Table of Contents

S.No.	Chapters	Page No.
1.	List of tables	14
2.	List of figures	15
3.	Abbreviations	17
4.	Chapter 1: Introduction	20
	1.1 General Introduction	21
	1.2 Significance of Camel Milk	23
	1.3 Camel Milk and Cancer	25
5.	Chapter 2: Review of literature	27
	2.1 Milk	28
	2.1.1 Immunological and anti-cancer activity of human milk	28
	2.1.1.1 α-lactalbumin	31
	2.1.1.2 HAMLET (Human α–lactalbumin made lethal to	31
	tumors)	
	2.1.1.3 TNF - Related Apoptosis Inducing Ligand (TRAIL)	33
	2.2 Epidemiological evidences of anti-cancer properties of	33
	Human milk	
	2.3 Camel milk	34
	2.3.1 Nutritional value of camel milk	36
	2.3.2 Medicinal properties and therapeutic potential of camel	38
	milk	
	2.4 Camelid antibodies	42

	2.5 Anti-cancer properties of camel milk	44
	2.5.1 Evidences supporting anti-cancer properties of camel	
	milk	45
	2.6 Mechanism of action of camel milk proteins	
	2.6.1 Role of aryl hydrocarbon receptors	46
	2.6.2 Modulation of aryl hydrocarbon receptors in cancer	47
	therapy	48
	2.6.3 Signaling mechanisms	
	2.7 Gaps in Research	49
		50
6.	Chapter 3: Aims and objectives	52
7.	Chapter 4: Research methodology	54
	4.1 Collection of milk sample	55
	4.2 Sample processing	55
	4.2.1 Separation of whey and casein fractions from camel milk	55
	4.2.2 Quantitation of milk proteins	56
	4.2.3 Sodium dodecyl sulphate (SDS) polyacrylamide gel	57
	electrophoresis of camel milk proteins	
	4.2.3.1. Protein separation	57
	4.2.3.2 Staining of polyacrylamide gel	58
	4.2.3.2.1 Commassie blue dye staining	58
	4.2.3.2.2 Silver staining	59
	4.3 Column chromatography	60
	4.3.1 Preparation of chromatography column	60
	4.3.2 Preparation of gel beads (Sephadex G 100)	60
	4.4 FPLC	60
	4.5 Culture of HeLa cell line	61
	1	1

4.5.1 Maintenance of cell line	61
4.5.2 Cryopreservation of cells	61
4.5.3 Thawing of cells	62
4.6 MTT assay for cytotoxicity analysis	62
4.7 Cell migration assay	63
4.8 DAPI Staining	64
4.9 Caspase Assay	64
4.10 Fractionation of camel milk whey	65
4.11 LC-MS/MS analysis	65
4.11.1 Sample Preparation	65
4.11.2 Mass Spectrometric Analysis of Peptide Mixtures	65
4.11.3 Protein hydrolysate analysis by Proteome Discoverer	66
4.12 In-silico comparative structural analysis of α -lactalbumin	66
4.12.1 Sequence Retrieval	66
4.12.2 Primary sequence comparison	66
4.12.3 Secondary structure comparison	67
4.12.4 Comparative Conformational Analysis	68
8. Chapter 5: Anti-cancer property of camel milk proteins and	69
associated cytotoxicity mechanisms	
5.1 Introduction	70
5.2 Outline of work	71
5.3 Results	71
5.3.1 Quantitation of camel milk protein	71
5.3.2 Profiling of camel milk proteins by SDS-PAGE	72
5.3.3 Effect of camel milk, camel milk whey and Camel milk	73
casein on HeLa cell viability	
5.3.4 Cell migration assay	75
5.3.5 Effect of camel milk whey on HeLa cells studied by	76
of the lifet of tamer min whey on fredu temp stated by	
fluorescent microscopy	
	79

9.	Chapter 6: Fractionation of camel milk to derive bioactive	83
	components	
	6.1 Introduction	84
	6.2 Outline of work	84
	6.3 Results	85
	6.3.1 SDS-PAGE Electrophoresis of camel milk and	85
	components	
	6.3.2 Protein purification by Gel filtration Chromatography	86
	6.3.3 SDS-PAGE of fractions separated by gel filtration	87
	chromatography	
	6.3.4 Purification of bioactive component from whey by	88
	FPLC	
	6.3.5 LC-MS/MS of whey fraction	89
	6.4 Discussion	92
	6.5 Conclusion	94
10.	Chapter 7: Comparative computational analysis of protein	95
	structure and physiochemical properties of camel	
	lpha-lactalbumin with other mammalian species	
	7.1 Introduction	96
	7.2 Outline of work	98
	7.3 Results	99
	7.3.1 Comparison of protein sequence of α -lactal burnin in the	99
	Camel, Humans, Cow and Goat	
	7.3.1.1 Comparison of the primary protein sequences	100
	7.3.1.2 Sequence identity and alignment score of camel α -	102
	lactalbumin protein with other three species	
	7.3.2 Comparison of the secondary structure of α -lactalbumin	102
	in the four species	
	7.3.3 Comparative tertiary structural analysis of α -	103
	lactalbumin amongst the four species	
	7.3.3.1 Tertiary structure of α -lactal burnin the four species	103

	7.3.3.2 Structural comparison of calcium binding domain of camel α-lactalbumin with all the other three species	106
	7.4 Discussion	107
	7.5 Conclusion	109
11.	Chapter 8: Conclusion and future scope of work	110
	8.1 Conclusion	111
	8.2 Limitation of study	112
	8.3 Future scope of the thesis	113
12.	References	114
13.	List of Publications	130
14.	Brief Biography of the Candidate	136
15.	Brief Biography of the Supervisor	137