

# **Chapter 1**

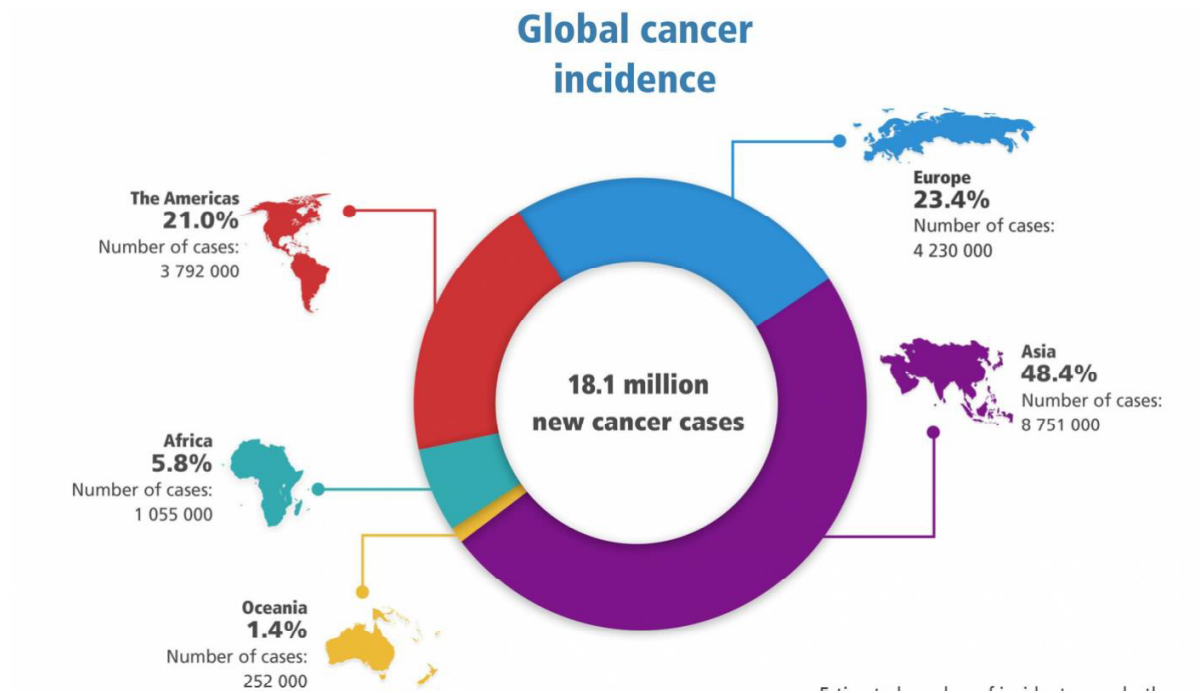
## **Introduction**

# Chapter 1

## 1.1 General Introduction

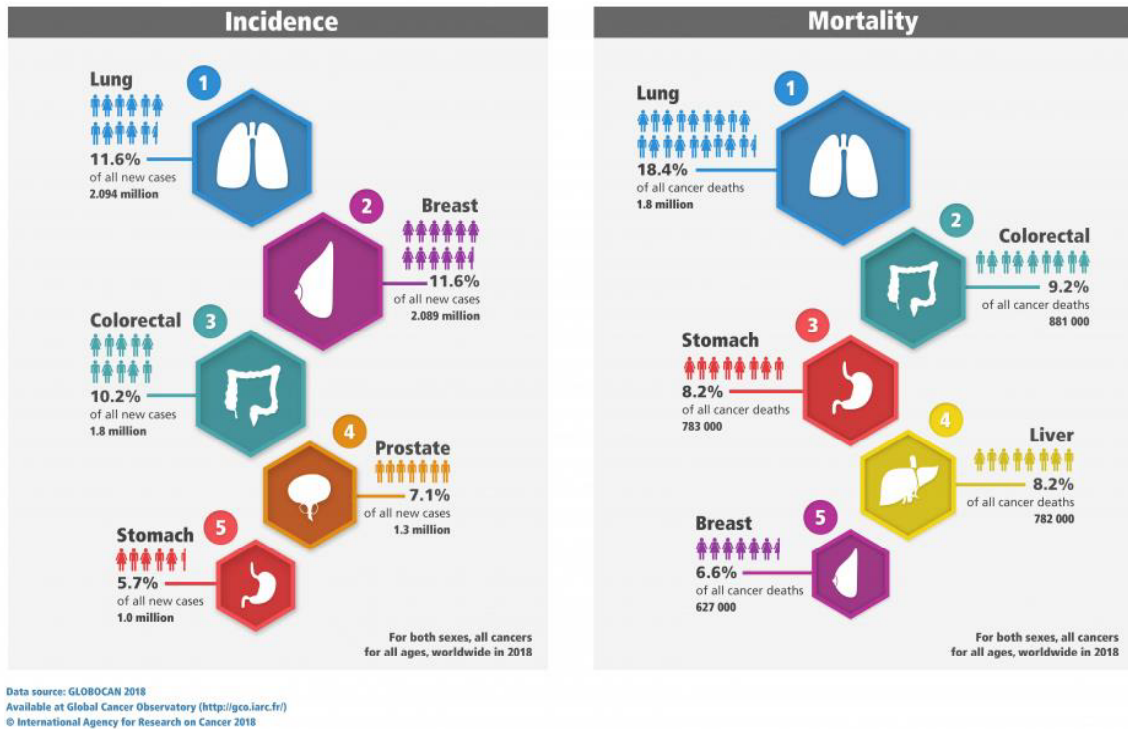
Over millennia, nature has evolved to ensure survival of diverse species against adverse environmental and pathological conditions. In case of mammals, maternal milk has paramount preventive and therapeutic benefits against vast variety of diseases, including cancer. Numerous studies in humans testify the immunological potential of human milk (Davanzo et al., 2013; Davis, 1998; Mathur et al., 1993; Parodi, 2007; El-Agamy et al., 2009; Mathur et al., 1993) . Cancer is killing more people across the world than tuberculosis, AIDS, and malaria combined. According to GLOBOCAN, an estimated 19.3 million new cancer cases and 10 million cancer-related deaths occurred in 2020. The global cancer incidence is depicted in Figure 1 and the incidences and mortality associated with five most commonly diagnosed cancers have been shown in Figure2.

This amounts to nearly 13% of all deaths. By 2030, the global cancer burden is expected to mount by about 75%, increasing to 21.4 million new cases and culminating in 13.2 million deaths (Sung et al., 2021). Cure of cancer and dealing with its side effects still remains a worldwide challenge.



**Figure 1: Global cancer data (published in Globocan-2018)**

**Percentages of new cancer cases and cancer deaths worldwide in 2018**



**Figure 2: Incidences and mortality associated with five most commonly diagnosed cancers in 2018.**

### 1.2 Significance of Camel Milk

Camel milk has a therapeutic potential against many diseases including cancer. Camel milk not only serves as a nutritional supplement well adapted to human needs but also has multiple microbicidal and immuno-stimulatory properties (Assaf and Ruppanneb, 1992; M. Ehlayel et al., 2011; El-Fakharany et al., 2008; Shabo et al., 2005; Yagil, 2013) .

Camel milk has long been utilized for its benefits in broad range of diseases like Insulin Dependent Diabetes Mellitus (IDDM) (Agrawal et al., 2005, 2003) , infant diarrhea (Yagil, 2013), hepatitis

(El-Fakharany et al., 2008), allergy, lactose intolerance (El-Agamy et al., 2009; Konuspayeva et al., 2009) and alcohol induced liver damage (Ahmed AS and Mustafa HA, Idris AA, Ismail AMA, 2011).

Its benefits can be attributed to the presence of many immunologically important molecules such as lysozymes, lactoferrin, lactoperoxidase, etc. (Elagamy et al., 1996). Although the level of lactoferrin is comparable to cow's milk, even then its bioactivity is slightly higher (Conesa et al., 2008; Narmuratova et al., 2006). It contains extraordinarily high levels of insulin like molecule (Agrawal et al., 2005, 2003). It is also a very rich source of camelid antibodies, which have an immense immunological potential. These antibodies have a very specialized structure and function. Camelid antibodies have only heavy chains (but no light chains) but still have a comparable specificity. Their increased penetrating ability points towards its therapeutic benefit by modulating the immune system (De Genst et al., 2006; Desmyter et al., 2001).

Camel milk's outstanding properties include its ability promote muscle strength, enhance wound healing (in normal and diabetic individuals), improve cognitive functions and promotes bone growth. It has been shown to successfully help in diabetes management. The components of Camel Whey Protein (CWP) exhibit an anti-inflammatory, antibacterial, and antiviral activities. Its consumption can be used to check diseases associated with exposure of environmental toxicants. When compared with bovine milk whey proteins, it has been observed that camel milk whey proteins have more antioxidant and anti-microbial properties. It can thus serve as an excellent nutraceutical compound with diverse medicinal properties (Shamsia, 2009).

The medicinal properties of Camel milk can be attributed to its two major fractions the whey and casein. Camel Whey Protein (CWP) is obtained after removing fat and the casein portion of camel milk while retaining the remaining bioactive proteins such as lactoferrin (LF),  $\alpha$ -lactalbumin,

lactoperoxidase, lysozyme, etc. Camel milk contains less lactose than cow's milk, making it more tolerable for many people with lactose intolerance. Due to its low fat content it is also a commendable slimming agent. Camel milk is found to be similar to human milk and therefore may be considered as super food. As per the opinion of Badr et al., (2017) camel whey protein is a new dietary approach to the management of free radicals and for the treatment of different health disorders.

In contrast to bovine derived whey proteins CWP lacks  $\beta$ -lactoglobulin, the main cause of milk allergies in people. It can thus be used by children and adults showing symptoms of milk allergy. Camel milk casein is a very rich source of protein with the ability to promote muscle building, increase metabolic activity, prevent dental caries and enhance the level of satiation. Camel milk casein is perfectly suitable for people who have bovine milk allergy, which is caused due to the presence of A1 beta-casein proteins. Camel milk, on the other hand lacks A1 beta-casein but contains A2 beta-casein proteins as a substitute, thus is perfectly safe for people with cow milk allergies. Camel casein derived peptides demonstrate Angiotensin-converting-enzyme (ACE) inhibitory activity. ACE inhibitors are a class of medication used primarily for the treatment of high blood pressure and heart failure. Thus it can be used for management of life style disorders.

### **1.3 Camel Milk and Cancer**

It has been traditionally believed in the Middle Eastern countries that camel milk has both preventive and therapeutic potential against cancer. Recently there have been many upcoming scientific evidences to lend support to this belief (Korashy et al., 2012b, 2012a; Magjeed, 2005) . It has been suggested to counteract cancer cells due to the presence of numerous molecules with proven potential antineoplastic activity in other species. Some such molecules are: lactoferrins, immunoglobulins, TNF-related apoptosis-inducing ligand (TRAIL) and iron - binding

glycoprotein. It has also been reported that camel milk contains lactoperoxidase which possess anti-tumor activity. The presence of TRAIL, an immunomodulatory molecule that counters cancer has been reported in camel milk (Dubey et al., 2016).

Moreover, structurally and functionally similar molecules with anti-cancer properties have been discovered in milk across diverse mammalian species (Zhang et al., 2009) . For example, Human  $\alpha$ -lactalbumin made lethal to tumor cells (HAMLET), a conjugate of  $\alpha$ -lactalbumin and oleic acid, is an antitumor biomolecule known to act not only against a wide range of cancer cell lines, but also against some human tumors. It has shown significant positive response in treating glioblastomas skin papillomas, and bladder cancers. Interestingly, a variety of HAMLET-like substances from milk of other mammalian species have been discovered (Zhang et al., 2009). These molecular species with anti-cancer activity have been referred to as XAMLET, just for the sake of generalization where X stands for any other mammalian species. The potential of presence of such a molecule in camel milk is of special interest.