is now by far the greatest producing region of all. The beans are harvested with success in Ceylon, Java and Samoa. The cacao beans from these different regions have quite different characteristics, and one of the arts of chocolate-making is the correct handling and blending of the different varieties. When the beans come to this country they have already been fermented to a certain extent and partially dried out : this is done as soon as the beans have been scooped out of the pods, otherwise they would go mouldy. The flavour is also developed during the fermenting and drying process.

All the further processing of the cacao beans has the object of building up a good chocolate flavour, and of removing excess acid and moisture, the latter being particularly injurious to chocolate. In the chocolate factory, the beans after blending are first mechanically cleaned to remove any dirt, pieces of the original husk, sacking, etc. Next, they are roasted—this being a very critical stage in the manufacture, as the degree of roasting exercises considerable changes in the flavour. The temperature of roasting varies between 100° to 135° F. In Mexico this was done in small quantities over an open fire ; in a modern factory they are roasted in large quantities in machines specially designed for this purpose, but nevertheless hand-control of each individual batch by experienced men is essential, and will probably remain so until machines that can taste and smell are a practical proposition.

Cacao beans contain about 40 to 50% fat or cacao butter, also proteins, carbohydrates as starch, fibre, traces of sugar, mineral salts, moisture, and other plant products.

The roasting process extracts a large part of the moisture, and removes many unwanted acids : the heat causes an active development of flavour inside the beans, and modifies the colour.

Next, the shell, with which each bean is covered, is removed by a winnowing machine ; like nut shells. These have considerable value as feeding-stuff owing to their vitamin content. Only the kernel or nibs, as it is called, is of value in making chocolate.

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The cacao nibs are ground at a suitable temperature, and produce a rich reddish brown coloured liquid of the consistency of paint, which sets hard on cooling. This is the unsweetened block chocolate, with the following average composition :

Moisture	-	-	-	-	-	4 to 5%
Fats	-	-	-	-	-	45 to 55%
Nitrogenous matter	-	-	-	-	-	13 to 15%
Starch	-	-	-	-	-	21 to 23%
Ash	-	-	-	-	-	3 to 3.5%
Silica	-	-	-	-	-	0.1 to 0.3%
Thebromine	-	-	-	-	-	1.3 to 1.5%
Cellulose	-	-	-	-	-	3 to 4%
Total nitrogen	-	-	-	-	-	2.1 to 2.2%

To make chocolate, sugar must be added to this ground mass, together with any desired flavourings. The flavouring used is Vanilla. The sugar used is always the best white crystal sugar pulverised to a fine powder with hammer mills. The sugar and cocoa masses are mixed together for the most part in the Melangeur machines, which were introduced in France and Switzerland in the latter part of the last century, and are still known by the original French name. Extra cocoa butter is added to bring the consistency of the finished chocolate to the desired degree of fluidity. Cocoa butter is expressed from the unsweetened chocolate in the making of cocoa. In the Melangeur a thorough blending takes place, and the grains or particles of cocoa and sugar are reduced to a very small size. The proportions depend on the purpose for which the chocolate is required.

In recent years milk chocolate has become very popular. Fresh milk (liquid) cannot be added to chocolate, owing to the amount of water it contains. This has to be carefully evaporated in such a way that the flavour of the milk is not impaired ; this is usually done in a special vacuum plant, as milk cannot stand the same temperature as chocolate.

The mixed chocolate is next further ground through powerful roller mills, known as refiners. It is passed through many times, the number varying with the degree of refinement required. If this is not done, the granules of sugar and cocoa can still be tasted in the chocolate as grit.

After this comes the process known as conching, again French-Swiss in origin. This process ensures that the chocolate will be smooth eating. In this machine the chocolate is buffeted about in a hot condition for periods of up to 72 hours, to effect a great improvement in smoothness to the tongue, and also in flavour, the whole mixture being amalgamated into a homogeneous mass. The

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chocolate is then ready to be run into moulds and set, ready for distribution. This product is then known as couverture.

It will be appreciated that it requires considerable skill and also expensive equipment to manufacture a good chocolate.

It was not possible to manufacture chocolate as it is now known until comparatively recently, when efficient grinding machines became available.

Types of Chocolate

When a confectioner buys chocolate he can make important decisions with regard to flavour. The differences in flavour are produced by the manufacturers by (1) Choice of beans, (2) Blending of nibs, (3) Degree of roasting, (4) Percentage of added flavours, (5) Amount of sugar used, (6) Process of manufacture, (7) Maturity of the chocolate, (8) Percentage of cocoa butter. Combinations of these variable factors produce numerous grades of chocolate. Some manufacturers run as many as seventy types of chocolate couverture to meet the demands of their various purchasers. The differences refer to the percentage of cocoa butter, sugar, added flavour, blend of beans, method of production, and fluidity of the product when melted. Lecithin is widely used to improve this factor. But couvertures are manufactured exclusively from cocoa, sugar and cocoa butter, and can be guaranteed for purity.

In recent years experiments have been made with a view to evolving a new type of chocolate couverture which is more plastic, and which it was felt would be more suitable for use by confectioners in covering their soft type of cakes. Lecithin is incorporated with the chocolate, and some hardened fats are added which make the chocolate more plastic, but unfortunately detracts from the flavour. This bakers' chocolate, as it is called, is much easier to use than chocolate couverture in the production of confectionery.

Tempering Chocolate for Use

The demands of the confectionery trade for chocolate couvertures are very different from those of other users. Chocolate as normally made has a short break. It also contracts considerably on setting, which is a very necessary characteristic if it has to be set in moulds. Both of these features are undesirable in the confectionery trade, because when chocolate contracts on a cake the area is so large, and the film so thin, that it easily cracks, both through shrinkage and its own inelastic nature when set. It is like trying to coat a bath sponge

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with a film of thin glass. Again, when a cake covered with normal chocolate couverture is cut with a knife, the chocolate cracks and tends to split in all directions. This has been overcome in flour confectionery by the use of chocolate coloured icings and fondants in the past; these have not, however, the same flavour as true chocolate, and also require considerable skill in handling.

A certain amount of skill and care has to be exercised when melting and tempering chocolate couverture for use in flour confectionery, not only care in the manipulation of the chocolate itself, but also in the choice of the ingredients with which it has to be mixed, otherwise the familiar fat and sugar bloom will become evident. The technical explanation of this fault is that cacao butter is the natural constituent of the bean and is a mixture of glycerides of different melting points. It is easily supercooled, and the liquid can be brought below its setting point without visible crystallisation taking place. This is one of the characteristics that has to be studied during manufacturing operations. While this solidification is taking place, the volume change in the case of crystallised fractions is sufficient to cause an uneven distribution of the fats, and some of the lighter fractions rise to the surface in the plastic mass. The result is that the surface of the chocolate becomes covered with the fat crystals, usually of a streaky formation, so in order to ensure the best results it is important to consider thoroughly the art of tempering effectively any chocolate couverture.

When chocolate is used for coating biscuits and other types of confectionery it must first be melted by heating; excessive heat and cold should be avoided. The melting should be done slowly and carefully, great care being taken that the chocolate does not burn or char at any point. Normally, for vanilla chocolate, it should not be heated above 120° F., and not above 110° F. for milk chocolate, and at the first melting not less than 5° under these maximums. If the melting temperature is too low, a good gloss and good flowing properties are not ensured; if the melting temperature is too high, there is unnecessary work in cooling the chocolate again; also the flavour and homogeneity of the mass are likely to be upset. Melting in a bowl over a hot water bath is recommended only when no thermostatically controlled chocolate melting pan is available. Care must be taken that no steam or water reaches the chocolate. Stirring is, of course, essential, and the chocolate should be broken up in small pieces before commencing to melt it.

After melting is completed, the chocolate must be cooled quickly to 82° F., or below the dipping temperature, and then reheated to

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the exact temperature required. If a proper chocolate mixing kettle with steam and cold water connections is available this is ideal. Otherwise if the chocolate has been melted in a bowl, the bowl may be taken to a cold place, and the chocolate is thoroughly cooled, with constant stirring, not exceeding 22 revs. per minute, until it is just on setting point, when it is reheated again to the dipping temperature of about 86° to 90° F., and it is ready for use. Milk chocolate temperatures are best about 3° lower, or 84° F. An alternative method of tempering is to pour the liquid chocolate out on to a marble slab, and keep moving it until it is cool, then scrape it back into the bowl for rewarming to the dipping temperature.

These temperatures are not fixed, and are best learned by experience. Many confectioners find consistency a more reliable guide than temperature. For instance, if a chocolate is cooled slowly, it will set at a higher temperature than if it is cooled quickly. The gloss may not be so good as that from the fast cooled chocolate, but it will be more durable.

Further, different chocolates have different characteristics; a thinner chocolate works best at a cooler temperature than a thicker one. The temperature and air draughts in a room in which the work is carried out also have an important influence. The room should be as far as possible free from humidity and draughts; if possible chocolate work should be done in a room with a temperature about 75° F., and the cooling of the goods in a temperature of 50° to 60° F.

Neglect of this tempering procedure results in failure to obtain a good gloss on the finished chocolate, and the chocolate may even turn grey or white. The reason for this is that the preliminary lowering of a temperature causes partial crystallisation. The subsequent rise of temperature is not sufficient to destroy all crystals. The unmelted crystals thus form a nuclei around which later crystallisation can take place when the depositing process is completed, and the goods reach the cooling stage. The colour can, however, always be restored by melting again.

The moral of all this is to avoid all extremes of temperature and rates of heating and cooling; also use a reliable brand of chocolate couverture, and when difficulty arises consult the manufacturers, who are always quite ready with expert assistance and practical advice.

On a large scale the process is basically the same, but is naturally more mechanised. The small user would be well advised to use a thermostatically controlled chocolate pan.

The new type of bakers' chocolate covering that has been mentioned does not require this elaborate tempering procedure: it

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need only be melted carefully in a similar manner to chocolate to about 130° F., and then cooled until it is of a suitable consistency for dipping or spreading. The cooler it is the thicker it becomes. Any temperature between 95° F. and 130° F. is quite workable. A rough guide is warm for large-surfaced cakes and cool for smaller ones. It only requires pouring over the cakes. It sets fairly quickly with a good gloss and plastic nature, without any special cooling and attention. It has the advantage that it is never sticky at normal temperature and is also practically impervious to moisture, thus preventing any drying out of the cake. It is unfortunate that it has not got quite such a good flavour as the good chocolate couverture possesses.

Most of the large chocolate manufacturers have a staff of expert advisers, who are prepared to give advice on the most suitable type of chocolate coating to use in any particular business, and also advice on how to manipulate the chocolate, and the most suitable type of equipment for the same.

Hints on Chocolate

Here are a few hints on chocolate worth noting.

1. Remember that chocolate easily takes up foreign odours, so it should not be stored in a damp or smelly place. A cool, dry store-room with good ventilation is ideal. Stack the containers on battens, so that there is air circulation under the stacks : stand them a few inches from the wall to allow air circulation on all sides.

2. When using chocolate, remember that moisture is a great enemy of chocolate ; it spoils the flavour, thickens the chocolate and spoils the gloss. If it condenses on finished chocolates, it causes sugar bloom. Make sure, therefore, the storage room is not damp ; over 75° humidity is dangerous.

3. Do not attempt to melt the chocolate as though it were a piece of cast iron ; it will not stand high temperatures at all. No direct heat must come in contact with the chocolate. While overheating will destroy the delicate flavour, under-melting should also be avoided.

4. All goods that have to be covered with chocolate should have the chill taken off them before being covered, as during cold weather a very dull finish is caused by neglect of this point.

5. When the goods have been covered, they must be cooled or dried in a cool room about 55° to 60° F., as the final gloss of perfectly covered chocolate goods is assured or spoilt by correct or faulty cooling. It takes about twenty minutes to set the chocolate thor-

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oughly. It is better to keep the drying room free from draughts, as a severe draught of cold air on to liquid couverture causes discoloration.

6. During hot weather, when it is impossible to keep the temperature low, it is helpful to keep all doors and windows open and use electric fans.

7. Chocolate goods that have been cooled in a refrigerator must not be brought too suddenly into a warm atmosphere, otherwise condensation will take place on the surface. Large users of chocolate should have some form of air conditioning. Rapid cooling ensures a good gloss and snap, but too low a temperature causes super cooling and subsequent blooming. Therefore a careful balance must be maintained between these two factors, and this has to be left to the discretion of the craftsman.

Chocolate-coated goods are often spoiled when stored under bad conditions, and so the importance of strict attention to the temperature and moisture conditions cannot be over-stressed. Too high or too low or even varying temperature will inevitably result in "bloom". The ideal storage temperature is 60° to 65° F. If any kind of heating is used it should be of a diffused nature.

The technical explanation of this is that 76° F. appears to be the critical temperature for chocolate, at which point lower melting fractions of the cacao butter begin to melt and rise to the surface as the heavier cocoa and sugar particles sink in the softened mass, with resultant "bloom". Therefore it is advisable to store well below this temperature. Too moist an atmosphere is definitely harmful, owing to the danger of condensation and subsequent "greying". The humidity should be kept below 50°. In the ordinary way chocolate goods will keep well if stored in a good dry room cool in summer, and with some form of supplementary heating during cold weather. The room should be well ventilated, with plenty of air space around the shelves.

Cocoa Powder

Cocoa powder is produced from the cacao mass after some of the cacao butter has been taken out of it. It varies in composition according to the process used. It may contain from 10 to 40% fat. The description pure cocoa is interpreted in this country as unmixed cacao nib with variable amounts of fat removed by expression. The best grades contain about 25% cacao butter, and cheaper grades about 15%. Husk beyond 3% is not a normal constituent, and the

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admixture of foreign starches and sugar prevents the name "pure cocoa" being used, but permits the name "chocolate powder". In pure cocoa with 25% cacao butter, the remaining 75% is classified as fat-free cocoa.

Cocoa is used as the flavouring and colouring agent in making chocolate cakes and sponge goods, which contain at least 4% fat-free cocoa. It is also used to colour and flavour various chocolate biscuits, icings, buttercreams, etc.

Uses of Chocolate

Chocolate is rather a hard and brittle covering when used in its normal state to cover light fancies and cakes, and because it requires much experience to handle it, and success is so dependent on conditions, and particularly temperatures, many confectioners avoid trying to use it. Apart from moulding and dipping purposes, there is a wide field for its application in the decoration of cakes, gateaux and fancies, etc.

It is now considered essential that chocolate iced cakes should be covered with a real chocolate icing, or fondant containing a proportion of chocolate to both colour and flavour it. Ordinary chocolate couverture, when used as a covering, or when cut out in shapes to be used as decorative material, sets hard and brittle, and does not really combine well with light cakes when eaten, because the cakes are soft and spongy, whereas the chocolate is hard and brittle. The two have to be eaten separately to enjoy them.

Chocolate Coverings.—There are various methods of using chocolate to make good coverings for the decoration of cakes, etc. It can be used so that it combines readily with the cakes and becomes better to eat than chocolate couverture and cheaper to use. It can be used at nearly half the cost of ordinary couverture. It can also be made so that it does not set hard and brittle, but will be soft and mellow, with a full chocolate flavour, and eating qualities between that and fondant. The difficulties and drawbacks of its use are solved by using it in the following manner :

Take 4 lbs. good chocolate couverture, break it up in small pieces, and place it in a pan and melt it down over a bain-marie or in a hot prover until it is all in a molten state. Mix it well with a spatula and after tempering raise the temperature to about 96° F. and add some stock syrup to it. The temperature of the syrup should also be about 96° F. Add the syrup, one gill at a time, and mix it in well with the spatula. At first it thickens to a stiff mass, because of the

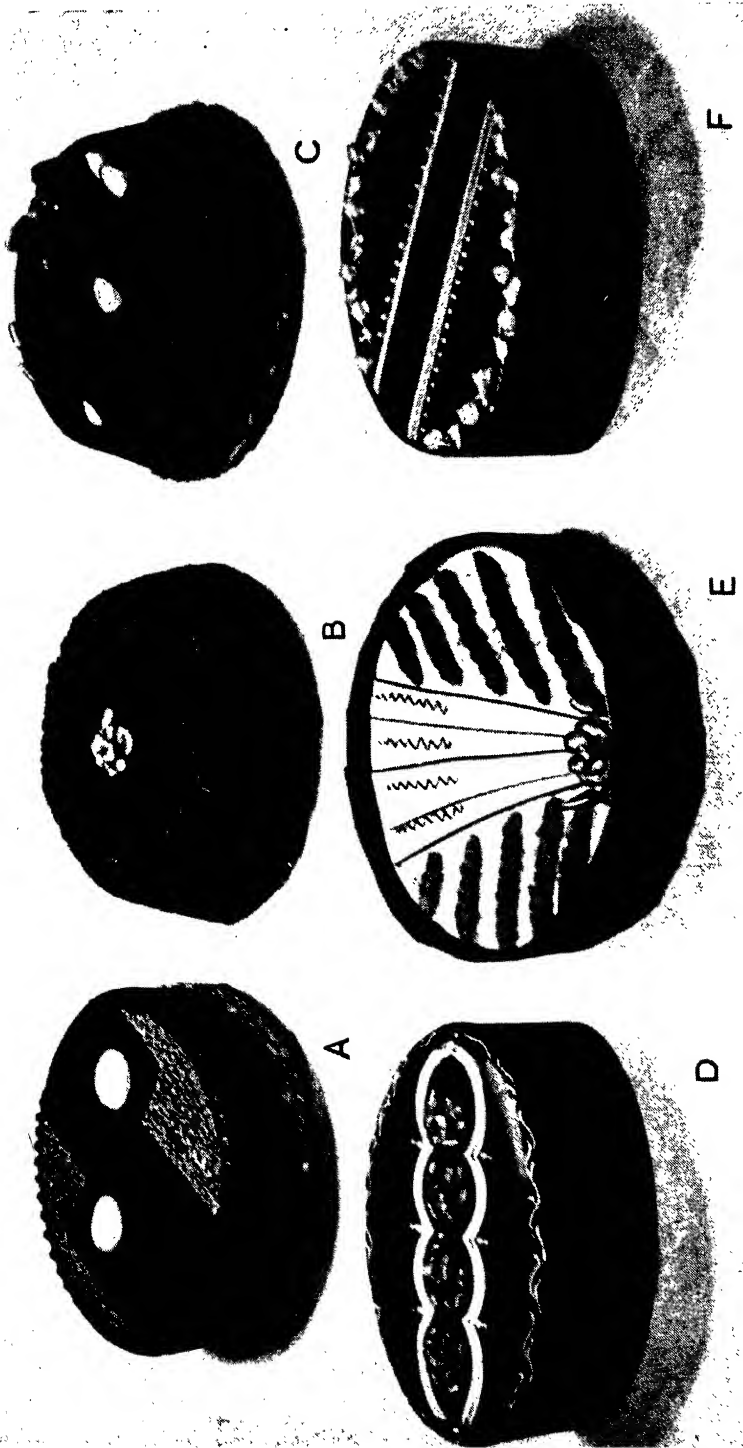


Fig. 3.—ILLUSTRATION ON USES OF CHOCOLATE ON GATEAUX.

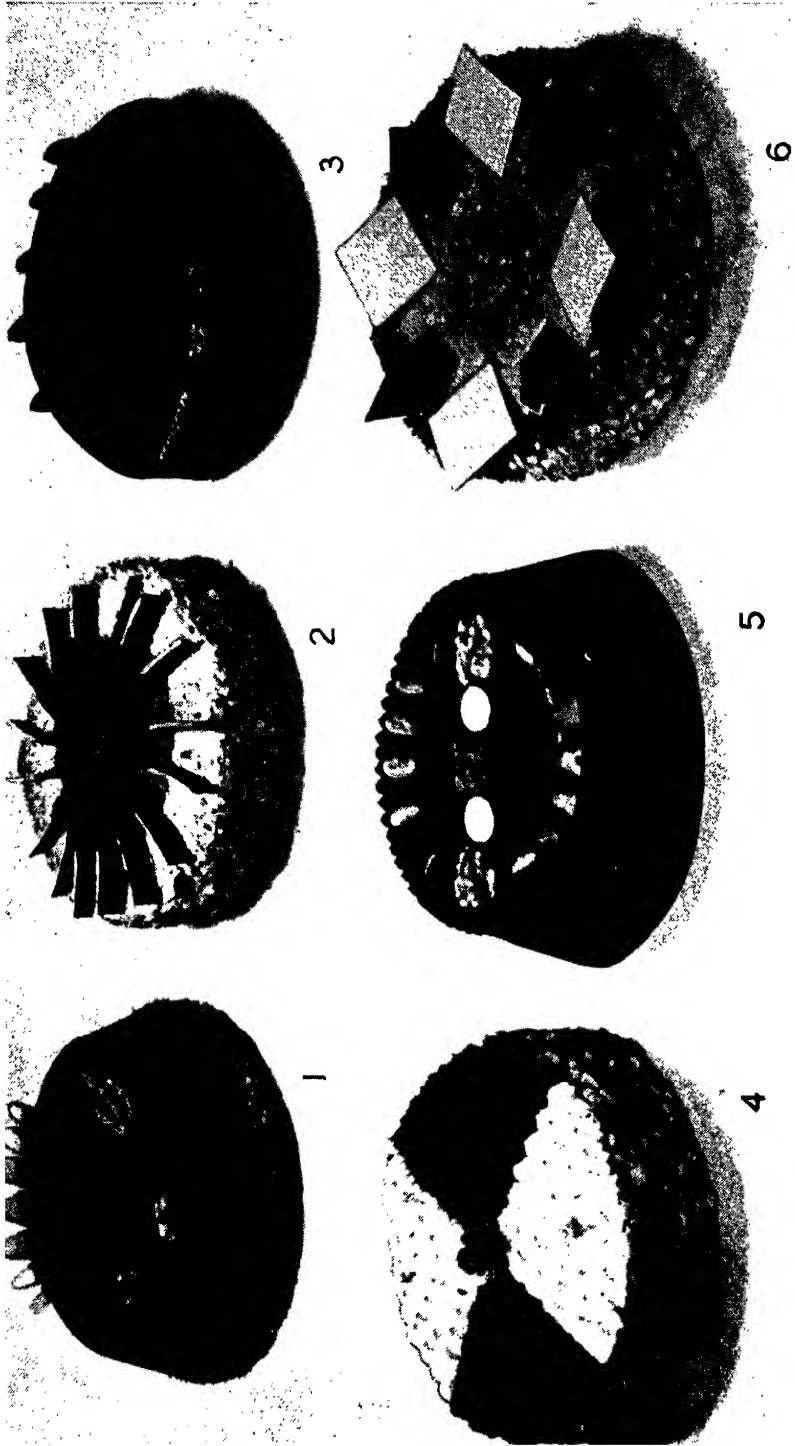


FIG. 4.—VARIETY OF GATEAUX.

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moisture present in the stock syrup, then it will get thinner and seem to curdle. Keep on adding syrup and stirring well, when it will take on a delightful smoothness and beautiful gloss. This covering is thinned down with sufficient stock syrup to get it down to the required consistency for the work to be done. It requires nearly two pints stock syrup to reduce 4 lbs. good chocolate couverture to the required degree for dipping fancies or covering gateaux or cakes or for coating eclairs. The chocolate should be used on the goods by spreading it thinly with a palette knife. It does not set so quickly as ordinary couverture, but it sets smooth and glossy. It combines excellently with the cakes, because when set, it is soft and mellow instead of being brittle and hard like chocolate. It is easy to make and use, and takes barely ten minutes to set. It has the full chocolate flavour, combined with an excellent glossy chocolate colour, and soft eating qualities. It goes much further in use than ordinary couverture, and is much nicer to the palate than chocolate fondant. It can also be used to pipe lines over the covering to form decorative work. Care has to be taken to keep the temperature of the chocolate and the syrup about 96° F. when mixing to get the two easily amalgamated in the minimum time.

Once a confectioner commences to use this chocolate covering for his chocolate gateaux, fancies or eclairs, he does not like to use anything else, because it is so superior to all other chocolate coverings for this work, and it gives to his products that quality and stamp of good craftsmanship that is so desirable.

The stock syrup used should be composed of 3 lbs. lump sugar, 1 lb. glucose, and two pints water, all made into a solution in a pan and just brought to the boil, impurities skimmed off, then cooled down and bottled ready for use.

Chocolate Fondant.—Chocolate fondant has probably been the most popular and favoured icing for the masking of gateaux and fancies. It should always be coloured and flavoured with real chocolate and not a mere chocolate colour and flavour. To make a full-flavoured and coloured-chocolate fondant from fresh white fondant take 4 lbs. fondant and place it in the fondant pot, and add 1½ lbs. of melted unsweetened block chocolate, that is 6 ozs. per pound of fondant. The fondant and chocolate should be heated together over a bain-marie. Stock syrup is added to reduce it to the required consistency. The whole should be well spatulated to mix thoroughly during heating. Care should be taken that the temperature of the fondant does not exceed 100° F. This fondant will take about 1½ pints of stock syrup to reduce it to the required

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consistency for masking gateaux and fancies. The chocolate has a binding effect, hence the reason for using so much stock syrup. A little vanilla extract should be added as a flavouring. A chocolate fondant prepared in this manner should have a brilliant gloss, which should be much better than the usual gloss on fondant prepared with chocolate colours and flavours. The flavour of this chocolate fondant is not quite so good as the flavour of the chocolate covering prepared from sweetened chocolate and stock syrup, because it does not contain quite such a high proportion of chocolate as the latter does. It is much sweeter, however.

A lower proportion of block chocolate may be used if desired, say 4 ozs. per pound of fondant, and a little less stock syrup. This is the average proportion used by many confectioners, but the flavour and colour are not quite so good as when 6 ozs. per pound of fondant is used.

An Addition of Butter to Chocolate Fondant.—Chocolate fondant can be very much improved in flavour and eating qualities if some good unsalted butter is added to it. Cocoa butter can also be used. Up to 2 lbs. of butter to the 4 lbs. of fondant can be used with good results. More than this will show a fat and sugar bloom on the cakes. To get a mellow-eating fondant with a beautiful gloss, one should use 4 lbs. fresh white fondant, 1½ lbs. melted unsweetened chocolate, 1 lb. unsalted butter or cocoa butter, and fully 1 pint stock syrup, with some vanilla extract to flavour the whole. These materials should all be heated together in a fondant pot over a bain-marie, and well spatulated together to mix thoroughly. The temperature should never exceed 100° F.

Either of these chocolate icings, when used on cakes, gateaux or fancies, will give that superior appearance to these goods that will attract the public to buy them, and that superior flavour that will make them want more of them.

An Addition of Oil or Lard to Chocolate Couverture.—When properly prepared and tempered, chocolate couverture is used for masking biscuits or small cakes; it has to be carefully manipulated to get a good gloss on the finished products, and the temperature of the chocolate and the goods on which it is used has to be carefully studied to prevent the familiar fat and sugar bloom becoming evident. Even after the most careful handling it is very often too thick on the goods and sets as a hard, brittle covering, which does not combine well with light fancies, cakes, and short-eating biscuits. By adding a small percentage of olive oil or ordinary lard to the melted couverture, the chocolate becomes more fluid, and consequently will go much farther on the goods, as a thinner coating will

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be used, and it will not be so hard and brittle when set, but it will set sufficiently firm to enable one to handle the goods without it being sticky. It will also combine much better with the light cakes or short-eating biscuits on which it is used, and so will be more enjoyable to the consumer.

One ounce of olive oil or melted lard can be used per pound of chocolate with good results. The chocolate is tempered in the usual manner, the oil is added to it, and well spatulated in until the chocolate is nearly set. The whole is then gently reheated until it is all in a molten state and about 87° F., and is then ready for use for covering biscuits or small fancy cakes, such as chocolate rolls, or othellos, or chocolate eclairs, etc. Care has to be taken not to over-heat the chocolate, but it can be used when the temperature of it is under 90° F. The cakes can be dipped in it, or it can be spread thinly over them with a palette knife. It should have a good gloss, and should set soft and be mellow to eat, instead of being hard and brittle. The cakes, etc., should not be dipped in purée when using this covering, as the jelly and chocolate do not combine well.

If, as sometimes happens when care is not exercised in the preparation of chocolate couverture, some steam or a few drops of moisture gets mixed into the chocolate, and the chocolate stiffens up like piping chocolate, it can be easily remedied by an addition of oil or lard, as in the above. Harder fats can be added to the chocolate in larger quantities (with good results) than the thin olive oil.

This gives the type of chocolate covering that is manufactured ready for bakers' use, known by various names, but sold as a baker's chocolate which can be used at a varying range of temperatures, and does not require tempering. The harder fats unfortunately detract from the flavour and spoil the eating qualities.

Chocolate Butter-Cream.—Chocolate butter-creams are often used for covering and decorating gateaux and fancies and sandwiching purposes. In many places this is prepared from ordinary butter-cream with an addition of chocolate colour and flavour, but a superior chocolate butter-cream should invariably be used which has an addition of melted chocolate as the colouring and flavouring agent. The following makes an excellent butter-cream for both covering and decorative purposes :

3 lbs. lump sugar.	4½ lbs. unsalted butter.
1½ lbs. glucose.	6 eggs.
¼ pint water.	1½ lbs. melted chocolate
Vanilla essence.	Chocolate colour.

The sugar, glucose and water are measured into a copper pan,

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and the solution is boiled up quickly to 240° F., taking the usual precautions to prevent graining of the sugar. The eggs should be beaten up in the machine bowl, and then the sugar solution is slowly poured over the eggs, and whisking is continued until it is nearly cold and light. The whisk should then be removed from the machine and the butter beater put on, then the butter is gradually added to the mixture and the whole is well beaten up to a light, velvety cream. Some drops of vanilla essence and the melted chocolate are added to it to colour and flavour the cream. If the colour is not deep enough, add sufficient chocolate colouring matter to get it to the required colour. The cream is then ready for use as desired. This butter-cream will set firm and mellow when cold. It should be heated if this happens, and mixed to keep it soft and at a working consistency.

A butter-cream of this description will be superior to ordinary butter-cream in which 2 ozs. melted chocolate has been used per pound of butter-cream.

Chocolate Gateaux.—It is not only essential to have some real chocolate in the coverings used on cakes, but it should also be introduced to the actual cakes, where possible, in order to enhance their flavour and eating qualities. Chocolate can be introduced to cake batters either in the form of cocoa powder or as melted unsweetened chocolate. These will both colour and flavour the cakes in which they are used, and give them superior eating qualities to cakes that are coloured and flavoured with ordinary liquid colourings and flavourings. The following recipe can be used to produce cakes for chocolate gateaux :

2½ pints eggs.	4 ozs. cocoa powder.
2 lbs. castor sugar.	1 lb. melted butter
1½ lbs. flour.	Vanilla essence.
4 ozs. cornflour.	Chocolate colour.

This batter should be made up on the sponge batter process of cake-making. It will produce ten gateaux scaled at 12½ ozs. each and baked in 7-inch-diameter hoops. The temperature of the oven should be 380° F. These gateaux should be matured for a few days in a cool room before decorating. They should be sandwiched with chocolate butter-cream and decorated in the desired manner with one of the chocolate coverings given above.

Chocolate Genoese.—When a confectioner has to make various chocolate fancies, such as chocolate slices, chocolate boxes, or chocolate dipped fancies, the cake used for these should be a good Genoese coloured and flavoured with either unsweetened chocolate or cocoa powder. One can use either of the following recipes to produce good sheets of chocolate cake :

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(1)

1½ lbs. butter.
 ½ lb. compound fat.
 2 lbs. brown sugar.
 2 pints eggs.
 2 lbs. soft flour.

½ lb. cornflour.
 ½ oz. baking powder.
 12 ozs. melted chocolate.
 Vanilla essence.
 5 ozs. water.

(2)

1½ lbs. butter.
 ¾ lb. compound fat.
 2½ lbs. brown sugar.
 2 pints eggs.
 3 lbs. soft flour.

1 oz. baking powder.
 ½ lb. cocoa powder.
 ½ pint milk or water.
 Chocolate colour.
 Vanilla essence.

These batters should be made up on the usual sugar-batter or creamed method of cake-making. When prepared they should be spread out on papered baking-sheets to barely one inch in thickness. The top should be slightly moistened with milk, and the batter is spread level with a palette knife. These sheet cakes should be baked in a cool oven about 360° F. It will take just over twenty minutes to bake them properly. When baked allow to cool and mature for a day before cutting up to decorate.

Quantity of Cocoa Powder to use.—In the making of chocolate rolls one must satisfy the authorities, if called upon to do so, that sufficient cocoa has been used to warrant the description “Chocolate Roll”, even although there is no legal standard defining the minimum quantity that should be used. It is quite easy for confectioners to get a minimum of 4% fat-free cocoa in a chocolate Swiss roll by using 4 ozs. of good cocoa powder or breakfast cocoa per pound of flour in the rolls made with whole eggs, and by using 3 ozs. of cocoa powder or breakfast cocoa per pound of flour in the rolls made with half egg and half milk as the moistening agents; provided one does not use drinking chocolate powder or crushed couverture.

Analysis of Various Cocoa Powders.—Cocoa powders vary in analysis, but one can always get the suppliers to give the composition of the cocoa powder they supply. Here is the analysis of various cocoa products sent to us recently for tests carried out at the National Bakery School:

<i>Grade</i>	<i>Cocoa Butter</i>	<i>Fat-free Cocoa</i>	<i>Sugar</i>
	%	%	
Breakfast cocoa -	26·0	74·0	—
B. cocoa - -	22·5	77·5	—
No. 3 cocoa - -	22·0	78·0	—
D. cocoa - -	16·0	84·0	—
Drinking chocolate -	6·5	18·5	75·0

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From this it will be quite evident that if drinking chocolate is used it must be used in greater quantities and an allowance made for the sugar present in it, by reducing the sugar added to the mixture.

Good Quality Chocolate Rolls.—The following recipe can be used in the production of the best quality chocolate rolls :

20 ozs. eggs.	2 ozs. cocoa powder.
12 ozs. castor sugar.	8 ozs. soft flour.
Chocolate colour.	Vanilla flavour.
16 ozs. cream filling.	

The total weight of ingredients used is thus 58 ozs. Total weight of cake portion only is 42 ozs. Average total loss in baking is $7\frac{1}{2}$ ozs. Leaving a total weight of finished cake of $50\frac{1}{2}$ ozs., or a total weight of cake portion of $34\frac{1}{2}$ ozs.

The percentage of cocoa powder used in these chocolate rolls works out as follows for the roll before baking :

$$2 \text{ ozs. in } 42 \text{ ozs.} = 4.76\%$$

$$\text{For the cake after baking } 2 \text{ ozs. in } 34\frac{1}{2} \text{ ozs.} = 5.79\%$$

The percentage of fat-free cocoa, using breakfast cocoa, which is 74% fat-free cocoa, works out by calculation at 4.26% in the baked rolls.

The percentage of fat-free cocoa, using No. 3 cocoa powder, which is 78% fat-free cocoa, works out by calculation at 4.52% in the baked rolls.

Cheap Chocolate Swiss Rolls.—The recipe used in the production of cheap-quality Swiss rolls is as follows :

17 ozs. flour.	20 ozs. sugar.
$\frac{3}{4}$ oz. baking powder.	10 ozs. eggs.
3 ozs. cocoa powder.	10 ozs. milk.
24 ozs. cream filling.	

The total weight of the ingredients used is thus $84\frac{3}{4}$ ozs.; the total weight of the cake portion only is $60\frac{3}{4}$ ozs.; average total loss in baking is 9 $\frac{1}{4}$ ozs., leaving a total weight of finished cake of $75\frac{1}{2}$ ozs., or a total weight of cake portion only of $51\frac{1}{2}$ ozs.

The percentage of cocoa powder used in these cheap chocolate rolls before baking works out as follows :

$$3 \text{ ozs. in } 60\frac{3}{4} \text{ ozs.} = 4.93\%$$

and for the cake portion only after baking :

$$3 \text{ ozs. in } 51\frac{1}{2} \text{ ozs.} = 5.82\%$$

The percentage of fat-free cocoa, using breakfast cocoa powder, which is 74% fat-free cocoa, therefore works out by calculation at 4.31% in the baked rolls.

Chocolate

The percentage of fat-free cocoa, using No. 3 cocoa powder, which is 78 per cent. fat-free cocoa, works out by calculation at 4.54% in the baked rolls.

The basis of calculation of the fat-free cocoa content of a chocolate Swiss roll should obviously be only on the cake portion, as the filling usually is a vanilla-flavoured cream filling, but where a chocolate cream filling is used it might be a different matter, because one might reasonably expect a chocolate-coloured cream to contain a proportion of chocolate also, just as one expects a proportion of chocolate in a good chocolate fondant.

If confectioners all over the country will take the necessary precautions to see that the minimum quantity of 4% cocoa powder or chocolate powder is used in these goods; better still, if they use such recipes as are suggested here and get nearer to the 5% cocoa powder, there should be no fear of having any more of these unfortunate prosecutions which spoil the good name of our craft.

If all our different types of chocolate-coloured and flavoured confectionery are kept to this minimum standard, there should be at least a definite improvement in the quality and flavour of many of these products sold in various places, and, we hope, a much better demand from the public for them.

Decoration of Gateaux illustrated (Figs. 6-7)

A. Sandwich with Buttercream and mask with Bakers' Milk Couverture. Decoration materials are Milk Chocolate, Raspberry Fondant or Fruilait (for stucco work) and two Raspberry Fruilait discs.

B. Cover and pipe with Bakers' Couverture. Roll sides in Chocolate Vermicelli; a Walnut in centre and crushed Violet Petals sprinkled around top edge completes decoration.

C. Cover with Chocolate Fondant. The futuristic design is piped in Bakers' Couverture, and finished with Split Almonds and Walnuts half dipped in Chocolate.

D. Cover with Bakers' Couverture. Decorate with Walnuts and Chocolate or Raspberry Fruilait.

E. Sandwich with Chocolate Buttercream. Cover top with Pistachio Fruilait. Decorating material required:—Chocolate, Chocolate Buttercream, fine green Almond Nibs, Walnuts, Split Almonds half dipped in Chocolate and Chocolate Couverture or Coffee Fruilait oblong pieces.

F. Cover with plain Bakers' Couverture. Decorate with Raspberry Buttercream and Pistachio Fruilait. The two side borders consist of floral designs using Fruilait for leaves and Buttercream for roses.

1. Split and sandwich with Chocolate Buttercream, cover and overpipe with Bakers' Couverture.

Use Split Almonds (half dipped in Chocolate), Walnuts, Pistachio Nuts and Burnt Coconut for decorating.

2. Split and sandwich with Praline Buttercream. Cover top and sides with Chocolate Buttercream, rolling sides in scorched Nib Almonds.

Place Chocolate Couverture $2 \times \frac{1}{2}$ in. pieces in position as shown.

Place round disc in centre of Gateau and dredge heavily with Icing Sugar.

Remove disc, place Walnut in centre and sprinkle undredged part with green Nib Almonds.

3. Split and sandwich with Chocolate Buttercream. Mask with Chocolate Fondant. Bakers' Couverture, Hazelnuts half dipped in Chocolate and Raspberry Buttercream (for stucco work) are all materials needed for finishing off.

4. Materials required for decorating this Gateau are Chocolate Buttercream, Vanilla Buttercream, scorched Nib Almonds, Walnuts and crushed Violet Petals.

5. This Gateau is entirely carried out in Bakers' Couverture.

Decorating materials are Pistachio Nuts, Walnuts and Raspberry Fruilait discs.

6. Cover top and sides with Buttercream. Roll sides in Nib Almonds scorched and top edge in Chocolate Vermicelli. Cut pieces are Raspberry and Pistachio Fruilait supported by Buttercream.

A Walnut and green Nib Almonds in centre complete decoration.

CHAPTER XV

FERMENTED GOODS

THERE is a whole range of fermented goods which come within the scope of a work on confectionery, because they are usually produced along with morning products. Very often, however, these are not up to as high a standard as they should be, because they are rushed, and the conditions suitable for the production of correct fermentation are not observed, "forcing" frequently being employed.

Bun Goods

With this class of goods, including buns of all kinds, fruit bread, and tea cakes, a ferment is generally used preparatory to dough-making, although a straight dough is sometimes employed, especially where overnight doughs are favoured. Such doughs give very satisfactory results when properly manipulated. For all buns a high-class flour suitable for bread-making is required in order that a bold bun may be obtained.

All fermented buns contain a considerable percentage of enriching agents, such as fat, sugar and eggs. These tend to retard fermentation, and therefore the quantity of yeast employed must be greater than that used in breadmaking for a similar quantity of flour fermented for the same length of time. If the yeast is adjusted according to the proportion of enriching agents used, then correct ripening of the dough can be obtained in the requisite time.

For bun doughs the strong or fast working types of yeast are best, since these are capable of bringing about a thorough maturing of the dough, followed by rapid gas production during final proof.

The use of eggs was formerly limited to the richer types of fermented goods, but research has shown that the use of eggs in all types of fermented small goods should be widely practised.

Eggs, apart from increasing the food value of buns, also condition the dough and impart silkiness on the texture of the finished product. They enable increased volume to be obtained by increasing the extensibility of the dough. This is brought about by the physical action of the albumen on the gluten and the lecithin present in the egg yolk. These properties can be capitalised by decreasing the scaling weights and so producing buns of normal volume,

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Eggs may also be added to a dough after it has fermented, as is sometimes customary with Bath buns. These may be in addition to those already used at the doughing stage, or may be supplementary to those already present.

When greater quantities of eggs are used this practice has the advantage of effecting a small saving in yeast, since increasing quantities of eggs require extra yeast in the dough.

Setting a Ferment.—For a ferment, the following quantities may be taken as a unit :

- 1 quart of water.
- 2 ozs. milk powder.
- 2 ozs. of sugar.
- 3 ozs. of yeast.
- 8 ozs. of flour.

The milk powder and sugar should be dissolved in the water by whisking ; the yeast is then thoroughly broken down and the flour mixed in, so as to produce a clear batter. This is then thoroughly aerated by whisking in order to stimulate the action of the yeast. The ferment should be at a temperature of 90° F., and should be left for not longer than half an hour.

Taking the Ferment.—The old idea, which still holds today, is to let the ferment drop before taking it ; this is not only unnecessary, but unwise in some cases. Whether a ferment will drop or not depends on many factors, and some ferments can be left for hours before dropping if thicker than the standard given.

1. *Shape of Vessel Used.*—The shape of the vessel in which the ferment is placed must influence the dropping of a ferment. If a sponge bowl is used, a large surface is exposed as the ferment rises, and the curved shape also has a marked effect. It will be seen that the time taken by the ferment to rise before it drops will depend on how long it can keep the “ head ” on the ferment as one mass. If, for instance, a tub was used, the surface of the ferment would be relatively small, and, moreover, the head on the ferment would be prevented from dropping by the straight sides of the tub, until a point had been reached when it was absolutely incapable of holding together and retaining the gas any longer. This may take any period from half an hour to several hours.

2. *Temperature.*—The temperature at which the ferment is made is a factor exerting a considerable influence on the ferment. Yeast works increasingly faster at high temperatures than at a low one, within certain limits, but in doing so it soon becomes exhausted. At a low temperature the yeast works slowly and takes more time to

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produce gas, but while doing so it retains its vitality. A ferment working at a high temperature will produce gas very quickly and soon drop, while one working at a lower temperature will take a much longer time before it drops, but be in better condition for using in a dough.

3. *Type of Flour*.—This is a factor of primary importance when dealing with a substance which depends on flour for its body. In the ferment given the quantity of flour is small, but it is sufficient to provide a medium in which the yeast can work and become acclimatised to the surroundings in which its work must be performed.

A soft flour with a small amount of gluten of a poor quality will not be able to retain the gas which is produced by the yeast, and so a ferment containing such flour will soon drop.

There are some flours with glutens of a sticky nature that will retain gas for a long time; a ferment made with such a flour will frequently drop only after a blow has been imparted to the vessel.

A fairly strong flour will produce a ferment which will hold the gas produced for a considerable time before breaking and causing the ferment to drop, whilst a strong flour will cause the ferment to drop fairly quickly.

4. *Milk Powder*.—Some types of milk powder affect the flour of the ferment, rendering it more extensible, and so capable of stretching and retaining the gas for a longer period. It is thus quite possible for a milk powder to have an effect upon the time taken for a ferment to drop.

5. *Quantity of Flour Used*.—In the ferment given, $\frac{1}{2}$ lb. of flour is used to a quart of liquor. Sometimes 1 lb. is used, and then the time taken for such a ferment to drop is bound to vary, since the consistency is different; the denser the ferment, the longer will it take to drop, because of the greater amount of flour used.

Objects of using a Ferment.—1. One object is to make the yeast capable of doing a large amount of work by starting the multiplication of the yeast cells, so that they become active and full of vitality.

2. Acclimatising the yeast to the medium in which it is to work, since yeast is affected to some extent by flour, and works best when stimulated by the preliminary use of a ferment.

3. A bun dough is very much richer than an ordinary bread dough, since it contains considerable amounts of fat or oil, sugar, and fruit. Yeast requires sugar to ferment, but with greater quantities it finds difficulty in working and in ripening the dough. In a bun dough at least 12 ozs. of sugar are needed to a quart of liquor, which represents a 30% sugar solution. Yeast works most satis-

Fermented Goods

factorily in a 10% sugar solution, so that in a bun dough it finds itself in the presence of too great a quantity of sugar, and therefore works slower, unless stimulated by means of a ferment. Above 40% or 1 lb. per quart the solution is too strong for yeast development.

4. Oil or fat has a retarding action on the yeast. Yeast works by surface action, absorbing all its food through the cell wall; consequently, there is a tendency for the oil and fat to become emulsified in the dough and to form a thin film round the yeast cell wall. This film retards fermentation, because the yeast has to overcome it before functioning satisfactorily. Not only is a ferment necessary to stimulate the yeast, but good fresh yeast should always be used, and in greater quantities than for ordinary bread.

These factors combine to operate against the yeast and render the use of a ferment imperative. When taking a ferment, the head need not be knocked down; this should be left until actual dough-making takes place, when the incorporation of the ingredients with the flour brings about this action. The more the head can be worked into the dough, the more finely divided are the yeast cells, and so the better and quicker the dough will work.

Time for Ferment to stand.—It is best to allow the ferment to stand for half an hour at 90° F., for the yeast will then get a good start in a suitable medium. This time is not sufficient to spoil any ferment.

The following is a suitable mixing for buns, and different types of goods may be made, in all of which the standard ferment is used. The dough should ferment for one and a half hours:

CURRENT BUNS.

<i>Ferment.</i>	<i>Dough.</i>
1 quart water.	4½ lbs. flour.
2 ozs. milk powder.	¾ oz. salt.
2 ozs. sugar.	12 ozs. fat or oil.
3 ozs. yeast.	10 ozs. sugar.
8 ozs. flour.	1 lb. currants.
	2 ozs. peel.
	1 gill eggs.

Fermentation of the Dough.—The main differences in bun doughs are the varying quantities of the enriching ingredients, eggs, fat and sugar; also, fruit may be present in varying amounts, or may be absent altogether.

All bun doughs should be kept at 78° to 82° F. and should not be worked warmer, otherwise an article is produced which will become dry and stale very quickly, and will be lacking in bloom. Cool

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doughs containing more yeast are preferable always to warm doughs, and better buns will be obtained.

Ingredients added after Dough Fermentation.—*Sugar.*—Castor sugar is not always used in a dough; for example, in Bath buns sugar nibs are used, and are worked in the dough only after it has fermented for its full time.

Clearly the reason for this is, first of all, that the sugar, if present as castor, would readily dissolve whilst the buns were proving, and so a small amount of it would be fermented and a much greater quantity inverted by the yeast. As a result, the sweetening power would be definitely reduced. Secondly, too large a quantity of sugar dissolved in the dough before it reached the oven would affect the gluten, and so cause the buns to flow in the oven, instead of having a bold appearance.

Eggs are another ingredient sometimes added when the dough has been fermented. When quantities greater than one half pint of eggs are used with a quart of liquor extra yeast must be used, since quantities in excess of this will retard fermentation. The greater the quantity of eggs, the greater the amount of yeast required. For ordinary English varieties of buns the above quantity is adequate. Quantities in excess of this alter the character of the bun.

Fat or Butter.—For bun doughs, a vegetable oil is undoubtedly the best, since it is more evenly distributed in the dough, and so brings about a greater modification of the gluten so necessary in the production of bulky buns. Buns in which oil has been used will always keep moist and fresh for a longer period than those which contain fat rubbed in the flour. Further, the crumb will possess a silkier appearance. In buns, such as Chelsea and richer varieties of Continental buns, extra fat is incorporated after the dough has fermented, so as to produce an effect similar to the layer formation in puff paste. As with puff paste, a good flavour is required, so that butter should be used, although for cheaper varieties a high-grade margarine, in conjunction with Demerara sugar, will prove quite satisfactory.

Fruit.—When currants are employed it is usual to work the fruit into the dough. In the case of products in which sultanas are employed, such as Bath buns, it has been customary to work the fruit along with sugar and eggs in the dough after fermentation has taken place. This practice, most probably, has arisen because of the greater amount of natural sugar present, and this would affect yeast fermentation. It may be that this practice was necessary, not because of the effect of the sugar in the sultanas alone, but because of the

Fermented Goods

collective effect of the three enriching ingredients, all of which are likely to retard fermentation. However, the best results are still obtained by fermenting the dough without the fruit in it.

Knocking Back.—As the dough ferments it increases in bulk, and, especially with short-process doughs, fermentation becomes very vigorous. The smaller the dough the more is it necessary that “knocking back” should be carried out in order to prevent the dough from being chilled.

With the rising of the dough its interior acquires an intimate cell-like structure in the form of a very fine network, each cell being filled with carbon dioxide gas. Consequently the yeast cells get farther away from their food supplies, and having utilised all the food available in their immediate vicinity, after a time cease to work as vigorously. Knocking the dough together brings the yeast back into contact with its food supply, eliminates waste products of fermentation, and so produces more vigorous fermentation. Moreover, the working of the dough stretches the gluten, which is gradually converted into fine threads, and renders it more elastic and capable of producing better and more even-textured goods.

This knocking back should be carried out at the early stages of fermentation; in fact, a bun dough should be knocked back every twenty minutes if a bun of good bulk and silk-like texture is required.

If a bun dough is coming along too fast it should be knocked back, since this will steady up its working by bringing the yeast into contact with its food supplies and equalising the temperature.

Proving.—As the dough ferments the temperature should not be allowed to rise too high, otherwise the dough will work too fast and become exhausted. As a result, poor volume buns deficient in bloom would result, which would not only be unattractive in appearance, but very dry to eat.

A dough temperature of 78° to 82° is most suitable, and this, in conjunction with frequent knocking back, will produce the best results.

The final proving is usually carried out in steam, and here the fatal mistake is often made of forcing. By this is meant proving the buns in a very hot prover in a superabundance of steam, so that first of all excessive condensation takes place, followed by rapid working of the yeast at the surface and the production of a broken skin.

Steam is necessary in the final proving, but the quantity should be controlled so that the surface of the bun is kept “green”, and not actually moist. The temperature of the prover should be about 88° to ensure against the cooling down when the door is opened.

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Baking.—For all bun goods a substantial oven is required, in order that quick cooking can be carried out with the production of good volume, a pleasing bloom, and the loss of moisture just sufficient to bring about correct baking without any excess drying out.

For most buns other than Bath buns an oven at 460° F. is best, but for Bath buns a cooler oven at 420° F. is necessary, because of the sugar nibs used for decorative effect; a cooler oven is also required for Chelsea buns, which are batched close together on baking sheets.

The following is a summary of ingredients for different types of bun goods, using a standard quart ferment.

TABLE OF QUANTITIES OF VARIETIES OF BUNS

	Flour	Sugar	Oil or fat	Currants	Sultanas	Peel	Eggs	Butter	Demerara sugar	Sugar nibs	Salt	Scaling weight
	lbs.	ozs.	ozs.	ozs.	ozs.	ozs.	gills	ozs.	ozs.	ozs.	ozs.	lbs.
*Currant buns (A)	4½	10	10	16	—	2	—	—	—	—	¾	4
*Currant buns (B)	4½	12	10	16	—	2	1	—	—	—	¾	3½
*Tea cakes -	4½	6	6	8	—	2	½	—	—	—	¾	4
*Currant bread (1)	4	8	8	12	—	4	—	—	—	—	¾	14 ozs.
*Currant bread (2)	4½	8	8	2	—	4	—	—	—	—	¾	1
†Fruit bread -	4½	10	8	1	1	4	1	—	—	—	¾	14 ozs.
*Chelsea buns -	4½	8	8	12	—	—	1	8	10	—	¾	4
*Bath buns -	4	8	8	—	12	6	1	8	—	8	¾	3½
*Swiss buns -	4	8	8	—	—	—	1	—	—	—	¾	3
*Doughnuts -	4	8	8	—	—	—	1	—	—	—	¾	3
*Hot-cross buns -	4½	10	8	16	—	4	1	—	require liquid spice	—	¾	4
*Cookies -	4½	10	10	—	—	—	2	—	—	½	¾	2½
†Bridgè rolls -	4½	2	12	(2½ ozs. yeast for 1½ hrs. dough at 82°)				—	—	—	¾	2½

Glazing.—A pleasing appearance is desired on all goods, so that it is usual to wash buns over with some variety of bun wash after they have been withdrawn from the oven and cooled down slightly.

The following bun washes may be used :

Bun Washes.—There are many mixtures used for this purpose, and preparations are now sold which require only the addition of warm water to produce a liquid which can be used as a glaze. One of these, which has been examined, is nothing more than ordinary

* Used in conjunction with a standard ferment.

† Used in conjunction with a quart of liquid consisting of half milk and half water. Straight dough system.

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powdered glue, and whilst producing a glaze, confers an unpleasant hard surface and bitter flavour on the bun.

The following glazes will give satisfactory results :

1. An egg and water glaze, consisting of two parts egg to one of water, thoroughly whisked. Fresh eggs will give a better glaze than frozen eggs.

2. One egg, a gill of water, and 1 oz. of sugar, all thoroughly mixed. This will produce a good gloss, but will be slightly sticky.

3. Stock syrup, in which 1 oz. of gelatine has been dissolved, will produce a good glaze. Stock syrup alone produces an extremely sticky glaze—unless the buns are placed back in the oven to enable the syrup to set after it has been applied—and should only be used in those districts in which such a glaze is desired.

It is not the intention of the authors to make this a recipe book, because it is considered necessary to learn the fundamentals of the balance of recipes and then apply them to the type of goods to be produced. For example, in bun goods it is desirable to produce cheap buns, and also buns to sell at a greater price, and the selling price will control the quality of ingredients and the size of bun.

Doughnuts.—For doughnuts a Swiss bun or cookie mixing can be successfully used. Great care should always be taken in the frying of doughnuts, and the finishing off if attractive buns are to result. The following points should be noted :

1. The temperature of the fat should not exceed 380° F.

2. The best quality fat should always be used. Hydrogenated shortenings should be used, since their smoke point is very much higher than 380° F. Thus there is no objectionable odour while frying.

3. After frying, the doughnuts should be allowed to cool down before being rolled in sugar. As the doughnuts cool down steam is given off, and if they are rolled in sugar immediately on withdrawal from the fat this moisture is absorbed by the sugar and a wet, sodden sugar-coat is obtained. This spoils the appearance and uses a much greater amount of sugar.

Brioche.—Brioche is a very rich type of fermented teabread made by confectioners, and used for sweet or savoury fillings. They are rich in fat and eggs, but the sugar is very low.

Continental recipes for these goods are sometimes very complicated, but the following formula can be recommended to give good results :

3½ lbs. flour.	2 pts. eggs.
2½ ozs. yeast.	2 ozs. sugar.
½ pt. warm milk.	1½ ozs. salt.
1½ lbs. butter.	

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Method.—Take $\frac{1}{2}$ lb. of the flour and make a sponge with the milk and the yeast. Beat this sponge well, and leave it to ferment for half an hour at 80° F.

Sift the remainder of the flour, place it in the machine bowl, add the salt, sugar and $1\frac{1}{2}$ pints eggs, and mix these well to form a stiff dough. Add the remainder of the eggs, and beat the dough thoroughly. The butter is then gradually added, beating it well in until the dough loses its stickiness. Lastly, add the sponge, and clear it well through the mixture. The whole should be well beaten, until it will not stick to the dough hook or the fingers, although it is a fairly soft mixture.

This dough should be left in a cool place for two or three hours before working it off into small finger-shaped rolls, crescents, plaits, scrolls, etc. The weight of these goods need not be more than $1\frac{1}{2}$ ozs. to get goods of the same size as “2-oz.” buns or rolls. The brioche should be egg-washed before proving, then again after proving for about 25 mins. in the prover about 85° F. Bake them in a fairly hot oven.

When cold they are filled with savoury fillings or whipped cream.

Sometimes some of the eggs are replaced with soya flour and extra milk. Two-thirds of a pint of eggs or 8 eggs may be replaced with 12 ozs. soya bean flour and $\frac{1}{2}$ pint milk.

The procedure of mixing is the same.

Babas and Savarins.—Babas and savarins are a very rich type of fermented goods which, after baking, are soaked in a rum-flavoured syrup, and after draining are decorated with whipped cream before serving. More butter, but less eggs, are used in them than is used in the brioche.

The following recipe can be recommended to produce these goods :

3 lbs. flour.	$1\frac{1}{2}$ pts. eggs.
2 lbs. clarified butter.	$1\frac{1}{4}$ pts. milk (105° F.).
$2\frac{1}{2}$ ozs. yeast.	1 lb. currants.
3 ozs. sugar.	$\frac{1}{2}$ lb. orange peel.

A sponge is made with milk, yeast, and $\frac{1}{2}$ lb. flour. It should be well beaten to aerate it, before setting away to ferment for $\frac{1}{2}$ hour.

The remainder of the flour is sifted on to the board or into the machine bowl, the sugar and eggs are added, and these are made into a dough which should be well toughened by a thorough mixing, then it is made elastic by continuing the beating. The soft and creamy butter is added at this stage, and is well beaten into the dough. Lastly, the fermented sponge is added, and the whole is thoroughly beaten until the mixture loses its stickiness.

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It produces rather a soft batter, but by continuous working it is well matured, and should produce good bulky cakes.

It should be allowed to ferment for half an hour, then the fruit is mixed in, and it is ready for piping out into the buttered moulds.

After proving for half an hour, or until the batter has filled the moulds, they are baked to a golden brown colour in a fairly hot oven.

The cakes so produced should be light and porous. After cooling they are soaked in a rum-flavoured orange and lemon syrup, and after draining are filled with whipped cream.

The syrup used for soaking these goods is made from the following ingredients :

3 pts. water.
2 lbs. sugar.
1 gill rum.
Rind and juice of 2 oranges.
" " " 2 lemons.

Make a syrup of the sugar, water, fruit juices and rinds by bringing the lot to the boil. Allow to cool and add the rum before use.

Fermented or Danish Pastries.—Many recipes are used to produce fermented or Danish pastries, but the principle is the same in each case. A rich dough is mellowed by fermentation and partly aerated by puff paste principles.

The following ingredients can be used to make up these goods :

2½ lbs. flour.
½ lb. butter or cake margarine.
6 ozs. sugar.
¼ oz. salt.
1 gill eggs.
2 egg yolks.
¾ pt. milk.
4 ozs. yeast.
1 lb. pastry butter.

A cold dough is made up of all the ingredients except the pastry butter. This dough is left to ferment in a cold place for 2 hours. It is then pinned out and the pastry butter is rolled into it as if making puff pastry. Two turns are given to it, then after an hour another two turns are given.

This paste can be used after resting for a further hour, but better results are obtainable if it is left overnight in a refrigerator.

This paste can be moulded up into various shapes, and filled with numerous fillings such as custard, jams, curds, macaroon pastes, nuts ; and fruits like apples, pears and pineapples.

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After moulding the pieces are proved for about half an hour, then baked in a fairly hot oven. Wash over with stock syrup when baked, or mask with a fruit-flavoured icing and roasted flaked almonds.

There are numerous shapes and finishes to these goods. Each confectioner should have his own special variety. Many makers of fermented pastries make them from an ordinary fermented bun dough by rolling 1 lb. pastry butter into 4 lbs. bun dough, and after giving it four turns like turning puff pastry, it is placed in the refrigerator, then worked off into the various shapes as before.

CHAPTER XVI

CHEMICALLY AERATED GOODS

CHEMICALLY aerated goods are those morning goods which are lightened by the use of chemicals instead of yeast or eggs. There are many chemicals on the market which the confectioner can use for this purpose, such as cream of tartar, and various substitutes consisting of acid phosphates and sulphates. These are mixed in varying proportions with bicarbonate of soda. The various chemical actions which take place have been fully discussed in the chapter dealing with chemical aerating agents. Some of the substitutes for cream of tartar find great favour with certain sections of the trade owing to their comparative cheapness and the excellent result obtained in practice ; but where uniform results are required, cream of tartar should be preferred to any of its substitutes.

It takes about $2\frac{1}{4}$ parts of cream of tartar to neutralise 1 part of bicarbonate of soda, and so confectioners should standardise their baking powder by using $2\frac{1}{4}$ lbs. of cream of tartar to 1 lb. of bicarbonate of soda. These, when well sifted together with $\frac{3}{4}$ lb. of rice flour, form an ideal baking powder. The usual quantity of this baking powder required to aerate 1 lb. of flour would be 1 oz. The rice flour assists in preventing the baking powder from becoming moist and lumpy, and so losing its strength through interaction of the acid and alkali. It also facilitates the weighing of the powder, inasmuch as there will be no fractions of an ounce to weigh off in the majority of the mixings. This powder is that referred to in all mixings.

Where the confectioner has to make up a number of small mixings of aerated goods every day, it is probably better and brings about a saving in time to make up a bag, or even a sack, of flour into a scone flour. This contains the necessary quantity of chemicals, so that the weighing off in small quantities for each mixing and the risk of making slight mistakes is eliminated. This not only makes for economy in time, but reliability in results.

The quantity of chemicals used would be in the same proportions as given for the baking powder. *Thus, for a 140 lbs. bag of flour one would use 4 lbs. 14 ozs. cream of tartar and 2 lbs. 3 ozs. bicarbonate of soda.* The salt may also be added at the same time, using 2 lbs. salt. In Scotland and Ireland where buttermilk is used the proportion of cream of tartar or cream powder to bicarbonate of soda is

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generally 3 parts to 2 parts. Sometimes the buttermilk possesses sufficient acidity to enable satisfactory aeration to be obtained with equal quantities of acid and soda. The chemicals are first sifted together over the trough of flour, then well mixed into the flour, and the whole should be sifted twice together. When this is done, one is ensured of the correct proportions of chemicals being in the flour.

The flour used for making aerated goods should not be too strong, as bulk is not the main consideration. Texture, flavour, moistness, and colour are the main considerations. A flour that will impart these qualities to the goods is a winter wheat flour.

The fat must be of good quality. Butter is the best for flavour, but it is usually too expensive, so that either margarine or compound lard is substituted. Many confectioners use a good brand of cooking oil in their aerated goods. This imparts a better appearance, and makes them bulkier and softer eating, provided the oil and milk are mixed together first as an emulsion. This will ensure a more even distribution of the oil in the dough, and thus give better results.

The sugar for aerated goods should always be the best castor or sifted quality.

Eggs are not absolutely essential in aerated goods, but if price is not the first consideration, the flavour and colour imparted make their addition worth while.

The fruit used in this type of goods should be clean and bright. Dirty fruit is wasteful and expensive. There is nothing that will spoil a confectioner's reputation quicker than customers finding stones and stalks in their purchases.

Sultana scones are the most common variety of scones made in most English bakeries where the goods are baked in the oven. The mixture and method for the best type are as follows :

4 lbs. flour.	12 ozs. sugar.
4 ozs. baking powder.*	10 ozs. sultanas.
12 ozs. fat or oil.	4 eggs.
$\frac{3}{4}$ oz. salt.	About 1 $\frac{3}{4}$ pints milk.

The baking powder used should be the same as stated above, or if a scone flour has been made up, 4 $\frac{1}{4}$ lbs. of that should be used.

There are various methods of making up the dough for these goods. The flour should be thoroughly sifted on to the board with the baking powder and salt. The fat can either be thoroughly rubbed into the flour as finely as possible or creamed up separately with the sugar. The latter method ensures a better and more even mixing. If the former method is used, make a bay with the flour,

* Prepared according to directions given on p. 167.

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place therein the sugar, eggs, and milk, and place the fruit around the edge. Now mix up the liquid with the sugar, then dough all together into a smooth clear dough free from scraps. If the latter method is used, when the cream is ready work in the eggs, then dough all up together into a smooth clear dough free from scraps. The modern method of making up scones ensures a better distribution of the fats and softer eating scones of better volume.

An emulsion is made of the oil, or melted fat, salt, sugar, eggs, and milk by heating these ingredients slightly, then whisking them together until cool. The flour and other ingredients are then added to make a smooth clear dough. The dough should not be too soft or, on the other hand, too tight. A medium soft dough that is easily handled will give the best results. Scale off the dough in 9 oz. pieces and hand them up to get a smooth skin on the surface. Pin out round, about 6 inches in diameter and about 1 inch thick; place the rounds on cleaned and greased baking sheets, and divide each into four pieces of equal sizes, cutting right through with a scraper and separating slightly. Wash over carefully with egg wash, taking care to keep it out of the cuts and off the baking sheets. Allow them to stand for twenty minutes before baking, then bake in a warm oven about 450° F. This standing after moulding allows the goods to recover from any toughening that may have taken place. The gluten of the flour matures somewhat, and consequently bulkier, more evenly sprung scones are obtained.

Richer or cheaper scones than those given above can be made by simply altering the proportions of fat, sugar, milk and baking powder. In cheaper scones no eggs would be used, but a little egg colouring could be added to the milk if required to improve the colour.

A richer type of scones would be as follows for cream scones :

4 lbs. flour.	4 eggs.
3½ ozs. baking powder.	Fully 1½ pints milk.
1 lb. butter or margarine.	¼ oz. salt.
14 ozs. sugar.	

These are made up to a smooth dough in a similar manner to the sultana scones; then scale off in 5 oz. pieces, mould up round and smooth, pin out to 6 inches in diameter, place on greased baking sheets, egg wash, and after standing for twenty minutes bake in an oven at 450° F. When these scones are partly baked and can be handled without spoiling the shape, turn them over on the baking sheet and replace in oven to finish baking. Care must be taken not to bake too much before turning over. Small cream scones are made

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from this mixing by rolling out the dough and cutting out with a small cutter of the desired size. The small scones are finished off in the same way as the large.

An example of the cheaper scones would be as follows for Victoria or turnover scones :

4 lbs. flour.	8 ozs. oil.
4½ ozs. baking powder.	8 ozs. sugar.
¾ oz. salt.	2 pints milk.

The dough is made up in the modern way and scaled off in 12 oz. pieces, moulded up round and smooth, pinned out to 8 inches in diameter, then divided into eight equal parts, egg washed, and placed on clean baking sheets and baked at 450° F. These scones are also turned over when partly cooked.

Referring to the above mixings, it can readily be seen that the greater the quantity of fat and sugar in the mixing, the less the amount of baking powder and milk required. Also the smaller the amount of fat and sugar used, the greater the quantity of baking powder and milk required. The fat has a shortening effect on the goods, so that the more that is used the less the amount of baking powder required to shorten and aerate the goods.

Any of the above mixings can be used for any of the types of goods mentioned. It always depends on the quality demanded in any particular area. These goods are usually sold to ensure at least 50% gross profit.

The same rules apply to aerated buns as apply to scones, as will be seen from the three following mixings :

<i>Rock Buns</i>	<i>Coffee Buns</i>	<i>Raspberry Buns</i>
4 lbs. flour.	4 lbs. flour.	4 lbs. flour.
¾ oz. salt.	¾ oz. salt.	½ oz. salt.
4½ ozs. baking powder.	3½ ozs. baking powder.	3 ozs. baking powder.
12 ozs. fat.	1½ lbs. fat.	1½ lbs. fat.
1 lb. sugar.	1½ lbs. Demerara sugar.	1½ lbs. sugar.
1½ pints milk.	1½ pints milk.	1 pint milk.
12 ozs. currants.	4 ozs. coffee essence.	4 eggs.
	4 eggs.	

The dough for these buns is always made up in a manner similar to that for scones. There are variations in the finish of the goods. When the dough has been made for rock buns, it is dropped on to baking sheets in 2 oz. pieces of a rock-like shape, These are roughened, then egg washed, sprinkled with sugar nibs, and baked in a hot oven at 450° F.

When the dough has been made for coffee buns, it is weighed off

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in $1\frac{1}{2}$ or 2 oz. pieces. These pieces are moulded round, placed side by side on the board, and egg washed ; then dipped in sugar nibs, placed on pans, and baked at 440° F.

The dough for raspberry buns is also weighed off into $1\frac{1}{2}$ or 2 oz. pieces. These are moulded round, then flattened out, and a little jam placed in the centre of each. The buns are moulded again, so that the jam will be in the centre of the buns. They are then washed with egg whites, dipped in castor sugar, and placed on baking sheets. Two cuts are made in each, so that the jam will show through when they are cooked. The buns require careful baking owing to their richness. They are usually baked on double sheets at 420° F. If baked at a higher temperature, they would run flat and take on too much colour.

Raspberry buns or coffee buns could also be made from the rock bun mixing, but then they require similar baking to rock buns. Even less fat and sugar can be used in these goods if the proportion of baking powder and milk is increased.

Sometimes a pinch of "Vol" is used in cheap buns in order to produce a quick lift in the oven and a nice break on the top.

There are several varieties of scones, such as soda scones, Scotch pan cakes, and milk scones, which can be baked on the hot plate. These must be made as a soft dough ; also they must be turned on the plate and must flow to some extent in order that a good shape results. Buttermilk is often used instead of fresh milk, since it gives a much softer crumb. When it is used an adjustment in the proportion of the chemicals used for aeration must be made. With good buttermilk bicarbonate of soda alone can be used at the rate of 2 ozs. per stone of flour for Soda bread.

The following mixings can be used :

<i>Soda Scones</i>	<i>Milk Scones</i>	<i>Scotch Pan Cakes</i>
4 lbs. flour.	4 lbs. flour.	4 lbs. flour.
4 ozs. baking powder.	4 ozs. baking powder.	4 ozs. baking powder.
$\frac{1}{2}$ oz. salt.	$\frac{3}{4}$ oz. salt.	$\frac{3}{4}$ oz. salt.
1 gill oil.	$1\frac{1}{2}$ gills oil.	8 ozs. butter or lard.
2 pints buttermilk.	6 ozs. sugar.	1 lb. sugar.
	2 pints milk.	4 eggs.
		$2\frac{1}{2}$ pints milk.
		Lemon juice (if desired).

Other mixings can be evolved from the foregoing instructions.

The pan cakes require special care in dropping them on the plate by means of a Savoy bag, as the mixing gives a thick batter. The sugar is dissolved in the milk along with the salt, and the eggs are

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whisked in. The powder is sifted into the flour, and this is then mixed into the milk so that the batter is cleared. The melted butter or lard is now stirred in.

By the addition of another quart of milk a thinner batter is obtained which, when dropped by means of a ladle, will flow out and produce a cake similar to a crumpet full of holes. Both these products are turned during baking, and the hot plate must be well greased before dropping them. In order to get the best results, the plate should not be too hot.

CHAPTER XVII

CAKE-MAKING PROCESSES

General Principles

CAKE-MAKING is a very important branch of the confectioner's work, and is a part of the trade largely neglected by the smaller confectioners ; consequently, a great deal of this trade has passed into the hands of the wholesale cake manufacturers. One reason for this seems to be that many think that good and regular quality cakes can only be successfully baked in large batches, and that with a small sales turnover it does not allow them to make sufficiently large batches. Cakes are made more successfully in large batches because more care is taken to see that the methods and raw materials are standardised. For this reason factory-made cakes always have a uniform appearance, and there is no doubt that excellent value is given for the price demanded.

There is no reason, however, why the small baker should not be able to produce cakes regularly, provided that he, in turn, will standardise his recipes and processes.

When cakes are cut, they should show a multitude of evenly distributed minute cells without any large holes. They should have good colour and sheen, and should not cut crumbly. They should eat moist and have a good flavour. Their general appearance should be such as to induce customers to sample them. These points can only be obtained by using the correct ingredients in their right proportions and by manipulating them in the proper manner.

Flour

The flour used for cake-making should have a good colour ; it should not be too strong or have too high a percentage of gluten.

Soft flours, such as those from Pacific, Australian, and English wheats, are the best that can be used for this purpose. These flours contain from 7 to 9% of gluten, and will produce an even texture free from large holes. In recent years special cake flours have been produced by the home millers, which are excellent for use in cake-making, provided sufficient milk is used to free the batters.

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Faults in Slab Cakes

Cakes made with strong flour dry quickly when cut and exposed to air, and will have large holes, conferring an uneven texture on the goods. A strong flour or a batter that has been toughened will also make the cakes dome-shaped, because the cakes cannot expand so evenly in the oven. The softer flours give a softer batter which expands evenly and reaches its full height, so that flatter cakes are obtained. With the stronger flours the batter is stiffer, so that the heat takes longer to penetrate to the centre of the cakes; and as the sides and top skin are formed before the cakes have risen to the full height, the cakes expand and burst the top, which forces itself into a dome shape. Sometimes the bottom of the cake will assume the dome shape as well. Too hot an oven will also have the same effect.

Sugar

A fine-grained castor sugar is always to be preferred to the coarser variety of granulated sugar, since the latter may produce specks in the cakes after baking owing to the sugar not being properly dissolved. Sugar helps to improve the texture of the cakes and keep them moist, provided that the correct quantity is used. Too little sugar will give a harsh crumb, and the cakes will be lacking in bloom and appearance. Too much sugar breaks down the gluten of the flour, with the result that the cakes would be flat or may sink in the centre after baking. Dark-coloured sugars, such as Barbadoes or Demerara, are used in dark-coloured cakes to impart flavour and colour. The amount of sugar used should be about 20 to 25% of the other ingredients, excluding the fruit. The general average is 25%.

A little invert sugar in each mixing will improve the keeping quality of cakes.

Fats

There are many types of fat used in cake-making, and the particular one chosen depends on the quality of the cakes required. Butter of good quality is the only fat able to produce the best flavour in cakes, and where a mixing shows a reasonable profit it should invariably be used. They should also sell more readily and establish a reputation for good quality.

Vegetable and compound fats are also used in cake-making. A small proportion mixed with the butter—for example, 4 ozs. to

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every 12 ozs. butter—will help to improve the texture of the cakes, because they cream up readily and lightly. In cheaper cakes they are sometimes the only fats employed, because of the readiness with which they cream up.

Cake margarines produce similar results to butter, but the flavour of butter is lacking. They may be used alone in cakes or may be mixed with butter or with a compound fat. Hydrogenated fats with a butter-like consistency may also be used alone in making good cakes, but use only 14 ozs. hydrogenated fat to replace 1 lb. butter or margarine. Whatever fats are employed, they must have good body and creaming properties, and be able to hold up the maximum amount of eggs. If the fats are unsalted, use $\frac{1}{4}$ oz. salt per lb. of fat to develop the flavour in the cakes.

Eggs

Eggs are used in cakes as moistening, enriching, emulsifying, aerating, and colouring agents. Good eggs must be chosen to perform all these functions. Weak, watery eggs should be avoided, since they do not give the maximum aeration and are inclined to curdle the batters when added to the creamed butter and sugar. It should be possible, with good fat and eggs, to cream in one pint of eggs to each pound of fat employed. Eggs should aerate at least their own weight of flour, so that in the best cakes no baking powder should be required for aeration purposes. Where there is a greater weight of flour than eggs, it is necessary to use baking powder in order to aerate the extra flour; $\frac{5}{8}$ oz. of baking powder should be sufficient to aerate each extra pound of flour in pound fruit cakes. In plain cakes a little more is required, up to $\frac{3}{4}$ oz., and in large slab fruit cake a little less should be used—only about $\frac{1}{2}$ oz. to each pound of flour over the weight of the eggs.

The baking powder should always be sifted with the flour. This ensures its being thoroughly mixed into the flour, and also that the flour will be free from lumps and easier to incorporate into the batter.

When there are not sufficient eggs to moisten the batters, milk is employed as the extra moistening agent. Each pound of flour requires about 14 ozs. of liquor (eggs and milk) to make a batter of the proper consistency for fruit cakes, and 15 ozs. for plain cakes when 25% sugar is used. If too little is used in the batter, the cakes will be toughened and eat harsh and dry; if too much, the cakes may sink when baking, and the paper bands will leave the sides of the cakes when cold.

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A little milk or water in all cake mixings helps to free the crumb and improve the texture of the finished cakes. It also helps to prevent toughness.

Fruit

Fruit of the best quality only must be used in cake-making. Many otherwise good cakes are spoiled through employing poor quality fruit or not cleaning and preparing it carefully.

The carrying or supporting of fruit in rich cake batters has always been a matter with which confectioners have had to contend. This has been particularly so in the case of cherry cakes. When the batter is too soft the cherries or other fruit tend to sink, and will not remain uniformly dispersed unless certain precautions are taken to prevent this happening.

The practice usually followed in the past has been to reduce the liquor content of the batter or employ a leaner mixing in order to make sure that the fruit would be evenly dispersed throughout the cakes.

The Hedley Research Bakery have investigated this problem, particularly in connection with high-ratio cakes, and have found that by the addition of an acid substance, such as tartaric acid or cream of tartar, rich slack batters are enabled to carry a full fruit content in a stable manner, producing cakes in which the fruit is evenly distributed.

Influence of pH on the Ability of Cake Batters to carry Fruit.—Acidity and alkalinity are measured to-day in pH units, because this represents what may be termed the active acidity which has been found to play an important part in the stability of cake batters.

pH = 7 represents a neutral solution, units below this represents acidity and above this alkalinity. Thus pH = 5 is acid, whilst pH = 8 is alkaline.

In order to produce stability in a rich moist cake batter a pH of 5.4 or less is essential if it is to carry fruit satisfactorily. Such a pH is not normally obtained, but an adjustment can easily be made by the use of tartaric acid. Other acids or acid salts can also be used, but the quantity used will vary with the nature of the salt.

Experiments by the authors have shown that by the addition of $\frac{1}{8}$ oz. tartaric acid per 5 lbs. of rich cake batter, at least an extra 3 to 4 ozs. of liquor can be added to the mix, and with such an addition the batters can be thoroughly cleared without fear of any toughening and the fruit will be evenly distributed.

Cake-making Processes

This enables softer batters to be used for all types of fruit cakes, and is of particular value with cherry cakes.

The following illustration shows the influence of such additions of tartaric acid on fruit and cherry cakes.

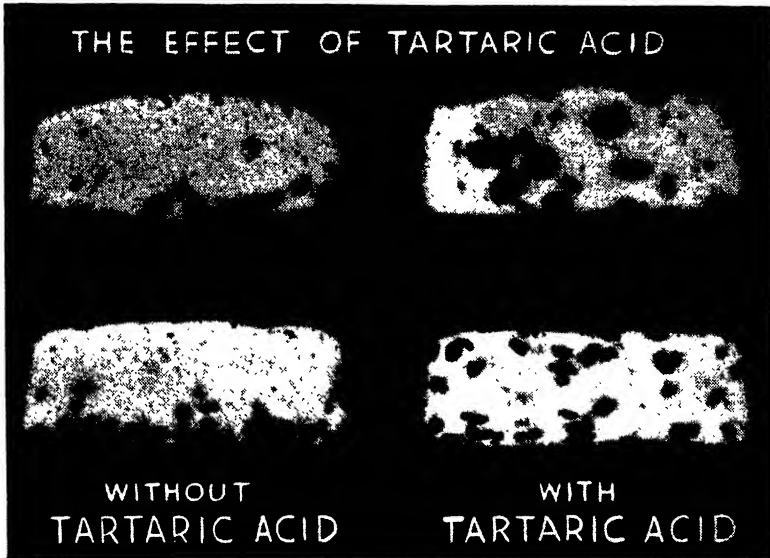


FIG. 5.

Essences

Essences are sometimes used to flavour cakes. Discretion should be exercised. If added too liberally they spoil the flavour of the cake, instead of giving it the delicate flavour required. It is often advisable, in order to produce the best flavour, to use the rind and juices of oranges and lemons rather than artificial essences. One orange or one lemon should be sufficient to flavour the batter made from 1 lb. of fat.

In cheaper cakes, where milk is used, egg colouring is added judiciously to give the yellow appearance required. Too much, however, will spoil the appearance of the goods.

Salt is also an ingredient of cakes, where it assists in bringing out the flavour of the other ingredients and prevents any insipid taste.

Glycerine is also added in some types of cakes where few or no eggs are employed, since it helps to keep them moist owing to its moisture-absorbing properties. Generally 1 ounce is added to each pound of fat.

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Cake-Making Methods

There are two general methods of preparing batters for cakes, known respectively as the *sugar batter* or creaming method, and the *flour batter system*.

Sugar Batter.—The sugar batter method is mostly applied to high-class cakes, and gives good results so long as the ingredients are good and care is taken in manipulation. In cheap cakes, in which few or no eggs are used, it is better to employ the flour batter system. Some confectioners maintain that the flour batter method always gives the best texture, but that depends largely on the workmanship.

The sugar batter method of cake-making is the most straightforward. It is carried out as follows: Weigh down the butter, fats, sugar and a small proportion of the flour into a bowl, when doing small mixes by hand. Butter creams easier when soft, so the butter and sugar are gently warmed on the oven stock, without making the butter oily, and then beaten together until a very light creamy mass is produced. If the butter is allowed to become oily, it must be solidified by placing the bowl in cold water; but if this is done, the results are never so good, because the butter will have lost its power to a certain extent of taking up the eggs. When cakes are machine mixed, there is no necessity to heat the butter unless it is very firm, as the machine beating will soon reduce it to the proper consistency, because of the heat developed by friction. It is common practice to shred the butter in order to make it easy to cream up. In large bakeries special machines are used for this purpose, but an ordinary mincer can be used. It is possible to overbeat the butter and sugar, but it is seldom done, since it would take too long. So long as the creamy mass does not become too soft, it is very difficult to overbeat it. About 10 mins. creaming of the fats and sugar is generally sufficient. When the cream is ready, proceed to add the eggs, not more than two at a time to each pound of fat employed, and they must be beaten well in between each addition. The eggs should be at the same temperature as the other ingredients, otherwise, if too cold, they may cause the batter to curdle. A suitable temperature is about 70° F.

Curdling of Batter.—When the eggs are added too cold or too quickly, or if they are weak and watery, then the batter may curdle. That is to say, the mixture goes into small lumps, and fat globules, which become coated with egg, separate out and present a curdled appearance. This is more pronounced the more it is beaten. If this

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happens or is likely to happen, one usually adds a small portion of the flour in order to get the mass back into a creamy mixture. This curdling is due to the breaking down of the emulsion of fat, sugar, and eggs which is being produced during the preparation of the batter.

If a batter does curdle, it is always possible to remove the curd by warming the batter and continuing beating until a velvety batter is attained. Curdled batters treated thus will always produce a much superior eating cake than would be obtained if this were not done. When all the eggs have been creamed in, the batter should have a nice soft, velvety feel. At this stage any required flavours are added. The flour should have been sifted with any powders that are required and it is gently stirred into the batter, and the required milk or water is added at the same time. When stirring in the flour, lift the whole well up from the bottom of the bowl, letting it run through the open hand. The fruit should be added when clearing the batter. If fruit is mixed with the flour, some adheres to damp fruit and will tend to produce holes in the cakes. Mixing in the flour by machine tends to toughen the cakes when there is not sufficient moisture in the batter, unless the experienced workman knows exactly when to stop the machine; but when sufficient liquor is used, there is not much fear of toughening the batters.

In all cakemaking processes temperature of ingredients and times of creaming and mixing must be controlled if consistent results are to be obtained.

Flour Batter System.—The flour batter method of cake-making requires more work or more machines. The mixture of fats is creamed up with its own weight of flour or a little less, 14 ozs. flour to each pound of fat being about the best proportions. Now cream the two together until a light creamy mass is obtained; then whisk up the eggs and milk with their own weight of sugar. This need not be so light as for sponge cakes, six minutes whisking being sufficient. Then carefully blend them into the creamy mass, making the addition in three portions. Cream in the first lot, mix the second lot well in, and stir in the third portion, and while clearing add the remainder of the flour. Since in cheaper cakes more milk and extra sugar must be added, these should be mixed together and added with the flour after all the eggs have been stirred in. Finally, add the fruit while clearing the batter, taking care never to toughen it. Exhibition cakes, especially the richer types of Madeira and fruit cakes, are usually made by this method.

When the batters are ready, they must be weighed off as required

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as quickly as possible into hoops or frames. The hoops or frames should be so papered with kitchen paper that there is no possibility of the batter running out in the oven. The paper in large cakes should be of such a height and thickness that it will protect the tops of the cakes to a certain extent from the fierce heat of the oven. The hoops or frames should be placed on baking sheets, with layers of paper or some other form of protective material, in order to obtain as thin a crust as possible on the base of the cakes. Sheet tins with little knobs on the bottom to raise them from the oven bottom are very useful for this purpose. In cake factories special pans are used. These can be covered over during baking, so that a thin crust can be obtained. In such cases hotter ovens than usual are necessary. The batter should be weighed into the hoops or frames with as little handling as possible. If it is placed in hoops or frames in more than one portion, it may cause large holes in the cakes where air has been enclosed between portions.

Scrapings from the bowl should, if possible, be kept for the next batter ; but if it is necessary to use them, they must be mixed into the batter, otherwise, if placed on the top, they show up in the crumb of the cake as dark streaks.

When all the cakes are weighed off into hoops or frames, the batter is usually levelled off with the back of the hand, using a little milk or water to moisten and prevent it from sticking to the hand. This moisture helps to form steam in the oven and aids in producing a soft thin crust.

New Method.—Another method of cake-making which gives satisfactory results has recently been reintroduced to the trade. By this method the fats and sugars are creamed lightly together in the bowl, then a quantity of flour equal in weight to the fat employed is creamed in. When this is light, the eggs and flavouring are creamed in to produce a light velvety batter ; lastly, the remainder of the flour, which has been sifted with the baking powder, is stirred in. Any milk in the mixing should be added with this last lot of flour, and any fruit should be added while clearing the batter. This method of cake-making is suitable for any of the mixings given in the table on the next page, provided one uses a little more baking powder in each mixing—about $\frac{1}{8}$ of an ounce extra being sufficient.

This method ensures that the cakes produced have an even texture and a moist yellow crumb, provided the mixing is well balanced to give bold bulky cakes. If the flour and baking powder are thoroughly sifted together there should be no large unsightly holes, as so often happens when the sugar batter method is employed. By

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this method a complete emulsion is made of all the ingredients, so that they are evenly distributed throughout the batter.

The temperature at which cakes are baked depends on their size and richness. It is not possible to lay down hard and fast rules; experience must be the guiding factor. Richer cakes have to be baked in a cooler oven than plainer cakes; the larger the cake the lower the baking temperature. Cakes must be baked as quickly and thoroughly as possible without giving them too thick a crust or too high a colour. For this purpose a good solid oven with a falling temperature should always be used, and if possible the oven should be filled with cakes so that they are baked in their own steam with the door kept shut for the whole period of baking. This produces a thin top crust. Too low a baking temperature is as bad as one too high, for this dries out the moisture from the cake, as a result of which the finished cake eats very dry and has a dirty coloured crumb.

If the oven is too hot, cakes are overcoloured on top; a skin forms on top before the cakes are fully risen, and as the cakes rise the skin breaks and so the batter runs out.

Careful adherence to the details considered in this chapter should result in the production of regular products of the highest quality.

The following table of recipes summarises the correct weight of ingredients for cakes of good quality:

Type	Butter and Fat	Sugar	Liquid Eggs	Flour	Baking Powder	Milk	Fruit	Other ingredients
	lbs.	lbs.	lbs.	lbs.	ozs.	lbs.	lbs.	
Heavy gateau -	1	1	1	1	—	—	—	} 2 ozs. ground almonds (if desired).
Rich Madeira -	1	1	1½	1½	—	1 oz.	—	
Wedding cake -	1	1	1½	1½	—	1 oz.	5½	
Xmas, best Dundee slabs -	1	1	1½	1½	—	1 oz.	2½	4 ozs. ground almonds.
Cherry slab -	1	1	1½	1¾	—	2 ozs.	2	2 ozs. ground almonds, ½ oz. tartaric acid.
Cherry cake -	1	1	1½	1½	¼	2 ozs.	2	2 ozs. ground almonds, ½ oz. tartaric acid.
Dundee -	1	1½	1½	1½	¼	2 ozs.	2¼	2 ozs. ground almonds.
1 lb. fruit -	1	1½	1	1½	½	$\frac{7}{16}$	1½	2 ozs. ground almonds.
Fruit -	1	1½	1½	1½	½	$\frac{5}{16}$	1½	—
Madeira -	1	$1\frac{5}{16}$	$\frac{1}{16}$	2	¼	$\frac{1}{16}$	—	—
Cheap Madeira -	1	2	1	3½	1	1½	—	½ oz. glycerine, ½ oz. salt.
Cheap fruit -	1	2	1½	4	1	1½	2½	½ oz. glycerine, ½ oz. salt.
Very cheap Madeira	1	3½	—	5½	2¼	4¼	—	1 oz. glycerine, ½ oz. salt.
Very cheap fruit -	1	2½	—	5½	2	4¼	3	1 oz. glycerine, ½ oz. salt. Egg colour.

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In the last four mixings the flour should be made up with a proportion of cornflour and rice flour. Where it gives $5\frac{1}{4}$ lbs. flour, it

should read $4\frac{1}{2}$ lbs. flour, $\frac{1}{2}$ lb. rice flour, and $\frac{1}{2}$ lb. cornflour. This helps to give the cakes a more even texture. The last four mixings would usually be made on the flour batter system, but perhaps better results can be obtained by a new method of making cheap cakes, such as is given at the end of this chapter.

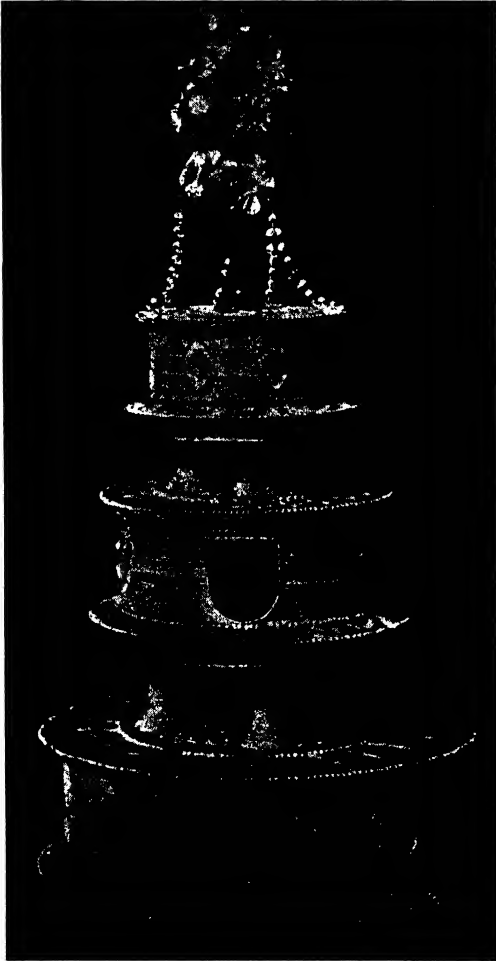


FIG. 6.—THREE-TIER WEDDING CAKE.

Summary of Cake Faults and How to Avoid Them

It does not matter how much one knows about cakes and how careful one is in the making of them, there are times when something goes wrong and the cakes are not up to the required standard. It is sometimes difficult to get at the source of the trouble which causes the variations in the quality of the goods.

It has been thought convenient to give here a summarised list of cake faults which might be

useful in solving the difficulties many confectioners experience.

When anything goes wrong with the cakes, the recipe should be checked over to see that it is properly balanced in accordance with the hints given in this chapter.

With each fault are given possible causes and suggested remedies.

Cake-making Faults

1. CAKES SINKING DURING BAKING.

Possible Cause.

Using too much baking powder.

Using too soft a flour to carry amount of butter and sugar used.

Using too much milk, and so getting batter too soft.

Using too much fat or sugar, making batter too soft, so that the expanding cells break through.

Underbaking the cake.

Knocking or removing cakes in the oven before they have set.

Ginger cakes cause more trouble through sinking than most other types, owing to the presence of too much aerating chemicals.

Suggested Remedy.

Reduce the amount of baking powder used.

Use a stronger flour or reduce amount of fat and sugar used.

Reduce amount of milk used.

Balance the recipe correctly according to the chapter on cake-making processes.

See that cakes are baked at the correct temperature and for the proper length of time.

Cakes should not be touched in the oven until set and nearly baked.

Use the correct amount of bicarbonate of soda.

Bake ginger cakes in a cool oven.

2. CAKES POOR IN VOLUME.

Possible Cause.

Insufficient aeration.

Not creamed up sufficiently.

Not having all ingredients at the same temperature.

Using too much flour or too strong a flour, thus toughening batter or getting it too stiff.

Baking in too hot an oven, thus getting a hard crust on top before cakes have fully expanded.

Baking in too cool an oven; thus the cakes do not rise to their fullest extent, and will take longer to bake and so be dry eating.

Not using sufficient moisture.

Suggested Remedy.

Use more baking powder.

Cream up fats and sugar well, then cream in the eggs properly.

See that all the ingredients are about 70° to 75° F. before using.

Use the correct type of flour or reduce strength of it by adding a proportion of cornflour.

Always bake at the correct temperature, and have some moisture in the oven to prevent a hard crust forming.

Bake the goods as quickly as possible at the correct temperature.

Balance the recipe correctly.

3. CAKES HAVING A POOR TEXTURE AND CRUMB.

Possible Cause.

Insufficient sugar makes a harsh crumb, and gives cakes a poor outside appearance.

Too much baking powder.

Suggested Remedy.

Use more sugar in accordance with suggested formulae.

Use less.

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CAKES HAVING A POOR TEXTURE AND CRUMB—*continued.*

Possible Cause.

Baking powder not properly mixed with flour.

Insufficient mixing of batter causes a patchy colour in crumb and hard cores.

Overmixing of batter, causing a toughening, and consequently holes in cakes.

Using the wrong type of flour, causing large holes in cakes when it is too strong.

Fats not properly creamed, and eggs not creamed in properly.

Scrapings from side of bowls give dark streak in cake if not properly mixed in.

Too much steam causes large holes near crust.

Placing batter into hoops and frames in several portions causes holes.

Using the wrong type of sugar, thus producing specks in cakes after baking, owing to sugar being undissolved.

Toughening batter by adding milk at the wrong time.

Using insufficient milk in the mix.

Too hot an oven causes elongated holes in cakes.

Too cold an oven gives a dry, harsh crumb.

Cakes delayed before going into oven.

Curdling a batter, causing crumbliness and dryness.

Dirty fruit, careless workmanship, cheap sugar, badly balanced mixing, cause a dulness of crumb.

Suggested Remedy.

Sieve baking powder and flour together before adding to the batter.

Always clear batter sufficiently, but not too much.

Do not overmix the flour, but study to get the batter properly cleared in a minimum time.

Study the type of goods to be produced and use the correct type of flour.

Cream fats and sugars until sufficiently light, and cream in eggs two at a time to each pound of fat employed.

Mix the scrapings in next batter or get them in thoroughly as the batter is weighed off.

Do not use too much steam.

Scale off batter and place into hoops or frames in one portion where possible.

Use a fine-grained castor sugar in the correct proportions to give the best texture.

Always add milk to batters when stirring in the last lot of flour.

See that sufficient milk is used in recipe.

Study the types of cakes to be cooked, and bake at the proper temperature.

Have oven temperature high enough to bake properly in minimum time.

As soon as batters are made they should be scaled off into hoops or frames and baked without delay.

Do not cream in eggs too quickly, and do not use weak watery eggs or fats containing too much moisture.

Use clean fruit, good sugar, see the mixing is thoroughly balanced, and mix correctly.

Cake-making Faults

4. CAKES CRACKING DURING BAKING OR HAVING TOO THICK A CRUST.

Possible Cause.

Skin forming before aeration is completed ; thus it cracks and batter flows out, and so the cakes have thick crusts by the oven being too hot on top.

Too much bottom heat, giving thick bottom crust.

Baking in too cool an oven causes thick, hard crusts, because cakes are too long in the oven.

Baking cakes in tins is likely to cause cakes to spring up and crack in the centre.

Lack of steam in oven causes cracks on surface.

Suggested Remedy.

See the oven has a solid heat and the temperature is not too high, or protect the cake tops by some form of covering.

The oven should have an even heat, but the cakes should be well protected on bottom or baked on a double baking sheet.

Bake at the correct temperature.

Bake in hoops or frames.

Bake where possible in large batches, or place a pan of water in oven with cakes to form steam. Keep oven door shut during baking.

5. FRUIT SINKING IN CAKES DURING BAKING.

Possible Cause.

Batter too soft or too light.

Using a very weak flour.

Citron peel sinking in Madeira cakes because it is too thick.

Syrup on cherries or cherries not properly dried after washing.

Wet fruit may sink in cakes.

Batter not sufficiently acid.

Suggested Remedy.

Do not use too much liquid or too much baking powder.

Use the correct type of flour.

Use a thin cut citron peel.

Wash off the syrup and dry the cherries again before using. Also rub them in rice flour or ground almonds.

After washing fruit to clean it, dry it again before using.

Use a little tartaric or citric acid dissolved in milk to keep fruit from sinking.

6. CAKES DRYING OUT OR STALING QUICKLY.

Possible Cause.

Baking in too cool an oven.

Not sufficient moisture in batter.

Using too much baking powder.

Suggested Remedy.

Use a hotter oven.

Use more eggs or milk. The weight of eggs and milk used should be about 14 ozs. per pound of flour.

Do not use too much baking powder.

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CAKES DRYING OUT OR STALING QUICKLY—*continued.*

<i>Possible Cause.</i>	<i>Suggested Remedy.</i>
Curdled batter.	Care should be taken not to curdle the batter.
Cheap cakes dry out quickly in warm weather.	Use glycerine, or invert sugar to prevent this.
Using a fat that does not cream up well.	Use a fat that has good body and creams up well.
Using too little shortening and eggs.	Use a higher proportion of fat and eggs.

Emulsions and Cake Making

Emulsions of oil, fats, and milk are now being widely used in the manufacture of scones and powder goods, as well as cheap pound and slab cakes. In all goods in which the quantity of fat per pound of flour is under 4 ozs. this method of procedure is to be recommended, because a more thorough distribution of the fat among the ingredients takes place.

Thus, for example, where scones are being made it is possible either to make an emulsion of the milk and fat in the proportions required for any mixing or to make a more concentrated emulsion and dilute it prior to using.

Thus the following emulsion would be suitable :

Skim milk powder - - - 1 lb.	}	Heated to 145° for ten minutes, passed through the emulsifier, then cooled.
White fat or cooking oil - 2 lbs.		
Water - - - - - 10 „		

In using such an emulsion it is usual to add the quantity of fat and milk together and take this weight of emulsion. Sometimes a little less is required with soft flours. Thus :

<i>Ordinary Recipe</i>	<i>Modified Recipe</i>
2 lbs. flour.	2 lbs. flour.
1½ ozs. baking powder.	1½ ozs. baking powder.
6 ozs. sugar.	6 ozs. sugar.
6 ozs. fat.	8 ozs. sultanas.
8 ozs. sultanas.	½ oz. salt.
½ oz. salt.	24 oz. emulsion.
1 pint milk.	

For slab cakes a similar modification is required, only in this case the creaming-up process is eliminated. Thus :

<i>Ordinary Method</i>	<i>Modified Method</i>	
Batter A { 1 lb. 2 ozs. fat	Emulsified A { 1 lb. 2 ozs. fat.	
1 lb. flour.		2½ pints milk.
Lemon essence.		

Cake-making Processes

Sift together B $\left\{ \begin{array}{l} 3 \text{ lbs. flour.} \\ \frac{1}{4} \text{ lb. cornflour.} \\ 1\frac{3}{4} \text{ ozs. baking powder.} \end{array} \right.$

Dissolve B in A $\left\{ \begin{array}{l} 2\frac{1}{2} \text{ lbs. sugar.} \\ \text{Egg colour.} \\ \text{Lemon essence.} \end{array} \right.$

Mix in C $\left\{ \begin{array}{l} 2\frac{1}{2} \text{ lbs. sugar.} \\ \frac{1}{2} \text{ oz. salt.} \\ 2\frac{1}{4} \text{ pints milk.} \\ \text{Egg colour.} \\ 4 \text{ lbs. fruit.} \end{array} \right.$

Sift together C and stir into B $\left\{ \begin{array}{l} \frac{1}{2} \text{ oz. salt.} \\ 4 \text{ lbs. flour.} \\ \frac{1}{4} \text{ lb. cornflour.} \\ 1\frac{3}{4} \text{ ozs. baking powder.} \end{array} \right.$

No glycerine is required in such a mixing, since emulsification brings about such a distribution of the fat in the milk, that in the resultant cake better moisture retaining properties result. Further, the texture of the cake is greatly improved.

Pound Cakes by the Emulsion Method

The following method and recipe for making cakes has recently been introduced by the authors owing to the shortage of fats, and it has been found to give excellent results :

<p>2 pts. cooking oil $1\frac{1}{2}$ pts. milk $1\frac{1}{4}$ pts. eggs $\frac{1}{2}$ oz. salt Egg colour flavouring</p>	}	<p>Heat these ingredients together over a bain-marie to 145° F., then pass through the emulsifier and cool, or whisk them together in the machine bowl until cool.</p>
<p>$2\frac{3}{4}$ lbs. sugar 4 lbs. flour 3 ozs. baking powder</p>	}	<p>- Add to the emulsion and dissolve. Sift together, place in the machine bowl. Gradually beat in the emulsion and continue beating for a total period of 5 mins.</p>

This makes excellent plain cakes, but will also hold fruit. $2\frac{1}{2}$ lbs. of mixed fruit may be added.

It would appear from many experiments that this method of cake-making can be applied to most properly balanced recipes, using melted fat or cooking oil to make the emulsion with the eggs and milk.

The cakes so produced have a clear crumb and texture and good keeping qualities.

CHAPTER XVIII

DEVELOPMENT AND PRODUCTION OF HIGH-RATIO CAKES

Development in the United States

“BAKE home type cake and you will sell more cake” is a slogan of a famous American bakery trade journal which all bakers the other side of the Atlantic take very much to heart. Certain sections of the American bakery and allied trades realised during the early 1930's that there was a large market for their cakes if they could persuade the housewife to give up making her own cakes and turn to the baker to provide them. This meant a radical change in the type of cake the baker had to offer, for at that time “baker's cakes” were not in good repute, and considered only as second best to “home-made cakes”. A good quality bakery-made cake in those days had a formula somewhat similar to the following. The quantities are given as percentage of the flour :

Flour	-	-	-	-	-	-	-	100
Shortening	-	-	-	-	-	-	-	35
Eggs	-	-	-	-	-	-	-	40
Sugar	-	-	-	-	-	-	-	95
Baking Powder	-	-	-	-	-	-	2.5	
Milk	-	-	-	-	-	-	-	60

This type of cake had a good appearance, good volume, and handled, cut and packed easily and well ; the only trouble was that it did not sell. It was evident that to compete with home baking this type of cake was of little use, and it was evident, too, that the reason for this was that the cake lacked the rich ingredients necessary to give it a good eating quality and flavour which was far and away the first criterion by which the housewife judged a cake. The realisation that the baking trade must give the housewife what she wanted, instead of what it thought would do, was the underlying reason and cause for the development of high-ratio cakes.

How was this to be done? When extra enriching ingredients were added to their cakes, bakers found that the cakes were a failure. They had a coarse, uneven texture or were soggy. To effect the required improvements it was necessary for the baker to have ingredients of a higher quality than he had used hitherto. It was

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about 1933 that these superior type ingredients in the shape of special shortening and special flours were made available to the baking trade of America by means of intensive research on the part of prominent allied traders, research both in their laboratories and their test bakeries.

Bakers were quick to take advantage of these ingredients, as they saw in them the solution to their problem.

The new formulas that were soon made available permitted production of a vastly improved cake, which was more tender, moister and better to eat. It carried extra quantities of sugar, eggs and fat, especially sugar to give it tenderness and moistness. A good quality formula, such as would be used for a yellow sandwich cake, became :

Flour	-	-	-	-	-	-	-	100
Shortening	-	-	-	-	-	-	-	55
Eggs	-	-	-	-	-	-	-	60
Sugar	-	-	-	-	-	-	-	140
Baking powder	-	-	-	-	-	-	-	5.0
Milk	-	-	-	-	-	-	-	105

The substantial changes in the quantities of ingredients, especially in the ratios of sugar and total liquid to flour, are immediately apparent when this formula is compared with the one given above as the typical high quality formula of former days.

Then, as now, the policy of finding out what the customer wanted was being energetically pursued by all progressive American businesses, by means of market research and "consumer surveys". These were frequently carried out by independent organisations which were quite impartial as to the results obtained. Such consumer surveys on the new type cake among American housewives showed a preference for them of over 80%, when compared with the old type cakes.

The door to the undeveloped market of home baking had been unlocked, and the new cakes, properly merchandised, were instantly successful in capturing a large part of this market for the baking trade. Over five years, the increase in business was estimated at 40%, a very substantial one that could not have been made were it not for the development of the special fat and flours which made the new formulas possible.

The Development in Great Britain

Those interested in this new type of cake for the British market were not willing to go ahead with its promotion without finding out

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what measure of consumer acceptance could be expected. It was realised that British and American tastes differ considerably, and it had to be determined what changes were necessary with these new type cakes to make them acceptable to the British taste. The question was answered by a series of consumer surveys, in which British housewives were asked to choose between two cakes and give reasons for their choice. The first comparison was between a good quality Madeira cake as commonly made by British bakers and the new American high-ratio cake with extra sugar and liquid.

The formulas of these two cakes were as follows :

	<i>American New Type Cake</i>	<i>Good Quality Madeira</i>
Flour - - - -	100	100
Shortening - - -	50	60
Eggs - - - -	50	75
Sugar - - - -	130	75
Baking powder - -	5	2
Milk - - - -	100	12

The result of the consumer test was 63% preference for the new cake, 37% preference for the Madeira. Although obtaining a majority, the new cake did not have the overwhelming preference shown in America. The main criticisms made against it were that it was too light and slightly too sweet, so that one or two bites were sufficient. The cake was also too wet. In America the problem of prevention of stales is very acute, for the humidity is so low that moisture evaporation from the cakes is very rapid, thus causing them to go stale. For this reason the new cake contained a high proportion of moisture, and also a high proportion of sugar, which being hygroscopic helps to retain this moisture content and retard its evaporation. In the higher humidity of the British Isles the moisture evaporation is not so evident, and the high sugar content kept the cake in an almost too moist condition.

Investigational work was necessary to remedy these faults without sacrificing the improvements which had been made. This resulted in a modified formula, which was then tested against the original new type American formula. This new formula, with the original one given again for comparison, was as follows :

Development of High-Ratio Cakes

	<i>Modified New Type Cake</i>	<i>Original American New Type Cake</i>
Flour - - - - -	100	100
Shortening - - - - -	75	50
Eggs - - - - -	75	50
Sugar - - - - -	130	130
Baking powder - - - - -	4	5
Milk - - - - -	75	100
Preference in consumer test -	90	10

The result of the changes on the preference shown was very marked. These changes were mainly :

1. Increase of fat and slight reduction in baking powder to reduce the excessive lightness of the American cake. This also produces an eating quality which is more acceptable to the British taste, which appreciates tenderness and the "melt in the mouth" quality which were the outstanding qualities of the new American cakes from the first, but which requires "something to bite on", and does not care for a mouthful of cake so light that it seems to go to nothing in the mouth.

2. Although the total liquid/flour ratio is not altered, a considerable proportion of the milk in the American cake has been replaced by eggs. This not only makes the cake less moist, but also makes it much richer in flavour and eating quality.

3. The sugar/flour is unchanged, but the percentage of sugar in the total mix is slightly reduced owing to the increase in shortening content. Moreover, the extra flavour and richness in eating due to the increase of fat and eggs reduces the sensation of being "too sweet", which was one of the criticisms of the original American cake.

Thus by maintaining the sugar/flour and the total liquid/flour ratios, all the outstanding qualities of the new type of cake were retained. It was made adaptable to British taste by the replacement of some of the milk by extra eggs, and, probably most important, by an increase in the fat content. In Britain a rich cake must be high in fat, and the changes in the American formula brought the new formulas, adapted for the British trade, into conformity with this principle.

The Production of High-Ratio Cakes

Special Ingredients.—The specialised ingredients which made possible the production of high-ratio cakes were a specially processed

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shortening and specially processed cake flours. It has been stated above that research work on these ingredients took place not only in the research bakeries of prominent allied traders, but also in their chemical laboratories. It was not only the finished form and texture of the ingredients which were changed to make them suitable for the purpose, but their chemical constitution was also investigated, and adjusted so that in the baking tests the results were satisfactory.

High Emulsifying Shortening.—In the case of the special shortenings, which are now well known to the baking trade, the improvement made was in the emulsifying properties of the fat.

The main object in the development of high-ratio cake formulas was to be able to incorporate successfully into the cake extra enriching ingredients such as sugar, eggs and fat. It was recognised that if this could be done the old aversion to the old type bakers' cakes could be done away. Now extra sugar in a cake means extra liquid to dissolve it, because undissolved sugar will make the cake crumb harsh and the surface crusty and sugar-spotted. Therefore, extra sugar and extra liquid are complementary, one cannot be successfully incorporated without the other. As the sugar dissolves in the liquid, the problem becomes one of how to incorporate the extra liquid successfully. In a cake it is known that the liquid content is emulsified with the fat and absorbed by the flour. Therefore, for extra liquid it was necessary to have a high emulsifying fat and high absorbing flour. The extra emulsifying properties of the fat enabled the extra liquid, which was made up partly of the extra eggs required, and which was carrying the extra sugar in solution, to be emulsified into a stable emulsion which then was successfully absorbed by the special flour.

This, however, was not the only advantage provided by the high emulsifying shortening. The function of the fat in a cake batter is to coat the flour and to emulsify the liquid content, so that flour, which is not soluble, the soluble solids such as sugar, salt, baking powder, etc., and the liquids all form a smooth homogeneous mass.

In this mass, however, the flour and liquid must not come into too intimate contact, for the gluten development in the flour would be too great, and the result would be a cake with a poor volume and tough crumb. When the shortening has emulsifying properties of an ordinary shortening (and these emulsifying properties vary considerably with the type of shortening, whether butter, margarine, compound fat or hydrogenated fat), this not only limits the amount of liquid that can be emulsified into the cake batter, but it also affects the type of emulsion formed.

Development of High-Ratio Cakes

It is known that in an emulsion of oil and water the smaller the droplets or globules of the oil in the water or *vice versa*, the more stable the emulsion will be. The larger these globules the more easily do they coalesce, the two phases separate, and the emulsion is broken. Conversely, it is known that the better the emulsifying powers of the oil or fat are, the smaller will be the globules or droplets formed when it is emulsified with water or a solution of various substances in water.

So that in a cake batter, which is a complicated emulsion, containing some soluble solid materials, the emulsifying powers of the shortening used determine the size of the globules of fat and liquid and their dispersion throughout the mass of flour. If these globules are large the finished cake will have a coarse texture, for the air cells formed in the baking will be large, and the walls of these cells will be thick.

With a high emulsifying shortening the emulsion formed is very stable, the globules of liquid and fat are very small, and the dispersion of the liquids throughout the flour mass is much finer. Viewed microscopically the batter can be said to be less discrete. When this type of batter is baked the air cells produced by steam, and gas from the baking powder, are smaller and much more numerous, and the walls of these cells are finer. Moreover, the dispersion of the cells is more uniform than in a cake made from a batter which was a poorer emulsion.

In the finished cake with the high-ratio formula all this results in a close even texture, with a very soft tender crumb, and yet very light. The large amounts of enriching ingredients present coupled with this tender moist crumb produce the excellent eating qualities of high-ratio cakes. The finished cake, of course, contains a large proportion of its original moisture, and this is firmly held by virtue of the high emulsifying properties of the shortening, increasing the length of its freshness considerably, and thus providing the better keeping qualities of this type of cake. This prevention of staling is also materially assisted by the close even texture of the cake itself, which again retards evaporation of moisture, which would take place more freely were the grain of the cake more open.

Thus it can be seen that the high emulsifying shortening makes the high-ratio cake possible, and also superior in eating and keeping, in two ways. It allows the incorporation of extra liquid by its high emulsifying powers, and the resulting absence of free liquid prevents the cake from being soggy. With this extra liquid, extra sugar can be incorporated, for it can be dissolved in the extra liquid, and

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solution is essential for successful incorporation of sugar into a cake batter. Also it enables the texture and crumb of the finished cake to be fine and soft, by virtue of its ability to form a fine and stable emulsion.

Special Cake Flour.—The special cake flours developed for high-ratio cakes had to have high liquor absorbing power, and strength without toughness in order to carry the extra quantities of fat and sugar. It was found that special wheats had a property of giving what was described as a “soft elastic gluten”, in contrast to the tough strong gluten of strong bread wheats. This “soft elastic gluten” was found to be very suitable for high-ratio cake work, for it had the strength necessary to carry the extra sugar and fat without giving a tough crumb, or tight bound cake of low volume. Furthermore, it was found that the nearer the centre of the wheat-berry the ground particles of flour came from, the better was this desired property of the gluten. This meant a high extraction in the milling, which is a characteristic of special cake flours. The protein content of cake flours is also much less than bread flours, so that the gluten, as well as being of a more suitable quality, is also less in quantity.

Also within limits one would expect that the finer the flour particles, the better liquid absorbing powers would the flours have. There is no doubt that special cake flours are ground more finely than ordinary flours, but the important feature of particle size is not so much the fineness, but the uniformity. Uniformity of flour particle size results in uniform absorbing rate, which has been found to be an advantage in this type of cake.

Other properties of cake flours which have been found to give most suitable results are a slight acidity, so that the *pH* is about 5·2, and an ash content of less than ·3%. This low ash content not only signifies a high extraction, but also it has been suggested that the inorganic materials composing the ash have a retarding or inhibiting effect on the various reactions in the baking of a cake and consequently are harmful.

Mixing Methods.—When the American type of formula for the high-ratio cakes was adjusted to British tastes, as described in the first part of this account, it was found that the mixing methods had to be adjusted as well. The American cakes were made on an ordinary sugar batter method, but it was found that the adjusted formula aerated too much on this method, so that in the oven the cake rose above its maximum stability and then fell back.

This led to the development of the “blending method” by which

Development of High-Ratio Cakes

high-ratio cakes are commonly made in this country. In this, solid ingredients and some of the milk are blended together on slow speed so they become thoroughly incorporated, and then the eggs are added and mixed in only for as long as it is necessary to get a smooth uniform batter. Sufficient air is incorporated by this method for small cakes. For slab cakes the mixing on the first stage is on medium speed for a longer period, as this type of cake requires more aeration.

This blending method for high-ratio cakes is shorter and simpler than the usual methods of preparing cake batter, and this is considered an advantage in many bakeries.

As with all cakes it is very important to finish with a perfectly smooth batter, and so the regular and frequent scraping down of the bowl and beater are very important in the blending method for two reasons: (a) It is necessary to get complete intermixing of all the ingredients in a short time, and the materials adhering to the bowl and beater must be removed regularly for this to be possible. (b) The final high-ratio cake batter is so much softer than the usual cake batter that it has not the tenacity or viscosity to clean the sides of the bowl, which remain covered with imperfectly mixed more solid materials unless they are scraped down.

Since the introduction of high emulsifying shortenings and special cake flours into this country, it is now possible to make an improved type of the ordinary English cakes, using these special ingredients. These cakes are not only cheaper to produce, but have better volume and better keeping qualities than the average cakes made with the normal ingredients.

How to Balance a Cake Formula

If several formulae for a particular type of cake are compared their similarity will be noticeable, but to produce a good cake a recipe must be well balanced. When summing up the balance of a formula the variability of the various ingredients must be carefully considered. Average conditions must be assumed. All the ingredients used must be of such quality as to contribute their share in the making of good cakes. When studying a series of formulae the following rules may be taken as a rough guide.

1. The total weight of sugar, as a rule, does not exceed the weight of the flour, but it should be at least 25% of the total weight of the ingredients used, excluding the fruit.

2. The quantity of eggs used should not exceed 1 pint per 14 ozs. of hydrogenated fat or 1 lb. cake margarine.

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3. The total weight of liquid ingredients (milk and eggs) should be at least $87\frac{1}{2}\%$ of the weight of the flour in fruit cakes, or at least 14 ozs. per lb. of flour when the sugar is only 25% of the weight of the total ingredients, excluding the fruit.

4. The total weight of liquid ingredients (milk and eggs) should be at least equal to the total weight of flour and other starchy dry ingredients in plain cakes, when the sugar is at least 25% of the total ingredients.

5. Allowance must be made for the moisture in butter and margarine when these are used in preference to the 100% fats.

6. Eggs should aerate their own weight of flour. All flour over and above the weight of the eggs should have an addition of baking powder. For small plain cakes $\frac{3}{4}$ ozs. baking powder per lb. of flour is enough. Plain slab cakes, $\frac{1}{2}$ oz. baking powder is sufficient. Lightly fruited small cakes require $\frac{5}{8}$ oz. baking powder per lb. of flour, and large fruit cakes require only $\frac{3}{8}$ oz. baking powder per lb. of flour.

These rules, however, must be considered with an eye to the variation of ingredients.

Cake-making Method using Hydrogenated Fat

Consistent results can always be obtained by standardising the method of making up the batters.

The standardised method that should be adopted to produce consistently good cakes from any of the recipes given hereafter is as follows :

Cream up the fat, salt and sugar for 7 to 10 minutes on top gear of the machine. Where there is twice as much sugar as shortening a proportion of the sugar should be dissolved in the milk. After 5 minutes' creaming the batter should be scraped down, and this should be done a second time before adding the eggs.

Add eggs gradually over two or three minutes on second speed, according to the quantity of eggs used. Scrape down the mixture when all the eggs are added, and continue creaming for two or three minutes to make a total of five minutes' creaming from the time of commencing to add the eggs until the finish. Scrape down the mixture again. Add the sifted flour, baking powder and milk to the batter, and mix the whole on low gear for two minutes, if plain cakes are being made, to get a thoroughly clear batter. In the case of fruit cakes add fruit after the flour has been mixed in for one minute, and continue mixing for one minute. This gives a total

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mixing time of 14 to 17 minutes. Any special flavourings used should be added at the initial stage of creaming.

The speed of mixing plays a very important part. If the weather is warm, creaming must all be done on medium gear, otherwise the frictional heat may ruin the batter. The time of creaming is also important, as this affects cake volume. Creaming should be continued until the maximum volume of air is incorporated. As the amount of sugar is increased in a mixing, so the beating time is increased. Bakers should note the best times for their purpose, and standardise their methods to get consistent results. After numerous experiments the times given above are those considered to give the best results.

TABLE OF RECIPES FOR MADEIRA AND LAYER CAKES

<i>Ingredients</i>	1	2	3	4	5	6	7	8
Fat - -	14 oz.	14 oz.	14 oz.	14 oz.	14 oz.	14 oz.	14 oz.	14 oz.
Sugar - -	20 oz.	20 oz.	24 oz.	24 oz.	28 oz.	28 oz.	32 oz.	32 oz.
Eggs - -	20 oz.	16 oz.	20 oz.	16 oz.	20 oz.	16 oz.	20 oz.	16 oz.
Flour - -	20 oz.	20 oz.	24 oz.	24 oz.	28 oz.	28 oz.	32 oz.	32 oz.
Baking powder -	$\frac{1}{8}$ oz.	$\frac{1}{4}$ oz.	$\frac{1}{4}$ oz.	$\frac{3}{8}$ oz.	$\frac{3}{8}$ oz.	$\frac{5}{8}$ oz.	$\frac{5}{8}$ oz.	$\frac{3}{4}$ oz.
Milk - -	4 oz.	8 oz.	6 oz.	10 oz.	9 oz.	13 oz.	15 oz.	19 oz.
Salt - -	$\frac{1}{2}$ oz.	$\frac{1}{2}$ oz.	$\frac{1}{2}$ oz.	$\frac{1}{2}$ oz.	$\frac{1}{2}$ oz.	$\frac{1}{2}$ oz.	$\frac{1}{2}$ oz.	$\frac{1}{2}$ oz.
Flavouring	$\frac{1}{8}$ oz.	$\frac{1}{8}$ oz.	$\frac{1}{8}$ oz.	$\frac{1}{8}$ oz.	$\frac{1}{8}$ oz.	$\frac{1}{8}$ oz.	$\frac{1}{8}$ oz.	$\frac{1}{8}$ oz.
Total wt. -	78 $\frac{1}{2}$ oz.	78 $\frac{1}{2}$ oz.	88 $\frac{1}{2}$ oz.	89 oz.	100 oz.	100 $\frac{1}{2}$ oz.	114 $\frac{1}{2}$ oz.	114 $\frac{3}{8}$ oz.
% sugar -	25.6	25.6	27.2	27.2	28	28	28	28

TABLE OF RECIPES FOR POUND FRUIT CAKES AND QUEEN CAKES

<i>Ingredients</i>	1	2	3	4	5	6
Fat - - -	14 oz.	14 oz.	14 oz.	14 oz.	14 oz.	14 oz.
Sugar - - -	22 oz.	22 oz.	24 oz.	24 oz.	26 oz.	26 oz.
Salt - - -	$\frac{1}{2}$ oz.	$\frac{1}{2}$ oz.	$\frac{1}{2}$ oz.	$\frac{1}{2}$ oz.	$\frac{1}{2}$ oz.	$\frac{1}{2}$ oz.
Eggs - - -	20 oz.	16 oz.	20 oz.	16 oz.	20 oz.	16 oz.
Milk - - -	2 oz.	6 oz.	5 oz.	9 oz.	8 oz.	12 oz.
Flour - - -	24 oz.	24 oz.	28 oz.	28 oz.	32 oz.	32 oz.
Baking powder	$\frac{1}{2}$ oz.	$\frac{1}{4}$ oz.	$\frac{1}{4}$ oz.	$\frac{3}{8}$ oz.	$\frac{3}{8}$ oz.	$\frac{1}{2}$ oz.
Fruit - - -	24 oz.	24 oz.	24 oz.	24 oz.	24 oz.	24 oz.
Flavouring - -	$\frac{1}{8}$ oz.	$\frac{1}{8}$ oz.	$\frac{1}{8}$ oz.	$\frac{1}{8}$ oz.	$\frac{1}{8}$ oz.	$\frac{1}{8}$ oz.
Total weight -	106 $\frac{1}{2}$ oz.	106 $\frac{1}{8}$ oz.	115 $\frac{7}{8}$ oz.	116 oz.	125 oz.	125 $\frac{1}{2}$ oz.
% sugar - - -	26.8	26.8	26.3	26.3	25.7	25.7

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Angel Cake or White Cake

Within the past few years confectioners have been interested in the production of Angel cakes or white cakes, as they are sometimes called. These are cakes which have been a centre of interest in the United States for the past decade. This cake did belong to the sponge class of cake, being light in weight and texture, very sweet and flavoured as desired. The crumb is white rather than yellow. The basic ingredients used were egg whites, flour, sugar, traces of acid or acidic salts, and flavouring as desired.

Since the introduction of the high-ratio cakes into this country, hydrogenated fat, salt, baking powder and liquid skim milk are now used along with the other basic ingredients to make this special type of cakes, which have proved very popular with the consumer. They are now generally made on the same process as the high-ratio cakes, instead of the sponge method as was formerly the case.

Various recipes are used to produce these cakes, either as loaf or pound cakes, cup cakes, or white layer and sheet cakes.

The following are a selection of the recipes that can be used :

<i>Ingredients</i>	1 <i>White Layer</i>	2 <i>Sheet Cake</i>	3 <i>White Pound</i>	<i>Blending Method</i>
Flour - -	5 lbs.	5 lbs.	5 lbs.	Mix for 5 mins. Scrape down the bowl and paddle once. Add to the blended mass in the bowl and mix for 5 mins.
Fat - -	2½ „	2½ „	3¼ „	
Sugar - -	7 „	6¼ „	6¼ „	
Salt - -	3 ozs.	3 ozs.	3 ozs.	
Baking powder	5 „	5 „	2½ „	
Liquid milk -	2 lbs.	2 lbs.	2½ lbs.	Scrape down once.
Egg whites -	3¼ „	3¼ „	3¼ „	Scale off egg whites, milk and flavour, mix together and add half to the batter. Mix until smooth, scrape down and mix till smooth again. Add remaining liquor and continue mixing for a total of five mins. at this stage, scraping down to ensure a smooth batter.
Liquid milk -	2¼ „	2½ „	1½ „	
Flavour -	to taste	to taste	to taste	

The total mixing time is about 15 mins. Bake 7-inch layer cakes scaled at 11 ozs. at 375° F.

Bake 1 lb. cakes at 360° F. for fully 1 hour.

Development of High-Ratio Cakes

Either of the following two formulae can be used for all types of sheet cakes, cup cakes, box loaves and sandwiches, and may be coloured and flavoured as desired.

<i>Ingredients</i>	<i>Angel Cake</i>	<i>White Cake</i>	<i>Base</i>
Flour - - -	5 lbs.	6 lbs.	Mix on slow speed until well blended and free from lumps. Approximate time 4 mins.
Fat - - -	4½ „	2 „	
Salt - - -	2 ozs.	2 ozs.	
Cream of tartar -	¼ oz.	¾ oz.	
Baking powder -	4 ozs.	3 ozs.	
Castor sugar -	6½ lbs.	5½ lbs.	
Egg whites - -	4½ „	3 „	Mix together in a bowl. Add about half to batter and mix for 4 mins. on slow. Scrape down and add the remaining liquor and mix a further 4 mins. on slow speed.
Liquid milk - -	2¼ „	3¾ „	
Glucose - - -	—	½ lb.	
Colour and flavour	as desired		

The quantity of milk used is variable.

If desired, one can divide the white batter up into different



FIG. 7.—VARIETIES OF ANGEL WHITE CAKES.

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coloured and flavoured cakes by adding the colour and flavour to each portion after the batter is mixed.

The baking temperature for these cakes is slightly less than for equivalent weights of yellow cakes.

The illustration shows different methods of presenting these cakes ready for sale.

CHAPTER XIX

BAKING OF CONFECTIONERY GOODS

IT is most important in the bakery to have good ovens, for a high consumption of fuel is ruinous to any business. It is essential that the top and bottom heat should always bear a steady relationship to each other. Ovens should be easily controlled, so that the heat can be regulated to the requirements of the goods. They should be easy to heat with a moderate quantity of fuel, and so constructed that when solidly heated they will not lose heat except in performing the work for which they have been designed. One of the first duties of an ovenman is to clean out his ovens regularly each morning ready for the day's work. A bright and clean exterior is also desirable, and so it is always best to have glazed tiles to oven fronts and polished handles on doors and fittings, since all these help to give a bright appearance to the bakery.

There are many types of ovens in use, and it is difficult to state which types are the best. The one chosen for any given bakery must depend on the work it is expected to do.

Ovens are classified in various ways, according to their construction, method of using, method of heating, or, it may be, according to the class of articles baked therein. Thus there are :

- | | | |
|----------------------------|---|--|
| 1. Internally heated ovens | - | { Side flue.
Scotch Chaffer oven and modifications.
Electric ovens. |
| 2. Externally heated ovens | - | { Steam pipe—peel, steel drawplate.
Hot air ovens { portable ovens.
shelf ovens. |
| 3. Travelling ovens | - | { Swinging tray.
Plate ovens.
Conveyer Type. |

Further, there are the different modifications of each, depending on the type of fuel used, whether coke, oil, gas, or electricity.

Oven Thermometers

Modern ovens are usually equipped with thermometers for the purpose of recording their average temperature. It is well known to most ovenmen that ovens do not always bake with the same degree of efficiency, although the temperature reading of the thermometer

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may be considered right for the particular goods. This is explained by the fact that the thermometer does not record the "solid" heat of the oven, by which is meant the actual baking heat, but only indicates the temperature of the atmosphere with which it is in immediate contact. The actual baking heat is supplied through the sole, side walls, and crown of the oven. There are few ovens which are uniformly heated throughout. In some, certain parts are cooler than others owing to faults in construction. The thermometer does not indicate the heat of the oven sole or that of the crown, but is affected only by the convection currents and radiant heat given off in that part of the oven in which it is placed.

The expert ovenman does not rely solely on the readings of the thermometer, but he is guided by his experience of the oven under working conditions. The actual temperature is usually less than the thermometer indicates when the oven is empty. On the other hand, when the oven is full it may be more than that indicated by the thermometer.

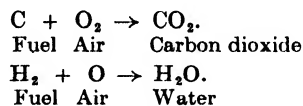
An oven that is easily or quickly heated is not usually so good as one that is slowly heated, because the one that is quickly heated will also cool down rapidly, since it does not contain a reservoir of heat; whereas the slowly heated oven does retain its heat, which is almost entirely utilised in the actual baking of the goods.

Fuels and Oven Firing

Ovens may be heated by coal, coke, gas, oil, or electricity. Anything that burns or generates heat can be used as a fuel, but it is not always advisable to burn the cheapest form of fuel. It might be the most uneconomical.

The treatment of the fires differs with each kind of oven, but there are a few general rules that apply in most cases. Coke is a much cheaper and cleaner type of fuel than coal. It saves trouble and dirt, and avoids all risk of creating smoke.

The combustion of a fuel is essentially a chemical process, the carbon of the fuel joining with the oxygen of the air to form carbon dioxide, and the hydrogen with the oxygen to produce water, along with a great amount of heat. Thus :



For economical working, all the carbon and hydrogen should be

Baking of Confectionery Goods

completely burnt in order that the maximum amount of heat is obtained. For this efficient stoking must be carried out, and the following points should always be watched :

Points to Observe in Firing Ovens

1. Keep the fire-bars properly raked out. This will ensure the admission of a plentiful supply of air to the fire and will help to produce efficient combustion. Also, it will prevent the formation of clinker and produce a minimum amount of ash.

2. Clear the flues frequently and regularly, so as to obtain a good draught.

3. Understand thoroughly the construction and working of the flues, otherwise control may be difficult.

4. Put fuel on the fire a little at a time, and see that it is spread evenly over the fire surface.

5. Exercise foresight in obtaining oven temperatures. See that the oven is at the desired temperature at the proper time.

6. Never bank up the fires overnight. This is a custom frequently carried out, but it is a short-sighted policy. What happens is as follows : the furnace is filled as full as possible with coke, the damper doors shut down, and the ratchet damper closed almost completely. A small amount of air can get in through the holes in the bottom of the furnace door. The fire keeps on burning slowly and the temperature of the oven is maintained. In the morning, however, it is found that all the fire has burned out from behind, and that it is only at the front, near the mouth of the furnace, that there is any fire. This means that most of the heat of the furnace has been at the front the whole time, as it could not get away up the flues, and it will be found in time that the front of the fire-bars will burn away and require renewal. The brick archway of the mouth of the oven will also suffer and need rebuilding, and so, too, will the furnace door. Thus the small amount of trouble which is saved in the way of remaking fires, or attending to them occasionally, is outweighed by the extra expense of renewals. When banking has to be resorted to on any occasion, it should be done as carefully as possible so as to avoid damaging the furnace structure.

7. If a fire-bar burns away, replace it by a new one immediately ; for if taken out and not replaced, the other fire-bars will buckle, and several of them, instead of one, will need replacing.

8. If an oven is getting too hot, one of the quickest ways of cooling it is to close down the ashpit doors, open the ratchet damper to

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the full, and the furnace doors, when the cool air will be drawn over the surface of the fire and cool the whole furnace.

9. Too much draught in the ordinary course of events can also cool down the fire, so care has to be taken in regulating it.

10. Always remember that the furnace is not a destructor for all the bakery refuse. Much can be burnt in it with due care, but some refuse almost puts out the fires, besides causing very unpleasant odours.

11. In ovens in which a shallow pit is built in the furnace for holding water, it should be seen that this is kept filled.

Baking Temperatures

No confectioner's oven is ever required to exceed 500° F. A competent confectioner should always know the temperature at which to bake his goods most effectively. When these have been well made and ready for baking, it depends on the efficiency of the ovenman whether they come out well baked, with an attractive and appetising appearance. The majority of the products should be baked in as hot an oven as possible, consistent with their being baked before taking on too much colour. When cakes are baked in too hot an oven, a thick crust is produced with a huge crack on top. This is due to the heat forming a crust before the cakes have finished rising; then as the gas in the interior expands it must crack the crust to escape. Thus too hot an oven will spoil the general appearance of goods and make them close and heavy in texture. On the other hand, if they are baked in too cool an oven they will come out with an insipid appearance, and the inside may look dark, open, and crumbly and have a bitter taste, or eat harsh and dry.

It is necessary to regulate the work so that the goods required to be made can be baked in the correct rotation in the oven. It is the usual practice to have the ovens solidly heated in the morning in preparation for the day's work, and the ovens so regulated that they gradually cool down during the process of baking. The following baking temperatures of the various types of products are only a guide to those whose ovens, when registering about 500° F., can bake a batch of bread properly. Others whose ovens register more or less must make the necessary calculations to get the correct baking temperature for confectionery. One should remember that it is not policy to be guided too closely by the reading of the thermometers; experience of the conditions of the ovens must be included. An efficient ovenman must be gifted with a large share of commonsense.

Baking of Confectionery Goods

Small goods of all types usually come first in the day's work, not only because they are wanted first in the shop and in a fresh condition, but also because the oven is usually more suitable then than later in the day.

Fermented Goods.—Fermented goods are usually made first thing each morning. When sufficiently proved they should be baked in a hot oven (450° to 460° F.). About eight minutes is sufficient to bake a batch of 2 oz. buns properly if the oven is right. They should be baked to a rich brown colour, careful note being made that they are properly baked by testing at the light coloured parts of the sides. Rich Bath buns require a slightly cooler oven (about 420° F.), and when the oven is inclined to be hot on the sole a good plan is to bake them on a double baking sheet. Chelsea buns, which are batched close together on baking sheets, should also be baked at this lower temperature, otherwise the hot oven would brown them on top before the centre buns were baked.

Chemically Aerated Goods.—Sultana scones, cream scones, whole-meal scones, other varieties of oven scones, the cheaper varieties of aerated buns such as raspberry, rice, lemon, orange, and rock buns, with not more than 4 ozs. fat and 4 ozs. sugar to each pound of flour, should all be baked in a hot oven (about 450° F.). Richer varieties of aerated buns, such as raspberry buns, containing more fat and sugar than the above proportions, should be baked in a cooler oven (about 420° F.). Small cakes, such as Madeira, Lunch, Cherry and Queen cakes, which are baked in patty pans or cases, require a moderate oven of 380° to 400° F., depending on the richness of the mixture.

Short Paste Goods.—The baking temperatures of these depend on the quality of the paste and filling employed. Notched jam and lemon tarts are usually baked at 420° F. Fruit tarts are also baked at the same temperature, but custards are baked in a slightly cooler oven (about 400° F.). Small meat pies and patties also require an oven about 420° F., but the larger sizes require a lower temperature. Madeira and rice tarts are also baked about 400° F.

Puff Paste Goods.—The majority of puff paste goods should lie at least thirty minutes before baking. Open tartlets or vol-au-vent cases are baked at about 420° F. Eccles cakes, Banbury cakes, Coventries, and other pastries of this type are baked at 420° F. Almond tarts are baked to suit the filling at 380° F. Sausage rolls should also be baked at 420° F.

Sweet Paste Goods.—These are products richer in quality than those previously noted. With Frangipan, Delicia, Maid of Honour,

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Congress, and other tartlets of this type made with sweet paste and a good quality filling, the oven temperature should not exceed 360° F. Almond slices and Frangipan slices are also baked at the same temperature.

Sponge Goods.—Sponge cakes and Victoria sandwiches should be baked in frames on the oven sole. The heat recorded should not exceed 400° F. Savoy fingers and drops should be baked in a warmer oven (450° F.). It is advisable, when the sole of the oven is too hot, to turn the baking sheet over and place the papers containing these products on the reverse side of the sheets. This ensures that they will not form a crust underneath, but will bake to an appetising colour without being dry. They require only a few minutes to bake. Swiss rolls and butter cream rolls are also baked in a fairly hot oven (430° F.). Savoy cakes and sponge loaves are baked in a much cooler oven. They require a steady heat of about 360° F. Othellos are a very rich type of sponge goods which also require baking in a cool oven (about 360° F.). Genoese pastes or light gateaux should be baked at 380° F. for about twenty minutes, depending on the thickness of the cakes.

Macaroon and Meringue Goods.—Almond macaroons require careful baking in a steady oven (about 360° F.). Too warm an oven will cause them to flow out more than is necessary. A little steam in the oven while they are baking will help to produce a better honey-combed appearance. Fancy macaroons, orange macaroons, ratafias, and other dessert biscuits of this consistency also require to be carefully baked at 360° F. ; care must be taken not to dry them out too much. Dutch macaroons and Patience biscuits are biscuits containing a larger quantity of sugar ; as a result, they must be partially dried before baking. After drying, they are baked in an oven at 350° F. to 360° F. Parisian routs and English rout biscuits are another type of biscuits that require to be dried or set before baking, so that they may retain their shape during baking. They must, however, be baked in a very hot oven (about 460° F.). They are not dried out, but only coloured to a nice golden, appetising colour, then washed over with stock syrup to enhance their appearance. Cakes decorated with boiled meringue need only be coloured for a few minutes in a hot oven (about 450° F.). Coconut macaroons should be baked in a cool oven about 330° F. Meringue shells and fancies require to be baked in an exceptionally cool oven (250° to 300° F.) with the door open, so that the steam is allowed to escape. Too hot an oven for these goods causes the meringues to colour quickly and rise more than is necessary during baking, thus spoiling

Baking of Confectionery Goods

their appearance. The majority of confectioners bake their meringues at the close of the day's work, when the oven is usually most suitable.

Choux Paste.—Cream buns are usually baked in their own steam under cover in a special cream bun pan in a hot oven (450° F.) for about twenty minutes. Care must be taken not to remove the cover until they are baked, otherwise the buns will collapse and be quite unsaleable. Eclairs are usually made from the same mixing as cream buns, but are not baked under cover, as they are not required to puff up so much; therefore they are baked on open baking sheets at about 420° F.

Gingerbread and Ginger Cakes.—Gingerbread, on account of the syrupy nature of the dough, must be baked in a cool oven (about 320° F.). If the oven is too hot the cakes will rise too much, then sink in the centre, and they will also be too highly coloured. Rich ginger cakes, containing more fat than ordinary gingerbread, should be baked in a moderate oven (about 350° F.).

Shortbread.—The baking temperature for shortbread depends on the size and thickness of the pieces to be baked. Small cakes should be baked in an oven at 420° F. Larger and thicker cakes should be baked in a cooler oven (as low as 380° F. for the thickest cakes). These require a band of paper round them to protect the borders taking on too much colour. It is not easy to tell when shortbread is sufficiently baked, but when the colour is right, then they can be regarded as finished. If the oven is too cold, they may colour through from the bottom and acquire a bitter taste before the top colour indicates they are baked. They should be baked in as hot an oven as possible, provided they can be sufficiently baked before taking on too much colour.

Round Cakes and Slab Cakes.—The baking temperature for all kinds of cakes depends mostly on their richness and quality. The rule is—the richer the cake, the lower the temperature at which it should be baked. Cakes should be baked in as short a time as is possible in an oven that will not give them too much colour or too thick a crust. Cakes are best baked in large batches with the oven door kept shut, so that the steam is retained until it is considered they are cooked. Good quality 1 lb. cakes require baking at about 380° F. Larger sizes require a cooler oven (about 350° F.). Cheap quality 1 lb. cakes require a warmer oven (up to 420° F.), and larger sizes at a corresponding lower temperature (down to 380° F.). The same rule applies to slab cakes. An oven that will bake an 8 lb. slab cake about 4 inches thick in 2 to 2½ hours is the best, depending on the richness of the cakes. For heavy fruited slabs and wedding

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cakes, the oven should be about 330° F. to do this. For medium fruited slabs the temperature should register 350° F. Madeira and seed slabs require a higher temperature (380° F.). Cheaper quality slabs containing a larger percentage of flour and milk than the other ingredients require to be baked at 400° F. During the baking of the slabs the oven temperature should be falling gradually. In no case, if it was right when the cakes were put in the oven, must the temperature be allowed to rise.

Hard-and-fast rules cannot be laid down about the baking of cakes. These are only a few guiding principles.

CHAPTER XX

PREPARATION OF ICINGS, FONDANTS, ETC.

IN order to make certain cakes more attractive and more appetising they are coated over with various substances, such as syrup, water icing, apricot purée, fondant, butter creams, or royal icing. Sometimes gum pastes are also used for a more lavish decoration. In this chapter it is proposed to deal with the methods of the making and the uses of these aids in the decoration of cakes.

Stock Syrup

A simple syrup is required for many purposes in making cakes more attractive. It is made by boiling together for a few minutes 3 lbs. of lump sugar, 1 quart water, and $\frac{1}{2}$ lb. glucose. Weigh the sugar into a copper pan, add the water, place on gas stove, and bring to boil, dissolving all the sugar before it boils. Wash down the sides of the pan, bring to boil, and remove the scum that rises to the top ; then add the glucose. A little citric acid or cream of tartar or lemon juice may be used instead of glucose to prevent the syrup from re-crystallising. Now boil for a few more minutes, take off any more scum, remove from stove, and pass the syrup through a tammy cloth or hair sieve into a clean vessel. This is known as stock or simple syrup, and is stored in glass bottles ready for use as required.

This syrup can be used for glazing purposes, for thinning down fondant, and for making water icing ; also in making water ices, orangeade, or lemonade. An orange or lemon syrup is very useful for flavouring purposes or for soaking babas and savarins, or for brushing over Dundee cakes when baked. The zest of eight oranges is added to each quart of hot syrup and kept hot for about five minutes. The syrup is then strained through a tammy cloth. The clarified juice of the oranges is added to it with a little citric acid, when it is ready for use.

Water Icing

Water icing is easily prepared for covering cheap cakes. The simplest method is to take boiling water and mix in sufficient icing or pulverised sugar to make it of the same consistency as fondant,

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such as is used for piping. A little glucose and a pinch of citric acid may also be added. The whole should be well beaten together before using.

Another method of preparing water icing is to take 1 pint of stock syrup and add about 6 lbs. of icing sugar, or sufficient to make it thick enough for spreading. It is heated in a bain-marie and beaten well together, and about $\frac{1}{4}$ lb. of glucose added, together with the juice of a lemon or a little citric acid. This makes an excellent water icing for spreading, but is not so good as fondant for dipping purposes. Water icings are easily coloured to any desired tint with suitable liquid colouring matters.

Apricot Purée or Jelly

Apricot purée is very useful to confectioners for flavouring cakes, and also for coating small fancies and gateaux before covering with fondant. If boiled to the thread degree it will set as a jelly when cold, so that cakes which are dipped in the hot purée will have a thin coating of this jelly, which will prevent them from absorbing moisture from the fondant, and thus help the fondant to retain its gloss.

To prepare this jelly, take a 10 lb. tin of apricot pulp and rub it through a fine sieve to remove all the stringy matter. Place the sieved pulp in a copper pan and add 10 lbs. of sugar to it, and boil the whole for fifteen minutes. The sugar must all be dissolved before allowing the mixture to boil. The sides of the pan are washed down occasionally to prevent crystals of sugar from forming. It should be stirred only occasionally during boiling. Any scum that rises to the top is taken off, and when ready the jelly is run into suitable sterile jars and covered until required for use.

When using apricot purée, a little of the jelly is placed in a copper pan and heated to the thread degree. To test for this, take a little between thumb and forefinger, and if it threads easily it is ready. The purée should not be beaten or worked overmuch during this second boiling, otherwise it will become cloudy and useless for covering meringue goods or for decorative purposes. Care should be taken when testing to get the correct consistency, because if too thin it will tend to soak into the goods instead of setting as a jelly on the top, and if over-boiled it will be tough and leathery and become discoloured. The purée may be coloured as required for decorating or covering meringue fancies, or used as a jelly after flavouring with fruit flavours.

Preparation of Icings, Fondants, Etc.

Cornflour Jelly

When a confectioner has made open fruit tarts or flans, he finds it necessary to cover them over with some type of jelly to enhance their appearance and also to preserve the fruit. Apricot purée, which has been coloured and flavoured to match the fruit, is sometimes employed for this purpose, but often the confectioner prefers a jelly made with cornflour and mixed with apricot purée. To make this jelly the following ingredients are required :

2 pints water.	2 ozs. cornflour.
1 lb. sugar.	2 lbs. apricot purée.
Colour and flavour.	

The water and sugar are brought to the boil in a copper pan ; then the cornflour, which has been mixed with a little of the water, is added and the boiling continued. The apricot purée is then added, and the whole is brought to boil again. Finally, the necessary colours and a suitable flavour are incorporated.

Arrowroot Jelly

Another very useful jelly for covering fruit flans and tarts is made from arrowroot. The following ingredients are required :

3 pints water.	2 lbs. water.
4 lbs. sugar.	1 teaspoonful orange colour.
$\frac{1}{2}$ lb. arrowroot.	1 teaspoonful carmine colour.
Strawberry essence.	

The water and sugar are boiled together in a copper pan. The arrowroot is mixed with the remainder of the water and then added to the boiling sugar solution. The whole is boiled together for five minutes, when it will be quite thick. The colours and flavour are then added and the jelly is ready for use. This is the jelly generally employed for covering strawberry tarts when the strawberries are in season. It is applied while still hot.

Many other types of jellies are used by the confectioner, but those given above are sufficient for most purposes. If they are required to set firmer, a little gelatine can be added ; for instance, in the case of the arrowroot jelly, one can add up to 4 ozs. gelatine, which has been soaked in 2 pints water, and obtain a jelly that will set firm.

Fondant

Fondant is employed as a covering for small and large cakes, and also in making creams for chocolate centres. It is used on cakes

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because it is easily applied, sets quickly, and has an attractive glossy appearance. It is prepared from sugar and water, with an addition of glucose or cream of tartar. Most confectioners buy their fondant ready prepared from the factory.

In preparing fondant for covering cakes, the required amount is placed in a pan and heated over hot water, to not more than about 100° F. If over-heated the crystals redissolve, and on cooling re-crystallise into larger crystals, which do not reflect so much light, and thus the gloss is spoiled. If it is under-heated the fondant will not set firm, but will be sticky and runny. The material should be heated carefully to 100° F., stirring continuously, then thinned down to the required consistency with stock syrup and used immediately. It can be coloured and flavoured as required by the addition of liquid colours and flavours.

Chocolate fondants should be prepared by the addition of 4 to 6 ozs. melted unsweetened block chocolate and 1½ gills syrup per pound of fondant, since this gives the best flavour. If scraps of fondant are used to make chocolate fondant, as is often done, it cannot be expected to give such good results as the fresh material. Fondant made with glucose is better for use on fondant-covered goods than that made with cream of tartar. The latter is creamier and better for use in fondant cream centres. Fondant pots should always be scraped down and covered with a damp cloth or plaster of Paris cover when not in use, in order to prevent the formation of a skin. (See also page 62.)

Butter Creams

Butter creams are used by confectioners as decorative agents, and also for sandwiching purposes in place of fresh cream. The butter creams used for sandwiching should be much lighter than those for decorative purposes. The latter must be firm enough to keep any desired shape that is given to it on the tops of cakes. The following butter cream is generally adopted for decorative purposes :

1 lb. butter.
1½ lbs.-icing sugar.
Vanilla essence.

The butter should be rubbed down in a bowl until smooth, then beaten to a cream, after which the sifted icing or pulverised sugar should be gradually beaten in and flavoured with vanilla. Any desired colour and flavour can be used with good effect. Some confectioners add a little condensed milk to makè it lighter, or about

Preparation of Icings, Fondants, Etc.

1 gill of egg whites. Either of these well beaten in will make a lighter cream.

There are various light butter creams used as fillings, known as meringue butter creams. The following ingredients are used to make this type :

1½ lbs. butter.	½ pint egg whites.
1 lb. lump sugar.	½ lb. castor sugar.
1 gill water.	Vanilla essence.

To make this cream, an Italian meringue is made first by whisking up the egg whites and castor sugar in a bowl, boiling the lump sugar and water to 245° F., pouring this syrup over the whites, and whisking continuously until light and cold. The butter is then creamed and blended into the meringue, and the flavour added. More or less butter can be creamed and added to this meringue as required.

A very light cream filling can be made with marsh-mallow, egg whites, butter and milk. Take 3 lbs. marsh-mallow, and beat up in the machine with 3 gills egg whites until a light but stiff foam is formed. Cream up 3 lbs. butter with a tin of condensed milk and blend into the marsh-mallow. Flavour as required.

A light cream which can be used for either filling or decorative work is made with fondant and butter. Take 2 lbs. fondant and heat over warm water to 100° F. Thin down if required with a gill of stock syrup. Cream up 2 lbs. butter and gradually cream in the fondant. This gives a very smooth product which can be coloured and flavoured as desired, and either used as a buttercream or as a covering for cakes in place of fondant.

American Icing

A very bright pure white or coloured icing is sometimes used to cover gateaux and cakes. This is made from the following recipe :

½ pt. egg whites	} Whisk to a stiff foam.
½ oz. salt	
Vanilla essence	
4 lbs. lump sugar	} Boil to 240° F.
1 pt. water	
½ oz. cream of tartar	

Pour the boiled sugar solution over the foam and whisk the mixture until light. Just before it grains it should be poured over the prepared gateaux or cakes.

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Royal Icing

Royal icing, or glacé royal, as it is sometimes called, is prepared with egg albumen, icing sugar, ultramarine blue, and acetic acid. Egg whites may be used, but the dried whites reconstituted give more satisfactory results, as the icing made from these usually dries whiter. The bowls and spatulas used for making royal icing should be perfectly clean and free from grease. The sugar should be carefully sifted through a fine sieve to take out all hard lumps. About 7 lbs. of icing sugar are required to each pint of egg albumen. Two-thirds of sugar should be added to the albumen ; mix together, add a pinch of blue on the point of a knife and a few drops of acetic acid. Beat the whole up steadily until it stands upright when the beater is withdrawn ; then stir in the remainder of the sugar ; scrape down the sides of the bowl, cover over the sugar with a damp cloth, or preferably a plaster of Paris covering, otherwise the icing will soon go hard and gritty on top. The addition of acid helps to toughen the albumen, but too much should not be used, as it makes the icing very hard and brittle when dry. Icing for covering a cake is best made without the acid, as then it will not set too hard and will eat mellow. The blue is added to make the icing appear whiter, but if it has to be coloured afterwards, other liquid colours can be used instead of the blue. The icing for coating purposes is reduced with a little albumen to a thinner consistency than that required for piping. The addition of a little glycerine will help to make it eat softer or more mellow ; 1 gill glycerine to the icing made from 1 pint albumen is the correct proportion to use. It is added when the icing is ready for applying to the cakes. Coloured royal icing should have no acid added to it.

Fondant and royal icing are sometimes mixed in equal proportions for coating birthday and Christmas cakes. The fondant is heated in the usual way, then the properly prepared icing is added to it. This gives a nice mellow eating icing which sets firm and yet has a satisfactory gloss.

Artificial Cream

With the introduction of the Artificial Cream Act of 1928, all cream other than that obtained from fresh milk must be labelled artificial cream.

This necessitates the labelling of all containers in which emulsified cream is sold, but as far as the baker is concerned, who uses the

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cream as fillings in cakes or for consumption in his restaurant, the Act does not apply so long as it is not sold as Fresh Cream.

Emulsified cream or reconstituted cream is produced by taking a high grade 100% soluble milk powder produced by the spray process and dissolving it in water. This produces reconstituted milk (such milk is largely sold in America). To this a high grade unsalted butter of low acidity is added, and the mixture heated to 145° F. and maintained at this temperature for not more than thirty minutes. During this time the butter particles are distributed in the milk by means of a suitable agitator and the whole mass is pasteurised. Now the mixture is passed through the emulsifier, and the cream produced is cooled down to about 40° to 45° F. and then placed in cold storage. It is generally kept twelve hours before being used, although it is suitable for use immediately, and if the butter fat content is sufficiently high it will whip readily.

Such cream is many times purer than fresh cream from a bacteriological view-point; it possesses the same vitamin content as fresh cream, has a perfect flavour, and will keep for a longer period, providing a good quality butter has been used.

The following mixing will give a cream of approximately 42% butter fat content, but by increasing or reducing the butter used the fat content is proportionately increased or lowered as required.

5 lbs. butter	}	Heated to 145° F. for thirty minutes.
4 lbs. water		
12 ozs. milk powder		

Stabilising agents, such as agar-agar or gelatine solutions, lecithin, or promulsion, are employed to stabilise the emulsion.

Gum Paste

For modelling purposes a paste made of icing sugar and gum is required. Gum tragacanth is the one generally employed for this purpose. 1½ ozs. of flakes are soaked in a pint of cold water for about twenty-four hours. The jelly formed is passed through a muslin cloth to remove impurities and hard pieces of gum. Icing sugar and cornflour in the proportions of 14 ozs. sugar to 4 ozs. cornflour are then worked into it until a firm paste is made. About 8 lbs. sugar and cornflour are required to the above quantities. Blue is also added during the doughing stage, and sometimes some royal icing to make it smoother and produce a better colour. Other colours can be added as required.

Powdered gum tragacanth can now be bought, and if this is added

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to firm royal icing it will make a firm, smooth paste which can be easily moulded.

A modelling paste, which does not set so hard, can also be made with gelatine. Soak 2 ozs. gelatine in cold water for one hour, boil up 1 gill of water and 1 lb. of sugar and $\frac{1}{2}$ lb. glucose ; remove from the fire and add the gelatine. Dough up with about 7 lbs. of icing sugar and add during doughing about 1 lb. of royal icing.

Marshmallow creams stiffened with icing sugar are now also used as modelling pastes.

All of these gum pastes should not be too stiff, otherwise they become short and break easily and would be difficult to handle or roll out. The pastes dry readily on exposure to the air, and therefore should be kept moist, under cover. The paste should be dusted with cornflour when using for modelling to prevent it sticking to moulds. It is used in the preparation of plaques and moulded decorations for cakes, and is useful for the reproduction of models for window attractions.

Continental Butter Cream

Another very smooth butter cream for either filling or decorative purposes is made as follows :

Boil up 2 lbs. sugar, 1 lb. glucose, and $\frac{1}{2}$ pint of water to 240° F. Whisk up $\frac{1}{2}$ pint eggs until light and add the boiled solution slowly ; continue whisking until light and cold. Cream up 3 lbs. butter and stir into the mixture ; then flavour and colour as desired.

A Marshmallow Cream

Marshmallow creams are made with either gelatine or agar-agar. This makes quite a good mixture. Make a solution by dissolving 2 $\frac{1}{2}$ ozs. of agar-agar in $\frac{1}{2}$ gallon of water for twenty-four hours. Boil together 12 lbs. sugar, 2 lbs. glucose, and 3 pints of water to 240° F. ; then add the agar-agar solution and heat to 225° F.

Make a meringue of 3 pints egg whites and 1 lb. sugar. Add the solution and whisk until very stiff. Store away when ready.

When using this to make a marshmallow meringue for fancies or gateau decoration, add 1 pint egg whites to 4 lbs. marshmallow and whisk until light.

Marshmallow is often used to produce good cream fillings and buttercreams. The following recipe makes an excellent creamy filling :

Preparation of Icings, Fondants, Etc.

4 lbs. marshmallow	} Beaten to a meringue.
1 pt. egg whites	
4 lbs. unsalted butter	} Beaten to a light cream.
1 lb. milk powder	
Vanilla essence	

Blend the meringue into the cream, and it is ready for use.

The marshmallow meringue made from 4 lbs. marshmallow to 1 pint egg whites is often used to blend into whipped cream in varying quantities to make a very light creamy filling. It also acts as a preservative on the cream.

Synthetic "Cream" without Milk.—Confectioners, and others who wished to produce synthetic cream in past days, have used unsalted butter or unsalted margarine with milk and milk products, as these made the production of an emulsion easier, and affected the whipping properties.

Since there is a shortage of milk and milk products the Ministry of Food has prohibited the use of them in synthetic cream for commercial use. The research bakeries of our allied traders have tried to overcome this difficulty, and after extensive experiments have developed the following formula, using only permitted ingredients. The cream produced whips well and is quite satisfactory.

The following will make about 1 gallon of synthetic cream :

- 6 lbs. water.
- 6 ozs. cornflour.
- 3½ lbs. unsalted margarine or cooking fat.
- ½ gill egg yolks.

Make a paste of the cornflour and a portion of the water. Boil up the remainder of the water, add the cornflour paste, and cook until it gelatinises, but keep stirring to prevent it burning or forming lumps.

Cool the mixture to 150° F., and add the melted fat slowly to it while stirring. When the mixture reaches 130° F., add the egg yolks and pass through the emulsifier. Store the emulsion in a refrigerator for some hours before use. Whisk up to the consistency of whipped cream while it is still cold.

Cake Decoration without Sugar.—The Sugar Restriction Order prohibits the use of sugar, fondant, etc., for the exterior decoration of cakes, etc., but it permits the use of chocolate, jams, jellies and fruit curds as decoration agents for cakes. A well-known research bakery published some time ago the following method of making the best possible use of jams, jellies and fruit curds as substitutes for sugar icing.

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For attractive cake decoration, more than the mere application of the jam or jelly as it comes from the jar is necessary. An attractive covering agent must have a fine surface, free from lumps, not too shiny, but with some body and easy handling properties. The preparation of such a decorating agent must be comparatively simple and quick.

These conditions are all satisfied by what is termed the "Jam Meringue" method.

Jam or jelly is whipped up on the cake machine with egg albumen in the proportion of 1 oz. egg white to 1 lb. jam or jelly. The result after about ten minutes' beating on the fast speed is a stiff jam meringue, with about four times the volume of the original jam or jelly. It has much less colour, through the incorporation of so much air.

This jam meringue makes a very good cake covering, and is an excellent substitute for butter cream. It has sufficient body for all masking purposes or for piping through either plain or star tubes, and it retains the form in which it is piped out.

It can be treated like a boiled meringue, if desired, and piped out in a bold design and flashed in a very hot oven to give it a slightly toasted surface, attractive in appearance, and more easily handled than when not toasted.

The advantages of this method of decorating cakes are that it makes the best use of some of the available cake covering agents allowed, also it is easy to work and economical. It is attractive to the eye, and more palatable than untreated jam or jelly when used as cake decorating materials. It can also be used for sandwiching purposes.

Jelly Meringue.—The same research bakery have also published the following method of making a "Jelly Meringue" for the decoration of cakes.

Piping jelly	- 2 lbs.	Bring to the boil.
Leaf gelatine	- $\frac{1}{2}$ oz.	Soak thoroughly, add to the boiled piping jelly and allow to cool.
Egg white	- 4 ozs.	Add and whisk for about 10 mins. at fast speed or until a stiff meringue is obtained.

This meringue should be used as soon as possible after making, and should be kept turned in the machine on slow speed until all of it is used. This jelly meringue will set quite firm in a few hours, but should not be packed for at least two days.

CHAPTER XXI

BAKEHOUSE MACHINERY AND PLANT

THERE are very few bakehouses today which are devoid of machinery, the smallest generally having a cake mixer, while the large ones have many other types of machines installed.

Those in general use in confectionery bakehouses may be divided into :

1. Cake mixing and sponge making machines.
2. Machinery such as depositors and pie machines which are necessary for mass production.
3. Ovens, with special reference to travelling ovens and the attachments for mass production.

Cake Mixing Machines

There are many types of mixers, some which are only suitable for cake making, whilst the more modern types can be used for both cake making and sponge whisking.

The universal mixer and the new " Baker " cake machine are representative of this class.

The " Baker " machine is of very strong construction, and the trough is so arranged that the ingredients can be readily put in and discharged.

The cake beaters are for mixtures containing butter or fats, and are so constructed that they will mix into the mass any kind of fruit without damage. The whisk beaters are for sponges, meringues, and other light batters. The beaters are readily interchangeable, thus giving access to the interior of the trough for easy cleaning after each operation.

An automatic safety lid is fitted to the machine as part of the standard design to meet the requirements of the Home Office, Factory Department. Two speeds are provided, the high for mixing light batter, and the slow for mixing in the flour, fruit, etc.

All gearing is totally enclosed and the machine can be supplied either for pulley drive or direct drive by electric motor.

The machine is made in four sizes with capacities from 65 to 560 lbs.

The " Nuovamixa " Whisking Machine.—This is a machine suit-

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able for all whisking purposes, but is mainly used for small sponges and flour batter sponges and possesses unique features.

The machine is massive in construction, is very compact, and neat in appearance. The driving mechanism is fully enclosed, but can be exposed for inspection by removing a one-piece cover on top of machine.

The machine base is flush with the floor without any holding-down bolt projections. All exposed metal parts are nickel-plated, and the whole design allows of easy cleaning.

Full self-aligning ball bearings are fitted throughout, and are capable of withstanding ten times the normal load required. All power shafts are made of extra high tensile steel, the main beater shaft being of specially tough oil-treated steel.

The bowl raising and lowering apparatus is very simple. In operation the mixing bowl, which is mounted on ball-bearing castors, is run into place in front of the machine in any position, and the turning of a hand-wheel automatically locks it in the correct working position: the bowl is then raised for the mixing process. After the mixing or whisking is done the hand-wheel is again turned, thus lowering and unlocking the bowl, when it can be taken away at the floor level. No effort is needed to turn the hand-wheel, as the bowl holder is counter-balanced. There is thus no necessity to lift the heavy bowl, with its contents, into the machine frame; this is an important point.

The mixing bowl is held rigidly so that it does not revolve, and the bowl itself, which is of tinned steel, is of relatively large diameter compared with the depth, so that a large whisk beater can be used, giving a greater working area, and thus securing improved mixtures in quicker time than would ordinarily be the case.

The beater coupling comprises a double bayonet pin, which rigidly holds it in position without any locking device, and consequently there are no projections on the beater head, thus obviating danger to the operator.

The whisking motion is on the Cadisch principle, but in addition a planetary motion is provided which causes the beater to revolve on its own axis at an angle from the vertical. This angular planetary movement gives the highest possible whisking and aerating results, as the ingredients are continually raised from the bottom of the bowl towards the side, thus ensuring no dead spots in the bowl during the mixing.

It is a well-known fact that a sponge mixing requires just the correct period of mixing as well as the correct speed of whisking,

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and the starting speed should be greater than the finishing speed. The "Nuovamixa" meets these points, there being automatic stopping and speed regulating controls. It is an easy matter to set the machine to stop automatically after any period of mixing from two to forty minutes, whilst the speed of the whisking can also be set automatically so as to vary to any degree during the mixing process. This arrangement is particularly useful when a battery of machines is operated by one attendant. The machine is set by moving two dials showing the desired mixing time and speeds, and the operator starts the machine by simply pulling a lever. The machine then works automatically, regulating its own speed, and stops when the batch is finished. When required, these devices can be rendered inoperative by pressing a button, and the machine goes on working in the ordinary way until stopped. Once the machine is set, no resetting is necessary.

A special and simple variable speed gear is provided, whereby the speed can be regulated whilst the machine is running, and this dispenses with the necessity for a gear box. The machine can be started at any number of revolutions, and run up to the highest or down to the lowest speed in a few seconds.

Lubrication is effected automatically from one supply only, and there is no risk of any oil escaping into the mixture.

The machine is designed for direct motor drive, the motor being mounted on a base which forms part of the machine standard, and drive is effected by means of pinion and spur wheel. The starter is housed under the motor at the back of the machine, and a no-volt release is built into the frame-work. As all adjustments can be carried out at the front of the machine, considerable floor space can be saved when more than one machine is installed.

The following equipment is supplied with the machine :

- One 80-quart and one 40-quart bowl.
- One large and one small sponge whisk.
- One large and one small flat cake beater.
- One dough arm.

"Melvin" Three-Speed Cake Machine.—For the varying mixings required in the confectionery bakery today this machine is specially adapted.

It will rub and thoroughly mix butter and sugar, and will finish the mixing of slab cake, etc., as well as the lighter mixings, such as sponges, egg whites, etc.

The standard equipment of each machine comprises two steel bowls, one 9 gallons and one 20 gallons capacity, with sponge whisk

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and cake beater for each bowl, and also a dough hook for the large bowl.

Special care has been taken over the design of the clutch and gear box. Three speeds are provided, and gear changing is simple and noiseless.

The bowl in use for any particular mixing is fixed in the circular ring and the beater or whisk secured to spindle. The beater is revolved on the "sun and planet" principle, and is so arranged as practically to scrape the sides and bottom of bowl.

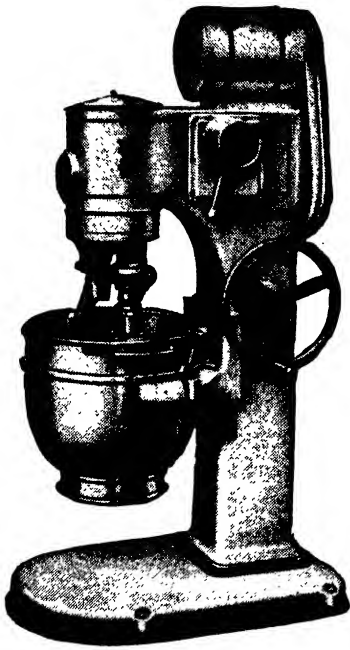


FIG. 8.—MORTON MIXER (HEAVY DUTY—50 QTS. CAP.).

Unlike other machines, it is not necessary either to raise or lower the pan or the beater. On completing mixing the beater is disconnected, a lever depressed, and the pan is swung clear of the machine. The saving of time by this method is obvious.

The Morton whisk is another machine of this type. It is three-speed machine. It has an exclusive feature in an automatic scraping device which keeps the sides of the bowl clean during mixing.

Such machines are fitted with variable speed motors, so that the three- or four-speed gear box is now eliminated. With alternating current this has been no easy matter, but has now been accomplished.

Among other types of mixers which are of an improved design are the Artofex, Peerless, Hobart, Ericsson, and Read machines. In the

Ericsson Mixer the gear box has been eliminated, and it is a very simple matter to change speed with just the movement of a handle, in a similar way to that employed on a variable speed motor, twelve speeds being available. Further, there are no oilers or grease caps to worry about.

With the **Artofex Mixer** some new features have been introduced. In the old Ovamixer there was an inclined, vertical planetary action, whilst in other mixers the spindle to which the beaters were attached was vertical, giving a vertical planetary action. Both these actions

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are considered to have different advantages as far as whisking and mixing are concerned. In this machine (Fig. 9) both these actions have been included, so that the user can utilise either action for the specific purpose found most efficient. With the inclined action, when a dough hook is used, a folding action is imparted to the dough,

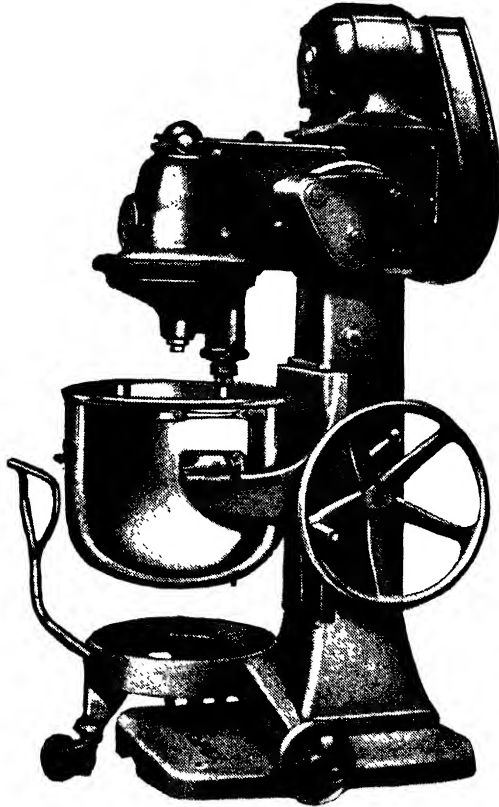


FIG. 9.—THE "ARTOFEX" CAKE MIXER.

and so develops the dough better, whilst for whisking a lifting action is imparted and efficient aeration results. The machine has four speeds, the gears being in permanent mesh, and speed change can be effected without noise and without throwing out the clutch. Consequently, speed change is fool-proof. The larger machines (80 quarts) are fitted with a trolley, as in photograph, in order that the hard work and extra wear and tear involved in lifting such a bowl is eliminated.

The Peerless cake mixer (Fig. 10) is of single unit construction

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made in four standard sizes, viz. : $12\frac{1}{2}$ qt., $12\frac{1}{2}$ -25 qt., 25-40 qt., 40-80 qt. The latest models have three speed, constant mesh preselective gear box, single lever gear control, Ransome and Marles ball bearing throughout, and complete automatic lubrication. The quick acting bowl lift is very convenient..

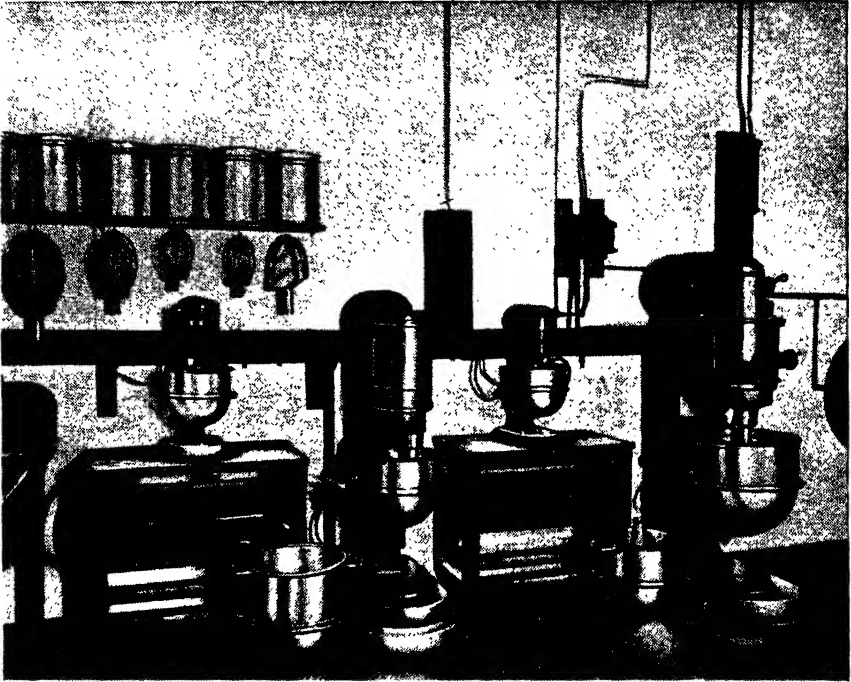


FIG. 10.—A RANGE OF PEERLESS CAKE MACHINERY.

Everything is enclosed—not only the motor, which has ball bearings, but all moving parts—so that dust cannot penetrate, nor lubricant work through.

Morton Pressure Whisk.—This is a new departure in sponge working machines, and the machine is of the stationary type. It embodies the familiar Morton whisk in the centre container, and has two hoppers, one at each side, by means of which the eggs and sugar are fed into the mixing compartment. The reason for having two hoppers is to prevent the sugar becoming wetted by the eggs, and so producing a stoppage in the hopper. The larger machines are motor driven, and there is an air compressor embodied in the structure. With such machines it is not necessary to remove the

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lid until the end of the day, since there is fitted an ejector valve through which the batter can be ejected when sufficiently whisked. The compressor is fitted with an automatic regulator, which is set and locked to ensure that the pressure will not rise above what is required to work the machine. There is also fitted a safety valve on the air receiver and a special type of safety cock on the machine itself, by means of which the lid cannot be removed unless the cock is open to allow the air to escape. Pressure gauges are also fitted on all machines in order that the working pressure can be observed.

The ejector valve is of the piston type. This is at the bottom of the container, so that when the valve is opened the pressure of air in the container ejects the batter into a bowl or mixing machine as required.

By means of this machine a sponge batter can be produced in three minutes, instead of from fifteen to thirty minutes, whilst an increased yield of 10% is claimed because of the more efficient aeration. The sponge produced has a very fine even texture of great uniformity. They are built in many sizes from 5 to 75 quarts.

Hobart mixers are made in various standard sizes to suit individual requirements. There are bench models of 10 to 12 qt. capacity and larger models ranging from 20 to 80 qt. capacity. The latest feature of these machines is the air compressor by which air is incorporated into the sponge while ordinary whisking action is taking place.

The air compressor A is on top of the machine. A tube leads from it conveying compressed air to the air chamber in the base of the mixing bowl.

The compressed air is introduced into air chamber, located immediately beneath assembly of circular metal discs, which are graduated in size, and pyramided one upon another.

These discs are held to-

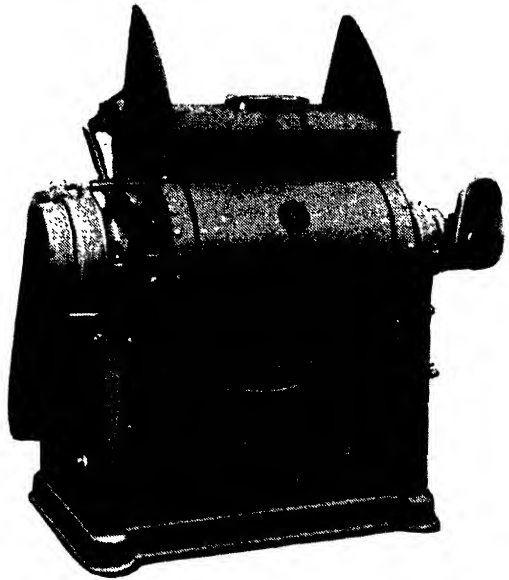


FIG. 11.—MORTON GRIDLAP MIXER FOR SLAB CAKES.

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gether under tension and each is scored with a multitude of hair line air tracts, through which air is forced and scientifically distributed throughout the sponge in million of infinitely small air bubbles. These tiny air bubbles are taken up and uniformly built into the sponge batters while the whip is performing its regular function. The resultant action of this machine is thorough aeration and mixing.

There is also an air whip attachment for the whipping of icings and meringues and a special unit for whipping cream.

Depositors and Pie Making Machines

Amongst the various machines useful in mass production there are the following :

Baker Copland Patent Cake Depositing Machine.—This machine

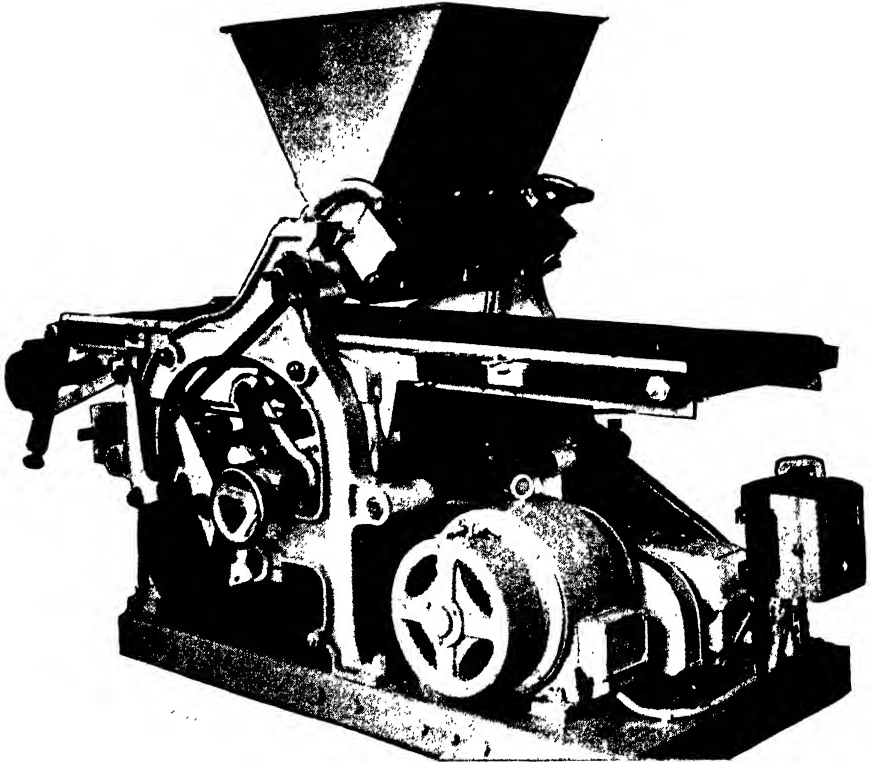


FIG. 12.—THE BAKER COPLAND DEPOSITOR.

(Fig. 12) deposits automatically given quantities of cake batter into shapes which are passed underneath the hopper.

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Any size of cake up to 7 lbs. in weight is deposited with perfect accuracy. If the batter contains fruit, the latter is deposited without being crushed in the process and is distributed evenly throughout each cake.

Besides large cakes, the machine can be used to great advantage in filling sponge sandwich tins and fancy shapes, laying out sheets of Swiss roll, and making eclairs.

The changes necessary to alter the weight or shape of cakes are simply made, and the machine can be thoroughly cleaned out in two minutes.

The lightest batter is not "worked" in the slightest degree. The action of the machine is so designed that a cake made by it is really lighter in consistency than one made by hand, because of the modifications in the mix employed.

The machine can be arranged to produce biscuits as well as cakes. Fig. 14 shows the range of products made with this machine.

It can also be mounted on a bedplate with wheels, with a motor and speed reducing gear complete. This enables the operator to run the machine under the mixer, and then, when charged, to run it close up to the oven.

This type of machine is made in two sizes to take pans 18 to 20 and 26 inches wide, and various dies are provided to meet any depositing requirement.

The Jam Fantafilla.—A very useful machine for rapidly and continuously depositing uniform quantities of jam on to sponge sandwiches, tarts, etc., is the jam fantafilla, which is built on the same principle as the well-known standard chocolate fantafilla, the essential difference being that the container is of special shape, is not jacketed for heating, and has no stirrers.

The container is of copper, $17\frac{1}{2}$ inches diameter at the top, tapering to $12\frac{1}{2}$ inches at the bottom, and is $12\frac{1}{2}$ inches deep. It is tinned inside, and has a capacity of 80 lbs. jam to within 1 inch of the top.

The working parts inside the container are constructed entirely of gun-metal, with the exception of the cut-off valve, which is of stainless steel.

The machine normally works at twenty-five deposits per minute, but it is capable of working at a higher speed provided the girls can handle quickly enough the goods on which the jam is to be deposited.

The deposit can be varied from $\frac{1}{2}$ oz. to a maximum of $4\frac{1}{2}$ ozs.

The jam fantafilla will measure an exact quantity of jam to any required setting of the pump, and when deposited the operator

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merely has to spread it over the sponges ; but when tarts are in question, the jam is simply deposited into the middle.

The jam fantafilla is so constant that a very large quantity of jam can be saved as compared with hand work.

Usually the machine is arranged for motor drive, but, if necessary, it can be built for belt drive.

Pastry Brakes.—Pastry brakes (Fig. 13) in general are designed to effect the simplest possible reversing movement, allowing the dough to pass backwards and forwards under the rollers without stopping

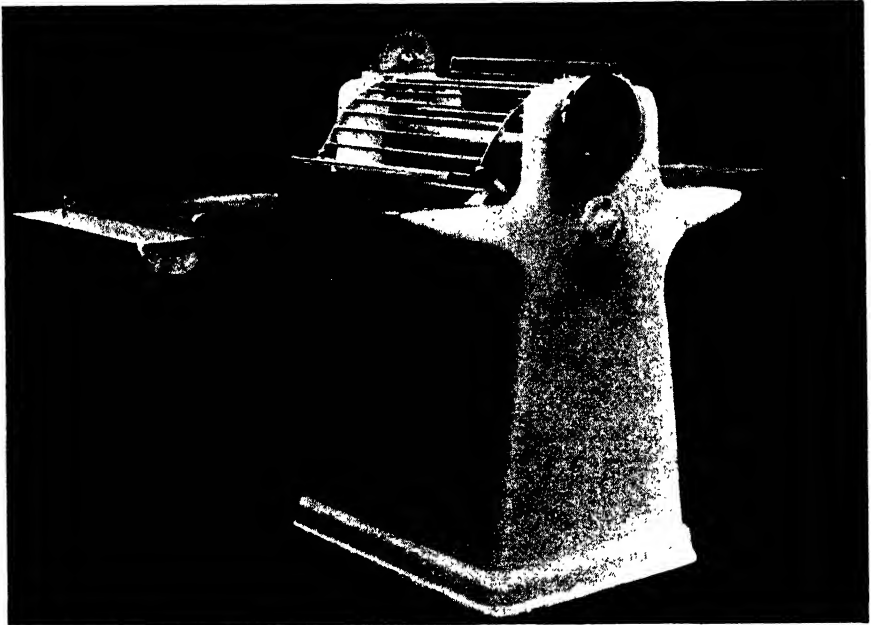


FIG. 13.—THE BAKER PASTRY BRAKE.

the motion. A short movement of the reversing lever at the side of the machine instantly changes the backward or forward movement of the dough, and the folding of it produces perfect regularity and smoothness. The machine is provided with an index wheel for gauging the thickness of the sheets of dough, and all the latest improvements yet applied to brakes, including an efficient safety guard.

The machine is mounted on a strong iron frame, and is so constructed that the friction is reduced to a minimum.

The tables are made of cast iron or stainless steel.

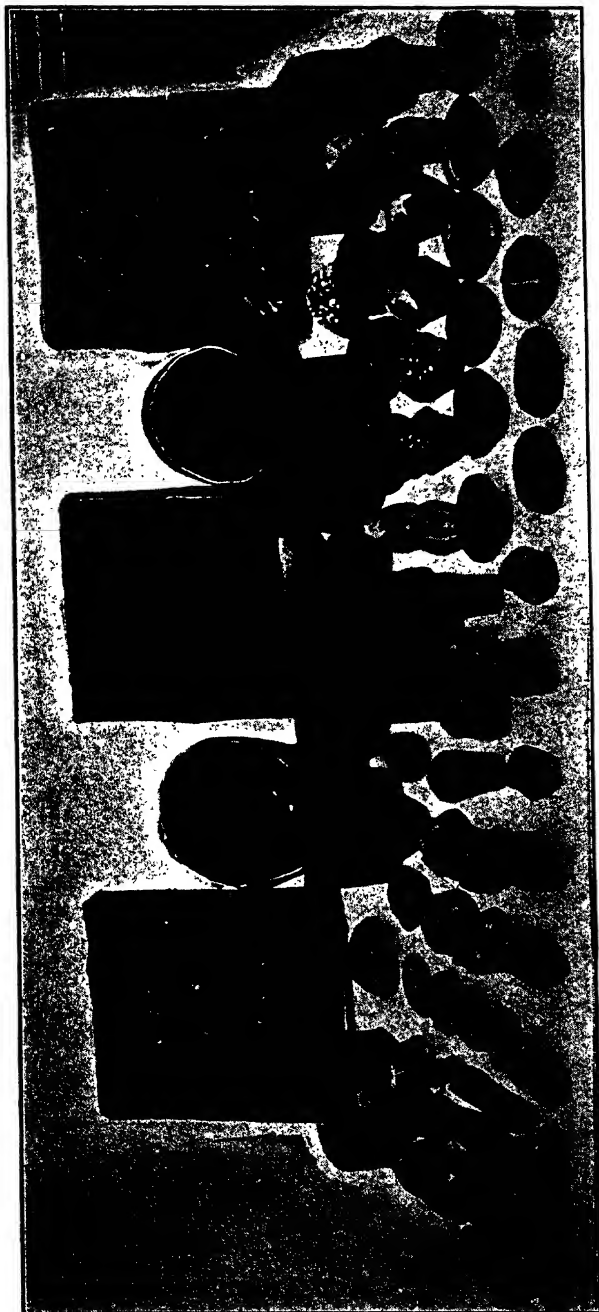


FIG. 14.—GOODS MADE BY DEPOSITING MACHINE.

Cake Manufacture

The Baker Perkins machine is also fitted with flywheel and handle for hand operation, and is made in the following sizes :

<i>Size</i>	<i>Rollers</i>	<i>Drive</i>
1	18 inches long by 5½ inches diameter	Hand
2	20 " " 5½ " "	"
3	22 " " 5½ " "	Hand or power
4	20 " " 6 " "	" "
5	22 " " 6 " "	Power
6	24 " " 6 " "	"
7	22 " " 7 " "	"
8	24 " " 7 " "	"

“Tornado” Fruit Cleaner.—When dried fruit reaches the confectioner it is dirty, and therefore requires washing. The trouble has always been to wash the fruit without leaving it wet and unfit for storage. The “Tornado” fruit cleaner (Fig. 15) solves the difficulty, as in it the fruit is actually washed, and therefore thoroughly cleaned. The fruit does not remain soaking in water, and it is so completely dried that it may be stored almost indefinitely without ill-effect.

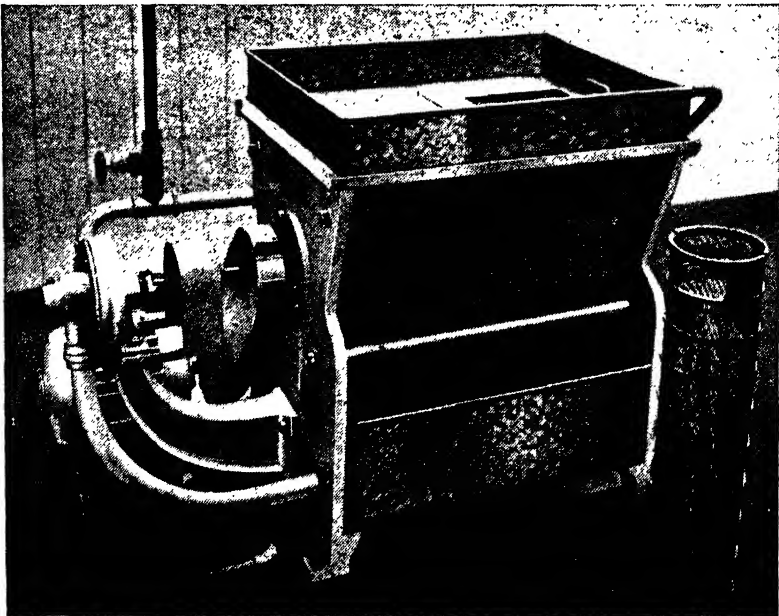


FIG. 15.—THE “TORNADO” FRUIT CLEANING MACHINE.

Bakehouse Machinery and Plant

In operation the fruit is put into the galvanised iron hopper shown on the top of the machine, and lumps are broken and the fruit freed as it passes through the grid, where it meets a high-feed spray of water which drives the fruit over a series of "steps". Any stones, being heavier, drop into the angles of the "steps", and during the fraction of time that the fruit remains in the whirling spray each berry is rolled over and over and thoroughly washed. The washed fruit, stalks, and dirty water then pass over the bottom step into a drying cylinder, the mouth of which is at the opposite end of the machine to the steps. The cylinder is made of tinned steel, and inside it are revolving blades, which take the fruit along the inner walls of cylinder. The blades work at about 1,000 revolutions per minute, and throw off the water and stalks between the rods of the cylinder. The swiftness of the rolling action begins to dry the fruit, and this is completed by the rubbing action between the blades and the rods of the cylinder as the fruit passes round. It will be appreciated that the action is a rubbing one, and not a beating one, so that the fruit is in no way knocked about, but is, in fact, brought up to shape. The action of the blades takes the fruit along the cylinder, and it is discharged at the other end. The water is collected in the tank at the bottom of the machine, this tank being provided with an efficient strainer, and the water is recirculated through an independent pump, a suitable valve being provided for the water service. The "Tornado" fruit cleaner takes about 2 to 3 h.p. to drive, and has been designed to admit of easy dismantling and cleaning. The pump is built outside the machine, and is connected to it by a flexible coupling. Two cylinders are supplied with each machine, one for currants and the other for larger fruit.

In practice it has been found that 6 to 8 cwt. of fruit in the worst condition can be washed and dried per hour in the "Tornado", whilst at least a ton of loose currants in good condition can be put through in the same time.

Emulsifiers.—Emulsifiers are almost a necessity in a bakehouse of any size today. A distinct impetus was given by the Preservative Regulations of 1925, and since then many machines have been installed, not only for making cream, but also for emulsifying oils, fats, and milk in the production of ordinary aerated goods, custards, ices, and cheap slab cakes. The action of the emulsifier is to reduce the particles of butter or fat to approximately the same size as those of water, as a result of which they remain distributed with them and so produce an emulsion. When a perfect emulsion is obtained no separation takes place, and in order to produce such emulsions a third substance,

Cake Manufacture

known as a stabiliser, is required. For this purpose milk powder is generally employed with agar-agar or gelatine solutions, lecithin, or promulein. On these machines cream of a definite butter fat content can be produced.

Pie Making Machines.—There are many varieties of these machines, and Fig. 16 shows the new Ericsson "O-Matic". This is a machine designed for the automatic raising and moulding of pies, tarts,

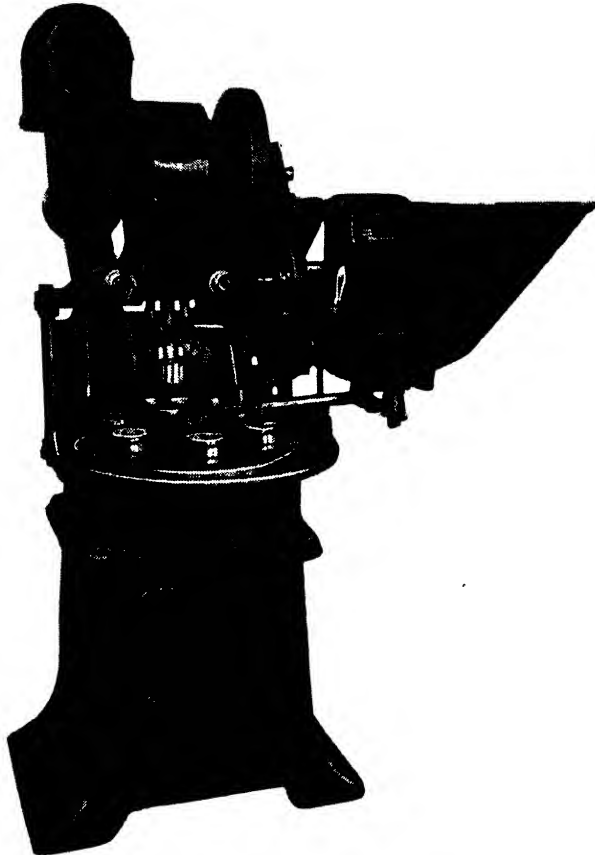


FIG. 16.—ERICSSON "O-MATIC" PIE MAKING MACHINE.

custards, etc. It can be supplied with filling attachments to deposit viscous fillings so that a series of operations can be carried out for the production of any particular article. It has a capacity up to 2,000 articles per hour and is fitted with a safety clutch to avoid accidents. The dies are interchangeable and can be used cold or electrically heated. The machine will raise paste in tins for articles

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of any shape up to 6 ins. in diameter by 3 ins. high moulding, gimping and cutting a clean edge all in a single operation.

There are many other varieties of machines, small and large ones ; hand and power operated, for the small and large trader. Some have gas-heated dies whilst others function in the cold. The object of all types however is greater production of articles which are uniform in appearance and which have not been touched by hand during the manufacture. The use of such machines means more hygienic production of foods, a very necessary factor, especially where large-scale production and distribution demands perfect keeping qualities. With the different types of machines, the kind of paste used must be altered to suit the machine, but guidance is always obtainable when such machines are purchased.

The "Zenith" meat scaling-off machine (Fig. 17) is capable of scaling off meat and depositing it in the cases at a rate of 2,000 portions per hour. Its use results in a regular distribution of meat.

In factories it is customary to work two multiple machines and a meat scaler in series, the first machine putting in the lining, the Zenith meat scaler filling this, and a further multiple machine putting the lid on and notching them.

Steel Band Travelling Ovens for Pies.—Various gas-fired ovens with steel bands have been installed in England for the specific purpose of baking pies with either pork, steak and kidney, fruit or other filling.

The variable baking time of these ovens can usually be adjusted from 20 minutes to 1½ hours, to suit the baking of any type of pie.

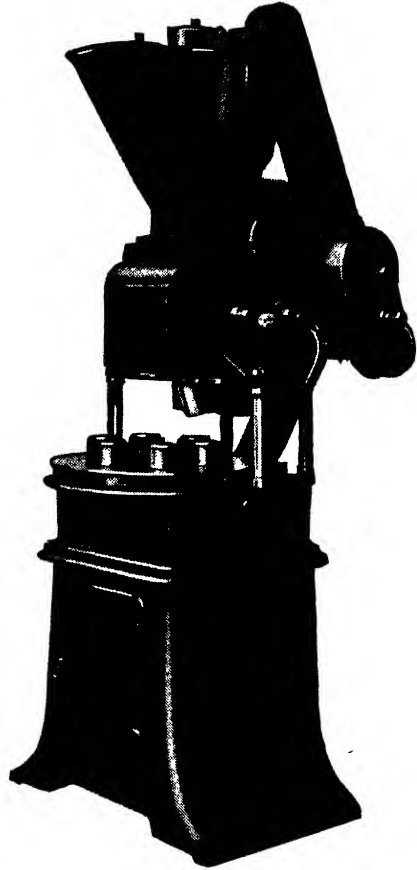


FIG. 17.—MEAT SCALING AND DEPOSITING MACHINE.

Cake Manufacture

Some of these ovens have been constructed with two bands one above the other in two separate baking chambers (Fig. 18), each deck having both top and bottom gas burners for accurate heat control.

The pies are shaped on an automatic Pie Moulding Machine (Fig. 16) which lines the tins with paste. The tins are then conveyed to a Scaling-off Machine (Fig. 17) where the meat or other filling is deposited into the paste linings. From here the tins travel

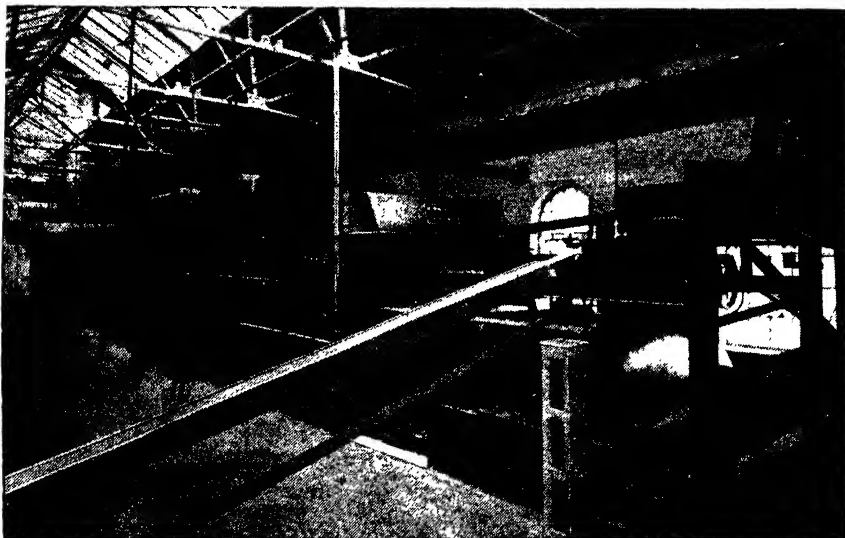


FIG. 18.—FEED END OF A PELKMAN DOUBLE DECK STEEL BAND PIE OVEN WITH ATTACHED AUTOMATIC COOLER WHICH CAN BE SEEN IN THE BACKGROUND.

to an automatic Lidding Machine before being fed to the oven on a conveyor band, from which they are automatically spaced directly on to the steel band of the oven. The pies are baked in the oven and then pass, on the same steel band, into the Cooler (Fig. 18) with its cool conditioned air.

The air is washed and purified and its temperature controlled before it is blown into the discharge end of the cooler, so that it travels both over and under the pies which have already been considerably cooled down, the draught then blowing towards the feed end of the cooler, gathering heat as it goes, until it reaches the hottest pies coming straight from the oven. The stream of conditioned air absorbs as much heat as possible, cooling the pies to a

Bakehouse Machinery and Plant

temperature at which they can be handled without damaging the crust, and which also allows jellying.

After cooling, the pies can be automatically demoulded and conveyed to the jellying and despatch departments.

The empty pie tins can be conveyed to the feed of the oven on the returning steel band on the top of the oven.

The output of this type of plant can be as much as 10,000 pies per hour.

Automatic Swiss Roll Plant

The past few years have seen many developments in the large-scale production of commodities which twenty years ago were the pride of the many housewives who specialised in the cooking of dainty cakes. One of these commodities, sold on such a scale as was never contemplated even by the greatest optimist, is the familiar "Swiss roll". As a result of the advertising which has been so successfully carried out there has been a continuous increase in the consumption of Swiss roll, a consumption which has by no means yet reached the saturation point.

In order to cater for this trade a new plant has been developed which is fully automatic. Previous plants have been produced having great outputs, but they were only semi-automatic, a considerable amount of labour being required in between the processes.

In the older method, which is now obsolete for large-scale production but still the general method for normal outputs in small bakeries, the Swiss roll was baked on special fine paper on baking sheets. The sponge batter was whisked in open whisking machines and then automatically deposited and spread on to the prepared sheets. These travelled through a gas-fired oven, and when baked were passed over cooling racks so as to be delivered cool at the tables. Here, the sheets of sponge were turned over and the paper was removed. This involved the use of much labour and the process usually resulted in the floor becoming heavily littered with torn paper and fragments of sponge.

With the development of conveyors, and especially of the steel band type, it has been possible to carry out the complete process of making Swiss rolls, from the preparation of the sponge batter to the wrapping and boxing of the finished product, without the removal of it from the conveyor and with the minimum amount of handwork, the operation being on the "line" or "flow" principle of continuous production adopted in so many industries.

Cake Manufacture

With the adoption of the steel band conveyor it has been found possible to eliminate much waste and to obtain much more hygienic production of this confection and in increasingly greater quantities. The conveyor carries the batter right through the ovens and is certainly a great forward step in baking practice, and considerable credit attaches to Baker Perkins, Ltd., and Mr. E. G. Ellis, who jointly evolved the process.

It is of interest to follow the process from start to finish and see how an endless piece of Swiss roll is obtained.

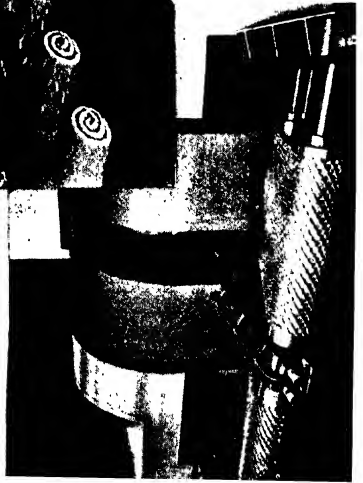
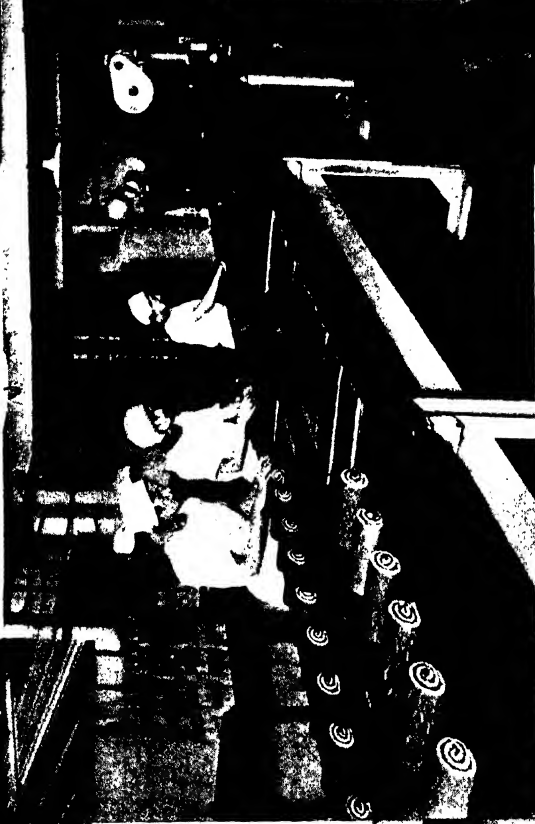
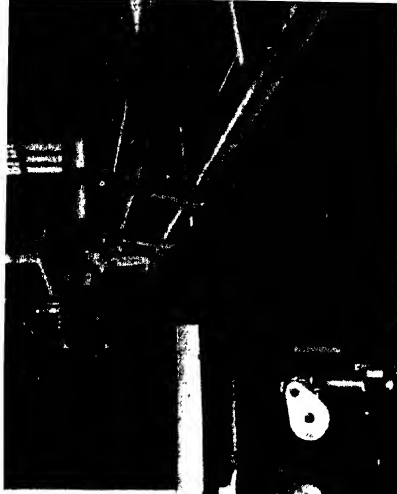
The sponge batter is produced by means of the Morton high pressure whisk, the operation being completed in this new machine in three minutes, compared with fifteen minutes on the ordinary vertical whisk machine. The value of such machines will be readily appreciated when it is realised that a continuous supply of batter is required. The batter from these machines is ejected by means of the compressed air which has assisted in the production of it; it is then transferred to the hoppers. From these hoppers the batter is deposited on the travelling steel band.

At the commencement of the oven conveyors the bands pass underneath special burnishing machines, by means of which they are scrupulously cleaned and polished—a most necessary factor in the production of any sponge goods. To each oven there are two conveyor steel bands of approximately 62-foot centres. These are 18 inches wide and travel at a speed of 10 feet per minute. The terminal drums are 36 inches in diameter.

After being burnished the bands pass under a greasing machine, where a mixture of flour and fat is placed on them by means of special brushes designed so as to produce a continuous film.

The batter is now fed on to the band, which has been preheated, in a measured uniform layer which can be controlled and to a width of 14 to 16 inches. This forms a continuous layer which is baked in the oven for about five minutes at a temperature of from 450° to 500° F. As it emerges from the oven as a correctly baked piece of sponge it is removed from the steel band by a suitably designed mechanism attached to the terminal wheel of the conveyor. This transfers it to fabric conveyors set at a decline so as to bring the two pieces of baked sponge on to the two main steel conveyors on the lower floor. During this process the sponge is reversed so that the baked surface is underneath and the spongy face is now ready to receive the jam or cream filling. These conveyors travel in the opposite direction to the oven conveyors. During its passage along these conveyors the sponge must be cooled down to a temperature

SWISS ROLL PLANT



- (1) TWIN STEEL BAND TRAVELING OVEN.
- (2) DELIVERY END OF OVEN. SPONGE TRANSFERRED TO CONVEYOR FOR COOLING.
- (3) JAM AND CREAM SPREADERS.
- (4) SPONGE CUTTERS FOR SMALL ROLLS AT END OF CONVEYOR.
- (5) HAND CUTTING AND ROLLING LARGE ROLLS.

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suitable for the spreading of jam or cream fillings, which have a fairly low melting-point.

In order to obtain this cooling, which is essential for good keeping qualities and freedom from mould, the conveyor is partially enclosed and a cooling chamber is constructed. On the efficient working of this there are two schools of thought. One considers that cooling down is the essential feature and loss of moisture is not to be considered, since the sponge should be made of such ingredients that it will have satisfactory keeping qualities, and therefore the possible loss of a small percentage of moisture, through the application of a forced draught, is not important. The second school of thought considers that the absolute minimum of moisture should be lost during this process, and so the humidity of the cooling air should be carefully controlled. This has necessitated a much more expensive plant, and practice alone will show which method is really best. From observations up to date, both Swiss rolls have good keeping qualities in the wax paper in which they are wrapped.

After cooling comes the spreading of the jam or cream. Here again there are two schools of thought, one preferring to weigh on to the sponge a definite number of ounces per foot of roll, whilst the other method is to deposit the jam in a similar way to that used originally for depositing the sponge batter. There is one objection against the second method, however, and that is that when a substance is being conveyed along a steel band it does not always run dead centre, so that if spreading is being carried out and the sponge is not fully spread then jam is wasted and labour must be employed to check such defects.

After the jam or filling has been spread the sponge ribbon is cut into pieces by hand operation, using a suitable gauging tool, and then the sponge is rolled into shape. From here by conveyor band they are transferred to an automatic machine which places the rolls in cardboard boxes, seals and wraps these boxes in wax paper, and at the same time recording the day of manufacture on them, so that in case of necessity each roll can be traced.

The daily production of such a plant is about 25,000 rolls, they have been a pronounced success and several are operating in London and the Midlands. They are used for producing both large and small Swiss Rolls of all varieties.

The steel conveyor is also used for baking small sponge cakes and sponge sandwiches, and with its introduction into the bakery a most hygienic method of handling, free from all risk of taint, rancidity, contamination, or spoliation by rough handling, has been made available.

Cake Manufacture

Ovens

It is not intended to deal with all the different types of ovens available ; for this the student is advised to consult such a book as *Bread Making : Its Principles and Practice*, by one of the authors, where a chapter is devoted to the different types of ovens generally used in bread bakehouses, which in turn are used by the confectioner.

There are, however, some types peculiar to confectionery bakehouses, and especially to factories where mass production of cakes, sponges, and biscuits is carried out. These ovens are for the most part gas fired.

Confectionery Travelling Ovens.—There are two main types of travelling ovens for confectionery, namely the Straight through and the “Swinging tray” Ovens.

Gas firing by multiple burners with the flame directly in the baking chamber is usually adopted for confectionery ovens. This method gives accurate control of both top and bottom heat along the whole length of the baking chamber and enables the baker to have any desired temperature at any point in the oven by lighting or turning-off burners at the required points. The greatest heat can thus be concentrated at either the feed or the delivery end of the oven to suit the goods being baked ; a marked advantage over peel and drawplate ovens where no such temperature variation can be economically exercised.

The ovens can be built to have the operating (control) side to suit the bakery layout. The drive usually incorporates a variable speed device so that the baking time can be quickly adjusted to suit a variety of goods.

The body of confectionery travelling ovens is usually constructed in steel, having double walls packed with insulating material. However, brick built ovens are not uncommon. They are all fitted with inspection doors to enable the operator to see the goods at various stages of baking. Oven lights, thermometers—and in some cases steam injecting pipes are also provided.

The gas burners are fed from a gas compressor which either simply boosts the gas from the main and allows for the air to be mixed at the burner injector, or else adopts the pre-mix method of adjusting the quantities of gas and air and then boosts both together. The raising of the pressure is to give an equal flame along the whole length of the burner tube and so ensure even baking across the oven.

Some ovens work on the “Heat flow” principle which comprises the radiation of heat from sets of tubes through which hot gases are passed,

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the heat being derived from either a single or anything up to 6 or 8 burners, each heating a section of the oven. These burners can be for either gas or oil firing, or alternately automatic coalstokers may be used.

Electrically heated travelling ovens have also been installed in one or two bakeries, but the price of the current in most districts is prohibitive when compared with other fuels.

Straight Through Travelling Ovens.—These ovens are built in many varieties, some having a single baking chamber, whilst others have two decks—one above the other—and each deck can again be subdivided into various baking chambers. Such ovens can be made to suit the output of any bakery, the length ranging from 25 ft. to 50, 60 or even 100 ft. It should here be stated that with their great flexibility, due to accurate control of both heat and baking time, these ovens can be used for an unending variety of goods. The articles to be baked should naturally be arranged to follow one another in such a way that only small adjustments need be made to either the speed or the temperature of the oven, as a new line is fed into the baking chamber,—the underlying principle being the same as in the case of baking in a peel oven with a “falling” temperature.

In these “conveyor” or “tunnel” ovens (as they are sometimes called) the goods are passed through the oven on baking pans (sheets) which are carried on special chains of the “camel back” type.

A great advantage of the Straight through Oven is that it acts as a conveyor between the mixing and moulding (preparing) room and the finishing department—thus avoiding congestion and at the same time giving a fixed speed for the bakers to work to as the oven must be fed continuously—a lag in production in any department being shown up immediately at the oven mouth.

Double deck ovens of this type can be fitted with 2, 4 or 6 pairs of chains—1, 2 or 3 pairs in each deck—and each pair, if desired, having an independent drive.

The decks can be divided into two separate baking chambers, each with its own set of burners, so that such a traveller actually comprises four distinct ovens—each capable of baking greatly varying types of goods all at the same moment.

The variation in the baking time can range from say 5-50 minutes or 10-100, or as required—each chamber having a different maximum and minimum speed to increase the total speed variation of the oven.

In many cases, the bottom deck has been fitted with a plate sole for cakes and other goods requiring “solid” bottom heat. (Fig. 20). The top deck however still retains its two sets of chains, resulting in a unit capable of baking every line the baker cares to produce and

Cake Manufacture

having the added advantage that the sole plate can be used for bread baking when it is not required for confectionery.

A further point of advantage of this type of oven is that only one baking chamber need be fired when only a small output is required at certain times of the week, whilst the capacity can be raised to a peak at such periods as Bank Holiday weekends, while the floor space taken up is small.

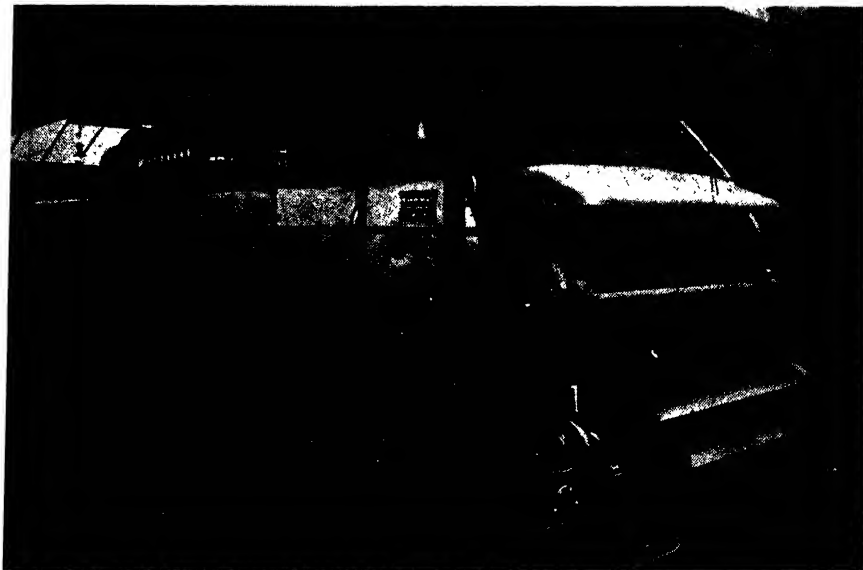


FIG. 20.—DELIVERY END OF A PELKMAN "STRAIGHT THROUGH" CONFECTIONERY TRAVELLING OVEN HAVING TWO SEPARATE BAKING CHAMBERS WITH CHAINS IN TOP DECK AND A PLATE SOLE IN THE BOTTOM DECK.

Swinging Tray Travelling Ovens.—These, like the straight through ovens, are usually fired by multiple gas burners. They come into two main groups, namely the two-lap ovens and the four-lap type. The latter, however, are not common for confectionery.

The feed and discharge points of the two-lap oven are at the same spot (Fig. 21). The capacity can naturally be made to suit bakery needs and sixteen swings each taking two, three or four baking pans are popular ovens.

The swings are in many cases so adjusted as to remain horizontal and might best be called "carriers" and not "swings". This is a special precautionary feature to ensure that sponge goods or slab cakes do not tilt, thus avoiding uneven height of the baked goods.

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Some ovens however still retain "swinging" trays and may even incorporate tiled soles in the framework of the swings.

The Rotary or Reel Oven may be classed as a "Swinging tray" oven with a smaller output but which like its larger counterpart can be used for most confectionery and bread lines. This type of Oven, especially popular in the U.S.A., is more fully described in "Bread making" by one of the authors of this book.

Electric Ovens.—Electric ovens (Fig. 22) have now reached a stage of proficiency such that their use for confectionery work is becoming widespread. Peel, drawplate and travelling ovens find favour, but as with all confectionery ovens, the Peel variety is very popular and gives most satisfactory results in smaller bakeries. The

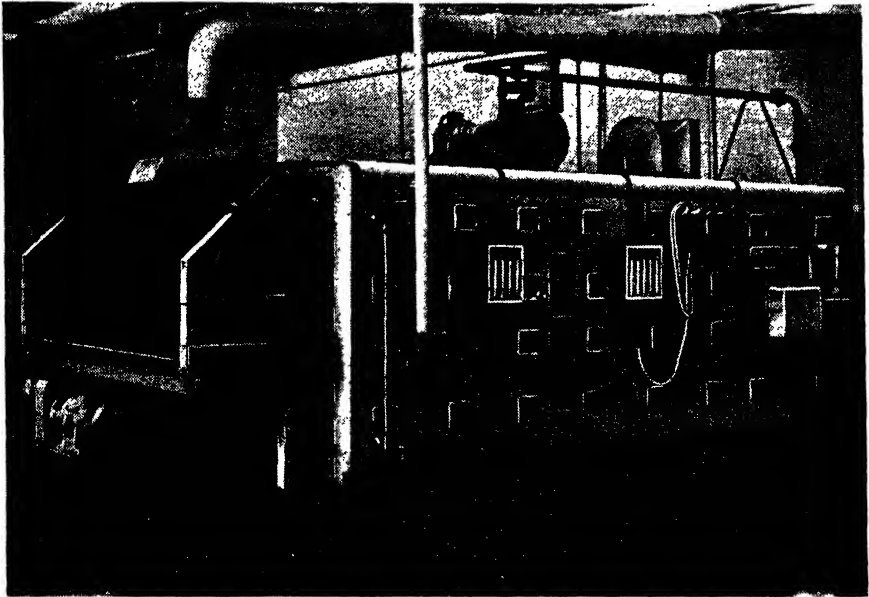


FIG. 21.—GAS FIRED CONFECTIONERY SWINGING TRAY OVEN.

method of heating by means of elements differs with different makes, and much attention has been given to the distribution of heat uniformly in crown and sole and the loading factor—a most important consideration. Travelling ovens are now being increasingly used for bread and confectionery. Cost of power is the dominant factor in determining their adoption. Fig. 20 shows one being used exclusively for confectionery, while a travelling plate oven is used for bread in this same bakery.

Cake Manufacture

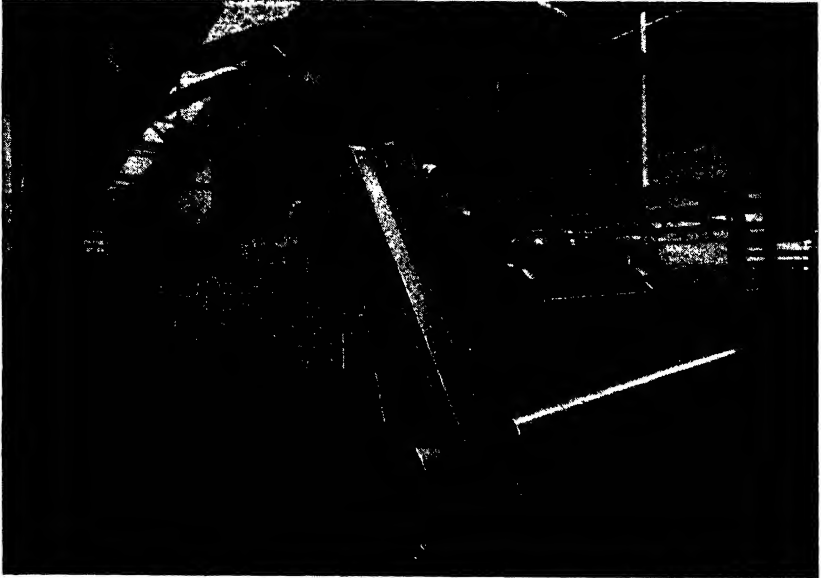


FIG. 22.—A CONFECTIONERY OVEN ; a FOUR-CHAIN CONVEYOR ENABLED TWO TRAYS TO BE TAKEN IN THE WIDTH OF THE OVEN.

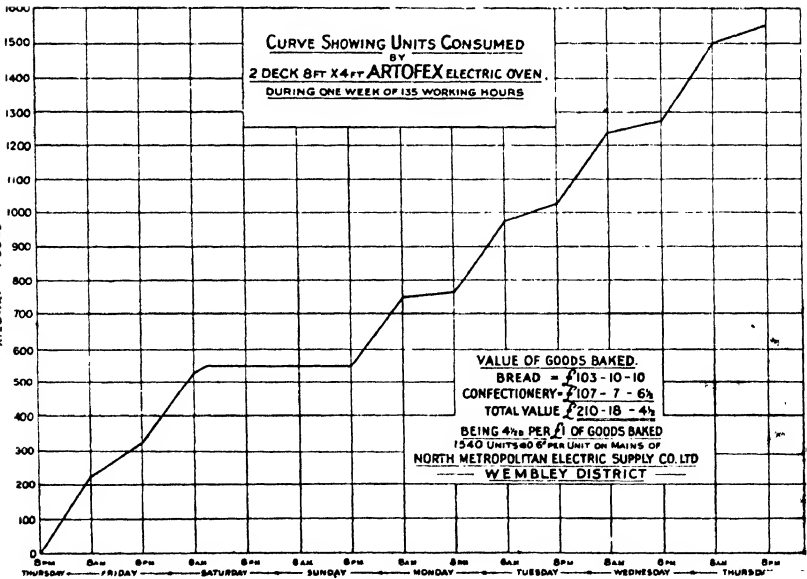


FIG. 23.

Bakehouse Machinery and Plant

The charts (Figs. 23 and 24) are of particular interest, showing the power consumption, cost of current per pound of goods baked, temperature variation, and kilowatt demand over a typical week-end period with a mixed trade. Such figures show the great possibilities in the development of electric ovens when current is obtainable at a reasonable price.

The following advantages are derived from the use of electric ovens :

Advantages of Electric Ovens.—1. Greater cleanliness and more hygienic production of foods.

2. Greater uniformity in the finished product.

3. No burnt goods obtained, unless through gross carelessness.

4. The oven, being portable, remains the property of the baker.

5. Cheaper to instal (in small units) than steam-pipe ovens.

6. Economical to run, if power is a halfpenny a unit or less.

7. Heats up quickly, so that fuel costs for this purpose are low.

Capacity of Ovens.—It is usual to express the capacity in terms of

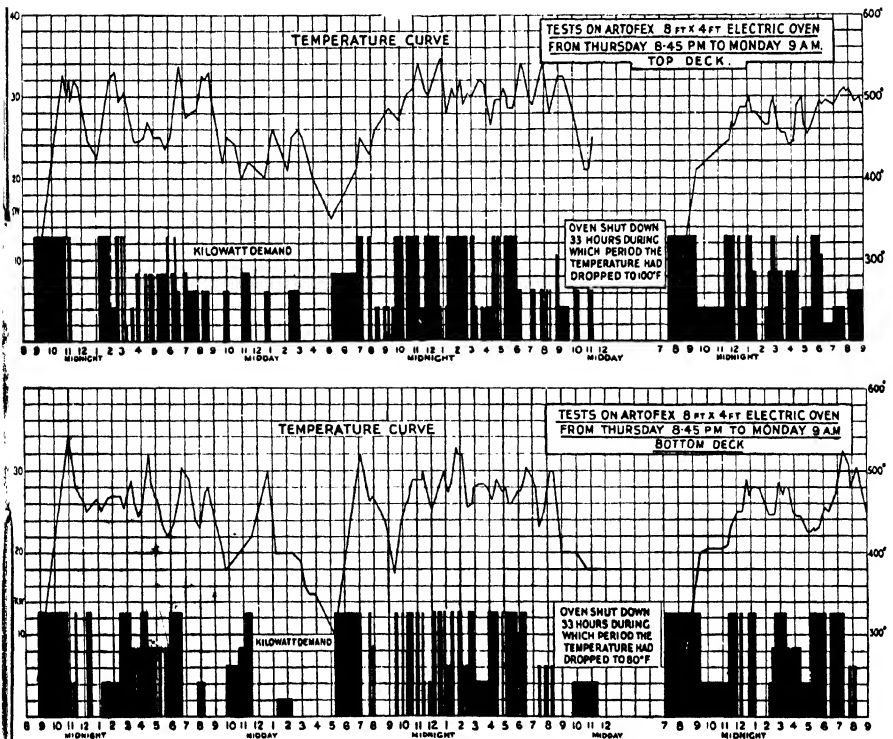


FIG. 24.—CHART SHOWING TEMPERATURE VARIATION AND KILOWATT DEMAND OVER A TYPICAL WEEK-END PERIOD WITH MIXED TRADE, USING AN "ARTOFLEX" ELECTRIC OVEN.

Cake Manufacture

sacks of flour made into bread. Where the confectioner is concerned this is a guide, but more important to him is the number of baking sheets which can be placed in the oven at a time, and so the dimensions are of paramount importance. Generally, however, the following dimensions refer to ovens of various sizes :

A quarter-sack oven will have internal dimensions of 4 by 4 feet, or a superficial area of 16 square feet. A half-sack oven will have a superficial area of about 30 square feet, or be 6 by 5 feet internal dimension. A three-quarter sack oven is usually 48 square feet internally, or 8 by 6 feet, whilst a sack size is from 60 to 64 square feet, being either 9 by 7 feet or 8 by 8 feet. Larger ovens than this are not usually used for confectionery, and it is not advisable that they should be used unless a full batch is to be baked. The increase in size continues at approximately the same rate, so that a one and a half sack size is from 96 to 99 square feet, or 11 by 9 feet, or 12 by 8 feet.

Conveyors.—Where travelling ovens are used, it is essential that the feed to the oven should be maintained, otherwise losses result, due to wastage of fuel. At the delivery end, unless the baked goods can be removed as soon as they are ready, congestion occurs and damage results. For this purpose the “Pantin” roller type of conveyor is most useful. It is a simple device, consisting of a series of rollers mounted on a carrier arrangement, with a slight incline just sufficient to allow the tins to gravitate from the depositor to the oven. The tins of batter are placed on the conveyor by hand, and taken off by hand and placed on the oven conveyor.

At the delivery end either a gravity conveyor can be used, or travelling bands or chains to carry the baked goods still on the baking sheets to the cooling and finishing rooms.

In all modern factories conveyors are in use in order to keep the flow of work constant, eliminate hard, wasteful labour in lifting goods, and facilitate ease of transport.

Confectionery Coolers.—Automatic Coolers for confectionery are used in some of the larger bakeries. These travelling coolers can be built to have either one- or two-tiered swings suspended from chains. The illustration (Fig. 25) shows such a unit with double-tiered swings driven by a small motor incorporating a variable speed device to regulate the variations in cooling time for different articles. The output is according to the size of the cooler which is naturally based on the available oven capacity. “Natural” or “open air” cooling is usually adopted, but “conditioned air” can be used if the cooler has a totally enclosed main structure.

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These coolers are especially valuable for Swiss rolls, cakes and pies when baked on trays—enabling the goods to cool off before going to the finishing and packing department, thus avoiding the congestions in the bakery which cooling racks so often cause. Further they



FIG. 25.—AN AUTOMATIC CONFECTIONERY COOLER OF SIMPLE AND COMPACT DESIGN BY PELKMAN BROS.

reduce the wear of the baking floor—a most important point. The cooler need not have its feed and delivery points at the same level, in fact the goods can be placed in the cooler on any floor where the ovens may be situated and delivered at the ground floor or suitable level of the despatch department.

CHAPTER XXII

WAR-TIME CONFECTIONERY PROBLEMS

WAR inevitably brings forth problems which have to be overcome by confectioners. Flour confectionery, although a necessity of modern life in times of peace, is still regarded as more or less a luxury in war-time, and therefore its production has been restricted through the control of the primary raw materials, sugar and fats. At the outset these were controlled and could only be purchased against buying permits. After several months fats were released from control, and so could again be bought in branded varieties. During the first control period, standard national varieties of margarine and cooking fats were marketed, and were again manufactured when they were controlled.

Flour also was controlled at the outset of the war, and National Straight Run flour was solely available. After several months, permission was granted for the continuance of special cake flours on national lines.

The initial control of sugar reduced the available amount to 75% of pre-war purchases of this commodity, and thus some alterations of recipes were called for. However, since many confectioners had reserve stocks of sugar, and also since other forms of sweetening agents, such as fondant, syrups, honey and invert sugar were not rationed, confectioners soon modified their formulae to replace sugar with these products, and thus kept the total sugar content practically the same.

During the first twelve months production was fairly straightforward, since there was an ample supply of sweetening material, although sugar rations were cut during this period. Eggs, however, became scarcer, but substitutes appeared in their place. The sugar restriction order of August 1940 prohibited the use of sugar for external decoration of cakes, so that stocks of sugar normally used for this purpose became available for cake-making.

Control of fats was reinstated in July 1940, and the rations have been progressively reduced since the initial period. The quality of the fats has varied, since it has been impossible to maintain uniformity owing to the variation of supplies of raw materials.

Restrictions next applied to the use of dairy cream, milk, jams, and eggs.—Frozen eggs have been replaced by spray dried whole egg for all forms of cake.

War-Time Confectionery Problems

Supplies of all forms of dried fruit were plentiful in the first year of the war, with even a superfluity of dates and figs.. As a result investigations were carried out by the authors for the Ministry of Food to evolve new methods and formulae for using these. Many delectable lines were produced.

With the continuance of hostilities all fruits are in short supply, so that the problem is now one of using as little fruit as possible. The history of confectionery production runs parallel with all other spheres of activity, one of constant change, adaption and modification.

Effect of Sugar Reduction.—In most goods sugar has been reduced by approximately 25% without serious effects on the finished products. The main effect of reducing the sugar content of cakes is to reduce volume. This can, however, be overcome by increasing the quantity of baking powder, and by using hotter ovens for baking the cakes. The keeping qualities of the cakes are impaired, but since the demand for them is so great this is not a serious matter, because the cakes are eaten while fresh.

Sugar and Sweetening Products.—Syrups, fondant, honey, glucose, invert sugar and jams were largely used to supplement part of the sugar, but these are now also in short supply. These materials have a varied sweetening power, according to what actual sugar content they possess.

Saccharine.—Saccharine and saccharine products have no relationship chemically to sugar. They taste sweet, but cannot perform the functions of sugar in baked products. Saccharine is marketed in three forms of 350, 450 and 550 times the sweetness of sugar. It is best used as a solution—say 1 oz. in 32 ozs. water. In this case, the 550 grade, 1 oz. of the solution would be about equal to one pound of sugar in sweetening power, $1\frac{1}{4}$ ozs. solution of the 450 grade would have approximately the sweetening power of one pound of sugar, and $1\frac{1}{2}$ ozs. solution of the 350 grade would replace one pound of sugar in sweetening power. Other sweetening agents of varying sweetening are also available for use.

Fats.—It is a most difficult problem to substitute fats, as these are the enriching agents in confectionery. Less fat in baked goods means lowering the quality and food value of the products. In short paste one can use less than the normal 7 or 8 ozs. fat per pound of flour by a slight change in the recipe. Potato flour, mashed potatoes, cornflour or rice flour can be utilised to reduce the gluten content of the flour, by using 2 ozs. or more of either per pound of flour. The fat can be reduced to 4 ozs. per pound of flour, but $\frac{1}{2}$ oz.

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baking powder per pound of flour should be used to shorten the paste. The moisture content would require increasing from 5 to 6 ozs. per pound of flour.

Cooking oils can be used to replace fats in some cakes, as has been suggested in the recipe for making cakes on the emulsion method, but the supply of oil is also now restricted.

Soya flour has been used to save fat in cakes and pastries. Certain emulsions are also marketed for this purpose.

Cheaper quality cakes have to be produced to maintain supplies, but here again these are usually sold and eaten before they have time to become stale.

Eggs.—The quantity of eggs available is restricted. Sponge goods and cakes are being made with Dried Whole Eggs after reconstitution. Frozen eggs and shell eggs are unobtainable. There are also many so-called egg substitutes or egg economisers on the market. The object of these is to help in the aeration of cakes by replacing some of the eggs normally used. Some are quite good for this purpose, many of them are overrated. These, when used, should only be bought after full baking tests have been carried out. The composition of these products varies: some contain soya bean and dextrinised starch, others albumen, whey powder, various gums or mucilage which swells on soaking, while others have starchy bases with a proportion of baking powder.

There are two main groups: those possessing foaming properties and those which do not foam on whisking, the former type containing soya flour, dextrinised starch, in about equal quantity, and a small amount of gums; while the latter contain up to 40% of baking powder, together with whey powder and starch and possibly some albuminous material.

Points to observe when comparing them are the price charged, the speed of whisking, type and stability of foam produced, ease of taking in flour, degree of toughening or collapse, oven lift of goods and the texture, appearance and eating qualities of the finished products.

Some confectioners used linseed in quantities up to 50% as an egg substitute. This was prepared by boiling one part linseed to twenty parts water for 15 minutes, then straining off the gelatinous mixture through a sieve. This was then mixed with an equal quantity of eggs for cake production.

Milk Products.—The prohibition of the use of milk in bakery products was another problem that had to be faced. Milk was used in cakes because it gave bloom, flavour, food value, richness, body, keeping qualities, and crumb tenderness. It also improved texture,

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colour and volume. Although milk is largely composed of moisture plus 13% milk solids, water alone will not adequately replace milk.

A number of research bakeries have suggested various ways of making up milk substitutes. It has been suggested that to make 1 gallon of milk substitute, 4 to 6 ozs. sweetening material is necessary to replace the milk sugar, 6 ozs. albumen is necessary to replace the protein content of milk, 4 ozs. starch is necessary to give it body, and 1 oz. salt for flavour. 1 gallon water is necessary. The starch is mixed to a paste with a little of the water, the remainder of the water and sugar is brought to the boil, then the paste is added, and the whole is boiled to gelatinise the starch. The egg whites or albumen are whisked in when the mixture is cool, and the salt is added. It is then ready to use as milk.

Another mixture that can be used to replace milk is as follows :

1 gal. warm water.	2 ozs. salt.
1 lb. flour.	2 ozs. yeast.
4 ozs. malt flour.	

These ingredients are well whisked together and left overnight to be ready for use in the morning. It is useful for the production of scones and other chemically aerated goods.

Dextrinised starch when available can also be used with water, using 5 ozs. per gallon of water, to make a milk substitute. When that is not available use cornflour or other starch, and make a jelly of it by boiling it with 5 parts of water, then mixing in the remainder of the water.

Whey powders and modified milk products can still be used, however, as also can buttermilk, but the available supplies of these are extremely limited.

The following are two recipes for pound cakes or small Madeira cakes, the former shows the original recipe and the latter shows the alterations to give a similar quality of cake using the various substitutes that are in use :

1	2
1 lb. fat.	1 lb. fat or cooking oil.
1 lb. 6 ozs. sugar.	18 ozs. sugar.
13 ozs. eggs.	7 ozs. eggs, 6 ozs. egg substitute.
14 ozs. milk.	15 ozs. milk substitute, or
Egg colour.	15 ozs. water and $\frac{1}{2}$ oz. starch.
Flavour as required.	Egg colour and flavour.
$\frac{1}{2}$ oz. salt.	$\frac{1}{2}$ oz. salt.
2 lbs. flour.	2 lbs. flour.
$\frac{1}{2}$ oz. baking powder.	1 $\frac{1}{2}$ ozs. baking powder.
	$\frac{1}{2}$ oz. liquid sweetener.

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The former recipe would be made up on the sugar batter or creamed method of cake-making, the latter should be made up on the emulsion method of cake-making to make similar cakes. Fruit in various quantities can be added to either batter to make fruit cakes or queen cakes.

Cakes with Carrot Powder.—The authors have been engaged in investigating the possibility of using Dried Carrot Powder in the manufacture of cakes. The carrot powder has been used to replace part of the sugar normally used in the cakes, and also to replace the milk solids, as it is rich in sugars and carotin.

The following table of recipes shows its use in increasing quantities, with the necessary reduction of sugar and increase of moisture required. The first recipe is the basic recipe.

	<i>No. 1 Original Recipe</i>	<i>No. 2 Fully 1% Carrot</i>	<i>No. 3 Fully 2% Carrot</i>	<i>No. 4 Fully 3% Carrot</i>
Mixed fats - -	1 lb.	1 lb.	1 lb.	1 lb.
Sugar - - -	1½ lbs.	1 lb. 2 ozs.	1 lb.	14 ozs.
Carrot powder -	—	1 oz.	2 ozs.	3 ozs.
Eggs - - -	1 pt.	1 pt.	1 pt.	1 pt.
Milk - - -	4 ozs.	—	—	—
Water - - -	—	5½ ozs.	7 ozs.	8½ ozs.
Flour - - -	1½ lbs.	1½ lbs.	1½ lbs.	1½ lbs.
Baking powder -	¾ oz.	½ oz.	½ oz.	½ oz.

In making these cakes with the carrot powder and water in place of the milk, a good method is to cream the carrot powder and ½ lb. of the flour with the fats and sugar for ten minutes or until light and creamy. The water can then be mixed into the eggs, and the mixture is gradually beaten into the batter, taking about five minutes to complete the creaming process. The remainder of the flour is then sieved with the baking powder, and is easily mixed into the batter.

This mixture will hold fruit if desired, using up to 1½ lbs. for the mixture.

The carrot powder has been utilised in other mixtures in the same manner, gradually decreasing the quantity of sugar used, while increasing the carrot powder and the moisture. It is not advisable to use more than 3 ozs. of the carrot powder per pound of fat made into cakes.

The carrot powder gives the crumb of the cakes a nice egg-yellow colour, so that they appear very rich in eggs.

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In the above mixings one could use up to 50% egg substitutes in the eggs.

Potatoes in Flour Confectionery.—During war time it is a duty of all consumers of imported foodstuffs to use them as sparingly as possible, and to substitute them with home grown products whenever this is possible. In the making of cakes it is possible to save at least 12½% of the flour normally used if it is replaced with mashed potatoes. This can readily be accomplished by the following method of rebalancing all the good cake mixings used :—

Reduce the flour content of all cake mixings by 2 ozs. per pound of flour used. Reduce the milk content also by 2 ozs. for each pound of flour used. Replace these two ingredients with 4 ozs. mashed potatoes. The batters are then made up in the usual manner, creaming the potatoes with the fat and sugar when making up the cakes on the sugar batter system, or creaming the potatoes with the fat and portion of the flour when making the cakes up on the flour batter system. Only in very few cases will it be found necessary to increase the baking powder content slightly when this method of rebalancing mixings is used.

The following recipe for a good quality Madeira Cakes will illustrate this method of rebalancing recipes :—

Madeira Cakes :

<i>Original</i>	<i>Rebalanced</i>
3 lbs. fats.	3 lbs. fats.
4 lbs. sugar.	4 lbs. sugar.
1½ ozs. salt.	1½ ozs. salt.
4 pints liquid egg.	1½ lbs. mashed potatoes.
1 pint milk.	4 pints liquid egg.
6 lbs. flour.	8 ozs. milk.
3 ozs. baking powder.	5½ lbs. flour.
	3 ozs. baking powder.

This mixing complies with the Cake and Flour Confectionery Order 1942 in that it contains 19·8% fat and 22·9% sugar. The flour saved is 12½%. The results obtainable in practice with the war time ingredients are equally as good with the rebalanced recipe as with the original recipe.

Short Paste.—Mashed potatoes can also be used in Short Pastry to save flour and at the same time to shorten the pastry. Oatmeal also has a shortening effect on the paste and can be used to replace part of the flour normally used.

Here are three recipes for short pastry which will illustrate these points :—

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	3 lbs. flour.		3 lbs. flour.		3 lbs. flour.
	1 lb. potatoes.		1 lb. potatoes.		1½ lbs. oatmeal.
(1)	12 ozs. lard.	(2)	1½ lbs. lard.	(3)	1½ lbs. potatoes.
	½ oz. salt.		½ lb. sugar.		1½ lbs. lard.
	5 ozs. water.		5 ozs. liquid egg.		½ lb. sugar.
					1 oz. salt.
					14 ozs. water.

Potatoes in Sponge Products.—The introduction of mashed potatoes into flour confectionery has actually been the means of improving the production of sponge products made with dried egg. The potatoes apparently have the effect of making the goods soft and moist, while sufficient chemical aerating agents lightens the products and the texture is built up by prolonged whisking.

There is no preliminary reconstituting of the egg, and sufficient acid is added with the moisture to ensure a modification of the protein and an incorporation of air into the mixture during whisking.

Sieve the dry egg, sugar, flour, and cream powder together. Add potatoes with the water, and colouring matter and salt where required. Whisk this mixture on top speed for a period of 20 to 25 mins. Mix the bicarbonate of soda or the baking powder where required with the final addition of water and mix it well through the sponge. Work off the sponge goods in the usual manner.

Swiss Rolls and Jam Sponges

2 lbs. 2 ozs. dried egg.
 4 lbs. 9 ozs. flour.
 5 lbs. 7 ozs. sugar.
 3½ ozs. cream powder.
 6 lbs. water.
 Egg colour.
 1 lb. potatoes.
 1½ ozs. bicarbonate of soda.
 4 ozs. water.

Cheap Swiss Rolls

1 lb. 2 ozs. dried egg.
 4 lbs. flour.
 3½ lbs. sugar.
 1 oz. cream powder.
 2 ozs. milk powder.
 4 lbs. water.
 ½ oz. egg colour.
 1½ lbs. potatoes.
 4 ozs. water.
 4½ ozs. baking powder.
 2 ozs. oil.

Good Chocolate Swiss Rolls can be made from the first mixing by leaving out 9 ozs. flour and replacing it with 9 ozs. Cocoa Powder.

Sponge Cakes and Sandwiches

12 ozs. dried egg.
 1 lb. 11 ozs. flour.
 2 lb. 2 ozs. sugar.
 1 oz. cream powder.
 2 lbs. water.
 ½ oz. salt.
 11 ozs. potatoes.
 Egg colour.
 4 ozs. water.
 2 ozs. baking powder.

Chocolate Sandwiches

1 lb. 1 oz. dried egg.
 1 lb. 10 ozs. flour.
 3 ozs. cocoa powder.
 3 ozs. browned flour.
 2 lbs. 3 ozs. sugar.
 1½ ozs. cream powder.
 2½ lbs. water.
 1 lb. potatoes.
 4 ozs. water.
 ½ oz. bicarbonate of soda.

STATUTORY RULES AND ORDERS
1943 No. 688 EMERGENCY POWERS (DEFENCE)
Food (Cake and Flour Confectionery)

THE CAKE AND FLOUR CONFECTIONERY (CONTROL AND MAXIMUM PRICES) ORDER, 1943. DATED MAY 8, 1943.

In exercise of the powers conferred upon him by Regulation 55 of the Defence (General) Regulations, 1939, as amended, and of all other powers him enabling, the Minister of Food hereby makes the following Order :

PART I. Interpretation.

1. In this Order—

“ The Minister ” means the Minister of Food.

“ Buy ” includes offer or agree to buy and “ sell ” includes offer or agree to sell or expose for sale.

“ By retail ” means in relation to a sale of cakes, a sale to a person buying otherwise than for the purpose of resale and includes a sale to a caterer for the purposes of a catering business carried on by him.

“ Cake ” includes fruit loaves, bun loaves and flour confectionery of any description, but does not include—

(i) bread other than fruit loaves or bun loaves ;

(ii) biscuits, within the meaning of the Biscuits (Maximum Retail Prices) Order, 1942, as amended(*) ;

(iii) any product containing a filling which has as an ingredient meat or fish of any description.

“ Catering business ” includes the business or undertaking of an inn, public house, hotel, restaurant, buffet, coffee stall, or of any place of refreshment open to the public or of any club, boarding house, refreshment contractor or canteen, and the expression “ caterer ” shall be construed accordingly.

“ Consumer price ” means the price at which any cake is sold by retail or intended to be so sold being a price not exceeding the maximum price applicable thereto under the provisions of this Order.

PART II. Control of Manufacture.

2. (1) Except under and in accordance with the terms of a licence (including a provisional licence) granted by or on behalf of the Minister for the purposes of this Article, no person shall manufacture any cake in the course of any trade or business.

(2) In the event of the transfer of a business in respect of which a licence is held under this Article or in the event of the death of the holder of such licence, the transferee or other person succeeding to the business shall, on having duly made an application for a licence under this Article and pending the decision of the Minister upon such application, be deemed to hold a provisional licence under this Article whereby he shall be entitled, unless the Minister shall otherwise direct, to manufacture cake, subject to any conditions contained in the first-mentioned licence.

(3) Every licence (including every provisional licence) granted under this Article, shall be deemed to be granted upon and shall take effect subject to the condition set out in the first Schedule to this Order, save as the Minister may otherwise authorise or direct ; so however that a licence granted under this Article may contain such other conditions as the Minister may consider expedient.

(4) Any licence granted under this Article—

(a) shall extend only to authorise the manufacture of cake by the licensee or by any servant of the licensee ; and

(b) shall not extend to authorise the manufacture of cake either on behalf of the licensee by any person other than such a servant, or by the licensee when acting as an agent for any other person who is not licensed under this Article to manufacture cake.

(5) A person licensed under this Article shall, before ceasing to carry on business as a manufacturer of cake, give to the Minister or to the Food Executive Officer for the area in which his business is carried on, not less than 14 days notice in writing of his intention so to do and shall return to such Food Executive Officer any licence held by him under this Article :

Provided that where in any proceedings a person is charged with a contravention

(*) S.R. & O. 1942 Nos. 678, 1036 and 2341 ; and 1943 No. 534.

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of this paragraph it shall be a defence for the defendant to prove that it was not practicable for him to give such notice or that he gave notice as soon as it was practicable for him to do so.

(6) Where the cake is no longer being manufactured in connection with any business owing to the death of a person licensed under this Article, without notice having been given under the preceding paragraph, the licensee's personal representative shall forthwith give notice to the Minister or the appropriate Food Executive Officer that such business has ceased to be carried on and shall return to the Minister or such Food Executive Officer any licence granted in respect of such premises under this Article.

3. No person shall in the course of any trade or business add to any cake after the baking or other cooking thereof any substance :

Provided that—

(a) dusting material may be added to any cake where this is reasonably necessary to prevent adhesion of the wrapping ;

(b) any one substance may be added as a filling to Swiss roll or sponge sandwich ;

(c) nothing in this Article shall prohibit the addition of butter or margarine to any cake by a caterer for sale as a meal or part of a meal served in the course of a catering business carried on by him.

4.—(1) No person shall in the course of any trade or business manufacture to sell any cake containing more than 20% of oils and fats or 30% of sugar, provided that any such percentage may be exceeded if the combined oils and fats and sugar content does not exceed 45%.

(2) For the purposes of this Article, percentages shall be determined in accordance with the following provisions :

(a) the percentage shall be determined by reference to the weight of the cake taken at any time ;

(b) the percentage shall be ascertained by analysis of a sample representing a fair average of the whole article ;

(c) all oils and fats and sugar contained in or added to the cake shall be taken into account in whatsoever form they may have been introduced ;

(d) the percentage of sugar in the sample shall be determined by adding the percentage of sucrose to the percentage of the total reducing sugars expressed in terms of dextrose ;

(e) the percentage of oils and fats shall be determined by ascertaining the percentage of the sample which is extractable with ether or other appropriate solvent after the sample has been suitably digested with diluted hydrochloric acid.

(3) In any proceedings under this Order, the production by one of the parties of a document purporting to be a certificate of a public analyst shall be sufficient evidence of the facts stated therein unless the other party requires that the analyst shall be called as a witness.

5. Nothing in this Part of this Order shall apply to any establishment which is not licensed as a catering establishment under the Food (Licensing of Establishments) Order, 1943(*).

PART III. *Maximum Prices.*

6.—(1) No person shall buy or sell any cake at a price exceeding the maximum price applicable in accordance with the Second Schedule to this Order.

(2) For the purpose of ascertaining the maximum price, the cost of the ingredients means the cost to the manufacturer (or in the case of any substance added after manufacture, to the person making the addition), including any costs or charges incurred in respect of the transport of such ingredients ; provided that in calculating such cost, the cost of any ingredient in respect of which a maximum or fixed price is prescribed under any Statutory Rule and Order under the Defence (General) Regulations, 1939, shall not exceed the lesser of the following two amounts :

(i) the actual cost of the ingredients to him ;

(ii) the prescribed maximum or fixed price applicable to that ingredient on a sale to him at the time of the sale by him of the cake, together with any addition lawfully made to such price in respect of transport.

(3) The cost of the ingredients of any cake shall be deemed not to amount to more than fourpence for every pound of the cake until the contrary is proved.

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7. No charge in addition to the maximum price shall be made on a sale of any cake in respect of the provision of a wrapper or container.

8. Every person who sells any cake otherwise than by retail shall clearly indicate in a statement upon the wrapper or container in which the cake is delivered to the purchaser or upon a label attached thereto or upon an invoice, price list or similar document delivered at or before the time of delivery of the cake, the consumer price of the cake.

9. This Part of this Order shall not apply to any sale of cakes as a meal or part of a meal served by a caterer in the course of a catering business carried on by him.

PART IV. *Miscellaneous.*

10.—(1) No person shall deliver cake to any person or to any other member of the same household at the same premises on more than three occasions in any week, and where a person delivers bread as well as cake to any person, the total number of occasions on which he delivers either bread or cake to such person or to any other member of the same household at the same premises shall not exceed three in any week.

(2) No person shall do any act likely to result in cake being delivered to him or to any other member of the same household at the same premises on more than three occasions in all in any week.

(3) In this Article—

“Deliver” means to deliver in connection with a retail sale, otherwise than at the seller’s premises, but does not include delivering—

(a) to any person in Northern Ireland;

(b) to a catering establishment or institution in respect of which a licence has been granted under the Food (Licensing of Establishments) Order, 1943;

(c) to the armed forces of His Majesty or His Majesty’s allies or co-belligerents; or

(d) to the Navy, Army or Air Force Institutes (“N.A.A.F.I.”).

“Week” means a period of 7 days ending at midnight between Saturday and Sunday.

11. Where in any prosecution a person is charged with an infringement of this Order by reason of having sold a cake containing more than the permitted proportion of oils and fats or sugar it shall be a defence for such person to prove that the infringement was due to a bona fide mistake or accident or to other causes beyond his control and that he took all reasonable precautions and exercised all due diligence to prevent the infringements.

12. Where in any prosecution a person is charged with an infringement of this Order by reason of having sold a cake at a price exceeding the maximum price and each unit of cake alleged to have been so sold does not exceed 4 oz. in weight, the Court shall disregard any inconsiderable excess in the price charged for a single unit and shall have regard to the average price charge for a reasonable number of other units of cake of the same kind (if any) sold by the defendant, or in his possession for the purpose of sale, on the same occasion, and generally to all the circumstances of the case.

13.—(1) Where in any prosecution a person is charged with an infringement of this Order by reason of having sold a cake at a price exceeding the maximum price it shall be a defence for such person to prove—

(a) that the price at which the cake was sold did not exceed the price stated to be the consumer price on a statement delivered to him in accordance with Article 7 of this Order by the person from whom he bought the cake; and

(b) that he had no reason to believe and could not reasonably have ascertained at the time of the commission of the alleged offence, that the price at which he sold the cake exceeded the maximum price.

(2) A statement shall only be a defence to such proceedings if the defendant has within seven days of the service of the summons sent to the prosecutor a copy of the statement with a notice stating that he intends to rely on it, and specifying the name and address of the person from whom he received it, and has also sent a like notice of his intention to that person.

(3) Where the defendant is a servant of the person who purchased the cake with such statement as aforesaid he shall be entitled to rely upon the provisions of this Article in the same way as his employer would have been entitled to do if he had been the defendant.

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(4) The person by whom the statement is alleged to have been delivered shall be entitled to appear at the hearing and give evidence.

14. No person shall in connection with the sale or disposition or proposed sale or disposition of any cake enter or offer to enter into any artificial transaction or make or demand any unreasonable charge.

15.—(1) The provisions of this Order are subject to any directions which may at any time be given by or on behalf of the Minister, and to any licence or authorisation which may be granted by or on behalf of the Minister under this Order.

(2) Every person holding a licence or authorisation granted under this Order shall comply with every condition imposed by such licence or authorisation.

(3) Every licence or authorisation granted under this Order is and shall remain the property of the Minister and any person being in possession of any such licence or authorisation shall, if requested to do so by or on behalf of the Minister, produce such licence or authorisation or deliver the same to such person or to a person of such class or description as may be specified in the request.

16. Infringements of this Order are offences against the Defence (General) Regulations, 1939.

17. The Cake and Flour Confectionery (Control and Maximum Prices) Order, 1942, as amended(*), is hereby revoked but without prejudice to any proceedings in respect of any contravention thereof :

Provided that any licence granted under that Order and subsisting immediately before the coming into force of this Order shall continue to have effect as though granted under this Order, and any reference in any such licence to any provision of that Order shall be construed as a reference to any corresponding provision of this Order.

18. This Order shall come into force on the 24th day of May, 1943, and may be cited as the Cake and Flour Confectionery (Control and Maximum Prices) Order, 1943.

By Order of the Minister of Food.

H. L. French,
Secretary to the Ministry of Food.

Dated the 8th Day of May, 1943.

THE FIRST SCHEDULE. CONDITION SUBJECT TO WHICH LICENSES UNDER ARTICLE 2 OF THE ORDER ARE DEEMED TO TAKE EFFECT

1. The holder of a licence or provisional licence granted under this Article shall not, except under the authority of the Minister of Food, knowingly permit—

(a) any person who was the holder of a licence granted to him by or on behalf of the Minister of a Food Control Committee but whose licence has been revoked as a result of his being convicted of any of the following offences :

- (i) an offence against any of the Defence (General) Regulations, 1939, or any Order made thereunder, in respect of any article of food ;
- (ii) an offence against the Larceny Act, 1916, in respect of any article of food ;
- (iii) an offence against the Sale of Food (Weights and Measures) Act, 1926, or any Regulation made thereunder ;
- (iv) an offence against the Food and Drugs Act, 1938, or any Regulation made thereunder ; or

(b) any person who was a director or officer of any body corporate whose licence has been revoked for the reason aforesaid, such director or officer having been convicted together with that body corporate in respect of the offence or offences in question ; or

(c) any person having the control or management of any premises in respect of which an Order under Regulation 420 of the Defence (General) Regulations, 1939, as amended, has been made, at the time of the making of such Order ;

to exercise any control, direct or indirect, financial, managerial or otherwise, over the policy, management or conduct of the business in respect of which such licence has been granted.

THE SECOND SCHEDULE. MAXIMUM PRICE OF CAKES.

1. Where for every pound of the cake the cost of the ingredients would amount to more than fourpence the maximum price shall be calculated at a rate not exceeding three times the cost of the ingredients, or 1s. 6d. per lb. net, whichever is the lesser.

2. In any other case, the maximum price shall be at the rate of 1s. per lb. net.

* S.E. & O. 1942 No. 2103 and 1943 No. 12.

Sugar and Fat Percentages

Sugar and Fat Percentages

The Chemists Panel of the Cake and Biscuit Manufacturers' War Time Alliance Ltd., has presented a report to the Committee of the Alliance giving information as to the sugar and fat percentages in ingredients, also on other points which might be of use to cake manufacturers in complying with the Cake Order. The list given hereunder gives the sugar and fat percentages in the more commonly used ingredients, and, in addition, to the amount of sugar and fat to the nearest quarter ounce contained in 1 lb. of each ingredient. It is thought that these latter figures might be more useful to the baker who is familiar with calculations involving pounds and ounces rather than percentages. Some suggestions are added as to precautions to ensure that the limits of fat and sugar laid down in the Order are not exceeded.

<i>Ingredient</i>	TABLE A.		TABLE B.	
	<i>Fat per cent.</i>	<i>Sugar per cent.</i>	<i>1 lb. contains Fat. Sugar. ozs.</i>	
Apples (peeled and cored) or puree	—	8.5	—	1½
Apple rings, dried	—	60	—	9¾
Cheese	29	1	4¾	¼
Cinnamon, ground	4	—	¾	—
Clove, ground	20	—	3¼	—
Dates (stoned)	—	79	—	12¾
Egg, dried whole	42	2	6¾	½
Fat compound, dripping, lard, suet	100	—	16	—
Figs	—	74	—	12
Flour, National 85 per cent. (and breadcrumbs)	2	2	½	½
Flour, soya	20	5	3¼	1
Fruit (raisins, currants, sultanas)	—	65	—	10½
Ginger, ground	15	—	2½	—
Jam (all kinds)	—	74	—	12
Lemon juice	—	3	—	½
Margarine, cake	84	—	13½	—
Margarine, pastry	90	—	14½	—
Milk powder, separated	1	34	¼	5½
Milk, unsweetened full cream	8	6.5	1¼	1¼
Nutmeg, ground	40	—	6½	—
Spice, mixed	7	—	1¼	—
Sugar, granulated	—	100	—	16
Syrup, glucose	—	35	—	5¾
Syrup, golden	—	80	—	13
Treacle	—	67	—	10¾
Yeast	2	—	½	—

For cocoa and chocolate and any other proprietary materials the necessary figures should be obtained from the supplier. It is quite clear, if the limits laid down are never to be exceeded, that as no tolerance is provided for on the Order, bakers to be on the safe side, must work to figures lower than are allowed. It is therefore suggested that they should work out their recipes to 18 per cent. fat and 28 per cent. sugar instead of 20 per cent. fat and 30 per cent. sugar, and 43 per cent. where the combined percentage must be below 45 per cent. This should give a safety factor sufficient to allow for variation in the sugar and fat percentages in different parcels of ingredients, and also for the increase in the content of sugar and fat which would take place if goods lost moisture before sale. In order to add a further safety factor, the figures given in the table are, if anything, very slightly above the value which would generally be expected. The figures given in the table represent those which would be found by the analyst, namely, the percentage of sucrose plus that of the reducing sugar expressed as dextrose. The method of calculating the results has been indicated in all trade papers, but agreed methods of analysis have been published in the *Analyst*, vol. 68, February 1943, No. 803, page 48.

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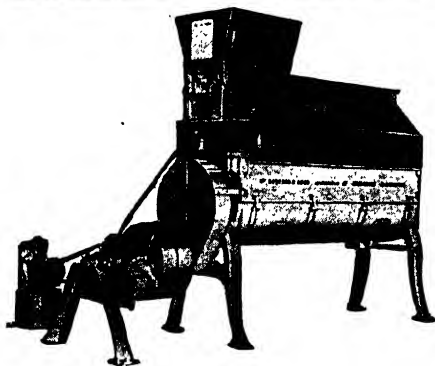
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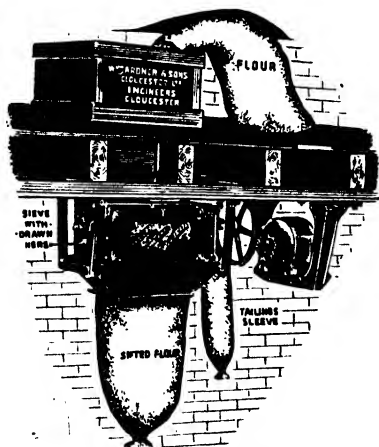


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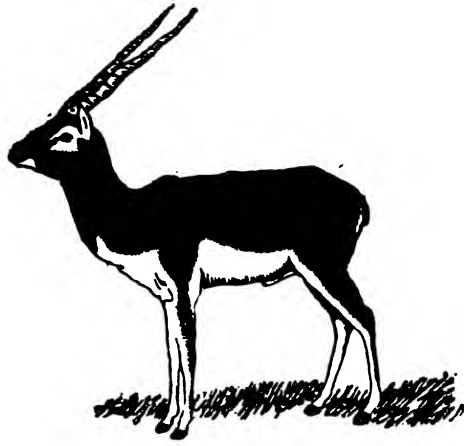
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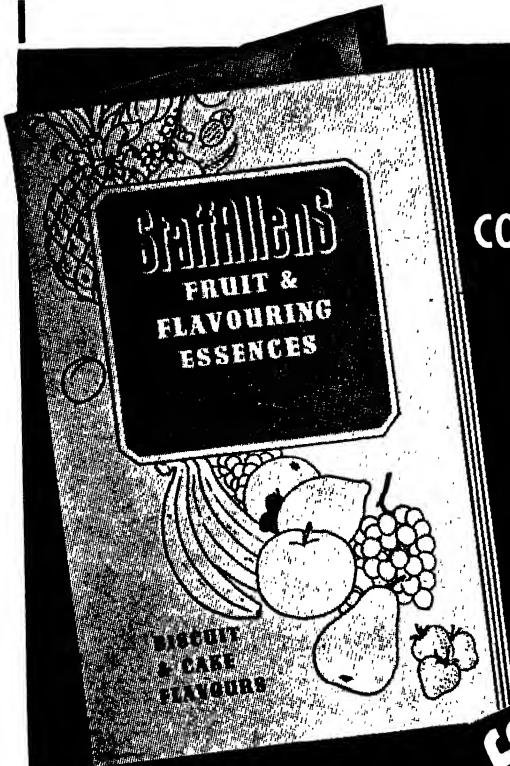
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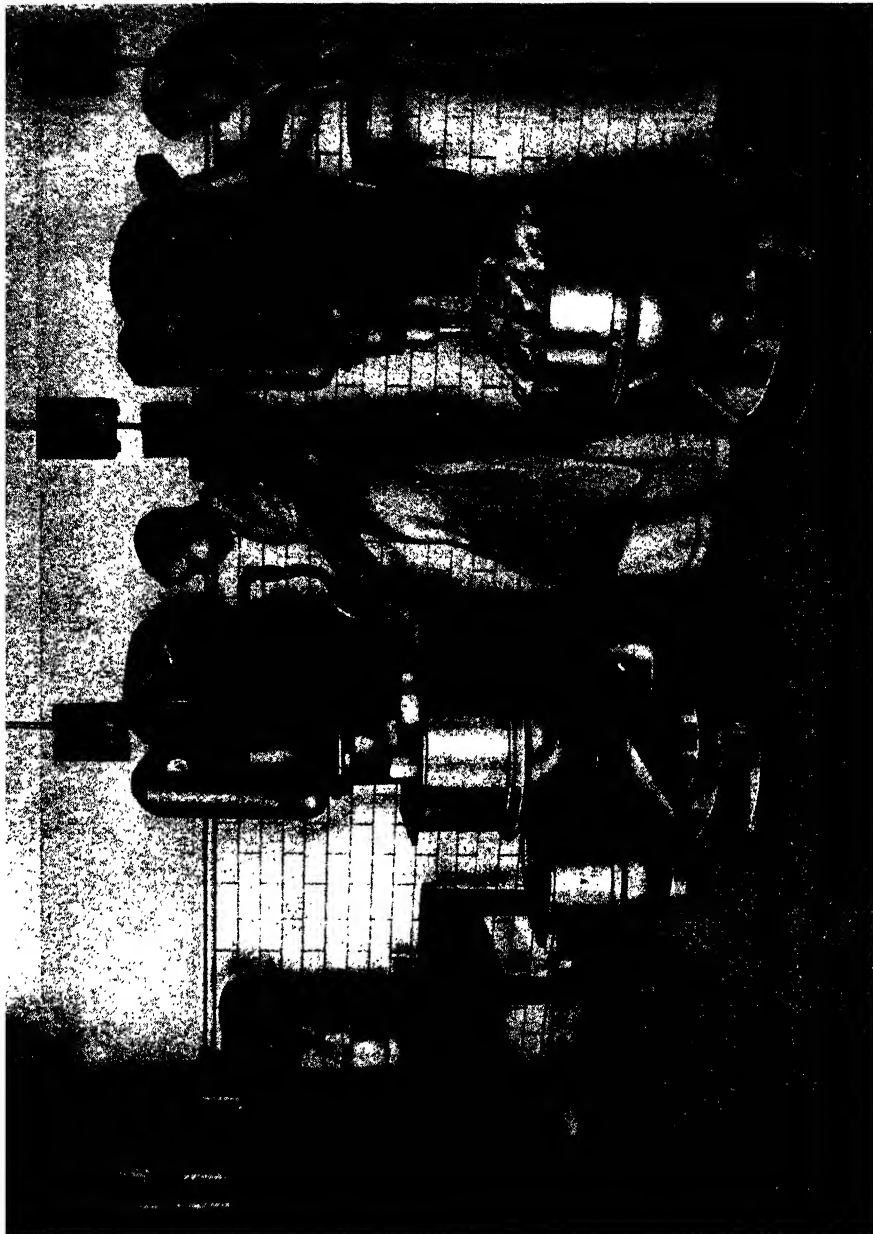
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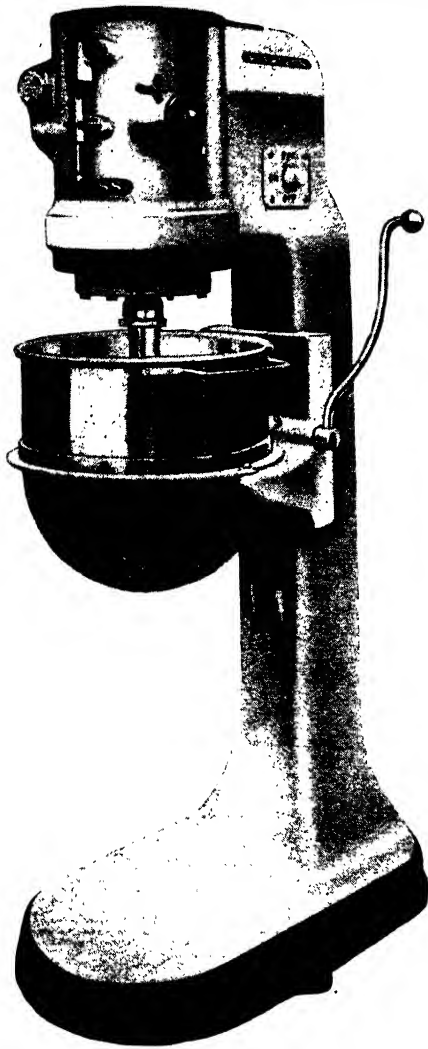
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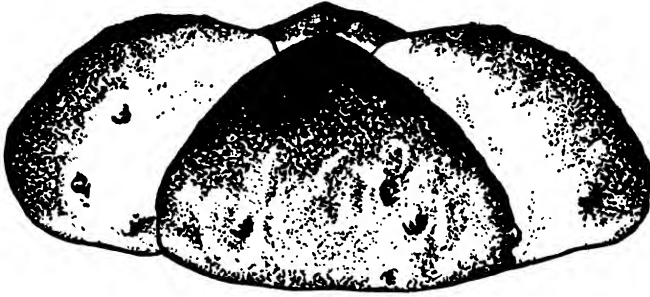
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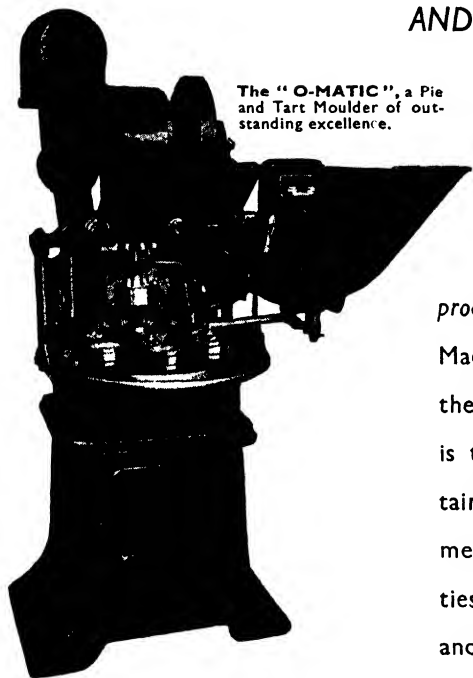
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