www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; SP-10(11): 855-860

www.thepharmajournal.com
Received: 07-09-2021
Accepted: 09-10-2021

Jorawar Singh
Department of Livestock Products Technology, CVAS, RAJUVAS, Bikaner, Rajasthan, India

Basant Bais
Department of Livestock Products Technology, CVAS, RAJUVAS, Bikaner, Rajasthan, India

Devendra Kumar
ICAR-Indian Veterinary Research Institute (ICAR-IVRI), Izatnagar, Bareilly, Uttar Pradesh, India

Lokesh Tak
Department of Livestock Products Technology, CVAS, RAJUVAS, Bikaner, Rajasthan, India

Jyoti Kumari
Department of Livestock Products Technology, CVAS, RAJUVAS, Bikaner, Rajasthan, India

Pankaj Kanwar
Department of Livestock Products Technology, CVAS, RAJUVAS, Bikaner, Rajasthan, India

Jena Ram Gahlot
Department of Livestock Products Technology, CVAS, RAJUVAS, Bikaner, Rajasthan, India

Ranjana
Department of Livestock Products Technology, CVAS, RAJUVAS, Bikaner, Rajasthan, India

Corresponding Author
Jorawar Singh
Department of Livestock Products Technology, CVAS, RAJUVAS, Bikaner, Rajasthan, India

Study on development and quality of khoa prepared from mixing of camel and buffalo milk

Jorawar Singh, Basant Bais, Devendra Kumar, Lokesh Tak, Jyoti Kumari, Pankaj Kanwar, Jena Ram Gahlot and Ranjana

Abstract
The present study was carried out to assess the best ratio of camel and buffalo milk mixing for khoa production. Camel milk was mixed with buffalo milk at different ratios (60:40, 50:50 and 40:60%), respectively. The amount of khoa obtained from each batch was measured and yield of khoa obtained on the basis of amount of milk taken was calculated. The data obtained for yield of khoa obtained from different treatments of mix milk of camel and buffalo i.e. T_1, T_2 and T_3 along with their total cost of production for Khoa (₹/Kg). The camel milk had the lowest total solids content therefore, lower yield of khoa obtained from camel milk. So mixing of buffalo milk and camel milk in equal quantity (50% camel milk and 50 % buffalo milk) was done to increase yield, low production cost and to obtain better consistency of Khoa. On the basis of sensory quality score, the khoa obtained from camel milk had the lowest overall acceptability score, followed by khoa from buffalo milk and the highest overall acceptability score was obtained in khoa from mix milk of camel and buffalo. On the basis of proximate analysis, the khoa obtained from mix milk of camel and buffalo have higher value of ether extract and crude protein whereas lower value of moisture and total ash as compared with khoa obtained from camel milk.

Keywords: khoa, yield, production cost, consistency, sensory quality, proximate analysis

Introduction
In the western world, camel milk is experiencing a novel awareness in these days and even the FAO has stepped in promoting camel milk (Ramet, 2001) [21]. Camel milk is considered to have anti-cancer (Magjeed, 2005) [15], hypo-allergic (Shabo *et al.* 2005) [22] and anti-diabetic properties (Agrawal *et al.* 2003) [2]. High content of unsaturated fatty acids contributes to its overall dietary quality (Karray *et al.* 2005; Konuspayeva *et al.* 2008) [11, 14]. Camel milk is rich in chloride. Chlorides contents ranged between 0.20 and 0.28 g per 100 g, respectively and the mean value (g per 100 g) was 0.26± 0.01 for chlorides (Khaskheli *et al.* 2005) [13].
Buffalo milk has a high fat content and can be preserved naturally for longer periods due to high peroxidase activity. Buffalo milk contains more calcium, better calcium**:**phosphorous ratio and less sodium and potassium compared to cow milk, making it a better nutritional supplement for infants. Buffalo milk is preferred for the preparation of western and traditional (indigenous) milk and dairy products and is superior in nutritional terms.
In India 46 per cent of total milk production consumed as liquid milk and 54 per cent is converted into milk products (www.nddb.org/statistics/milkproduction). Amongst the traditional milk products, khoa is an important indigenous heat coagulated, partially dehydrated milk product, popular in large section of population throughout the country. The chemical composition of khoa include 20-25% humidity, 25-37% fat, 17-20% protein, 22-25% lactose, 3.6-3.8% ash and 100-103 ppm iron depending on whether it is made from cow, buffalo or mixed milk (Moulick and Ghatak, 1997) [8]. It contains relatively large amounts of building proteins, bone forming minerals and energy giving fat and lactose. Most fat-soluble vitamins A, D, E and K are also expected to be retained. Above all, milk conversion to Khoa is the best milk preservation method for a relatively longer period of time without the use of any natural or chemical preservatives.

Material and Methods
Fresh camel milk was collected from camel dairy maintained at ICAR-NRC on Camel, Bikaner and fresh buffalo milk was collected from buffaloes maintained under the 'Buffalo Unit' of Dept. of LPT, CVAS, RAJUVAS, Bikaner. All samples were collected manually in

sterile bottles and were kept under chilled condition to perform the different experiments.

Experimental trials were done to select a suitable ratio of camel and buffalo milk for khoa preparation. In preparation of khoa, total solids (TS) of milk are concentrated by removal of water from the milk. Therefore, yield of khoa depends on initial total solids (TS) content of the milk and yield of khoa is expected to be closely proportional to the increase in total solids content of the milk. In trials yield of khoa obtained from three different types of milk was proportional to total solids content of the respective milk.

Formation and accessibility of khoa from mixing of camel and buffalo milk

There exist plenty of reviews and research studies on the manufacturing aspects and market qualities of Khoa. However, as the present study is restricted to the sweets prepared employing heat desiccation of milk, the review encompasses only the related studies of the selected milk sweets.

Dave (1938) [4], Davies (1940) [5], De and Ray (1952) [6, 7], Rajorhia and Srinivasan (1979) [20] have described the traditional method, followed commonly by the unorganized sector, for manufacture of Khoa by boiling 2-3 kg of milk in a small, shallow, open, round, thick bottomed iron pan (karahi) having two loop handles, placed over a brisk non-smoky fire. The milk is stirred vigorously and constantly with a circular motion by an iron stirrer known as khunti during this operation all parts of the pan with which milk comes in contact are lightly scraped to prevent milk from burning and overheating. Evaporation of water takes place and at a certain stage of concentration heat coagulation of milk proteins occurs resulting in a viscous mass, marked by an abrupt change in color. Heat desiccation is continued with closer attention and increased speed of scraping till a semi-solid consistency is obtained. The final product is ready when it shows signs of leaving the bottom and sides of the karahi and sticking together. Khoa was prepared separately from all the treatments groups for different parameters by following the indigenous method of open pan desiccation of milk in a shallow, open, thick bottomed iron pan 'karahi' of 6 litres capacity as described by Srinivasan and Anantakrishnan (1964) [24]. Stirring and scraping of the pan surface with iron stirrer was continued till a desired consistency was reached. After cooling, polyethylene bags (65 micron thickness) were used to pack the different treatment khoa under studies. Flow diagram for preparation of khoa has been presented in figure 1.

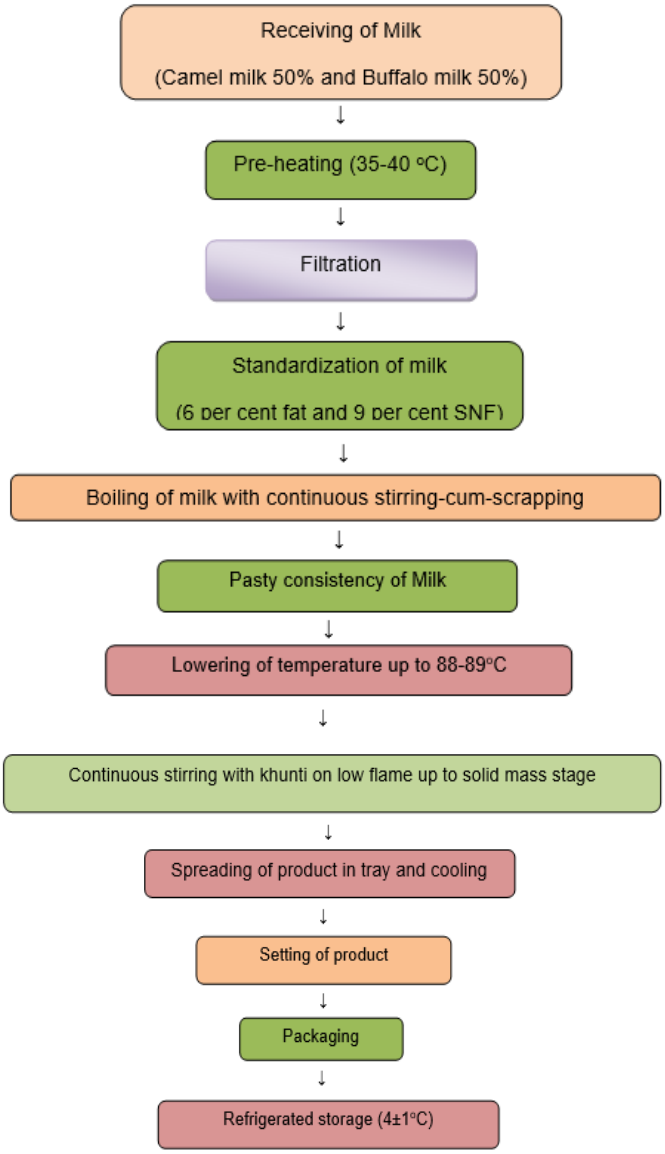

Fig 1: Flow diagram for preparation of khoa

Preparation of Khoa
The amount of khoa obtained from each batch was measured and yield of khoa obtained on the basis of amount of milk taken was calculated. The data obtained for yield of khoa obtained from different treatments of mix milk of camel and buffalo.
T_1 - 60% camel milk + 40% buffalo milk,
T_2 -50% camel milk + 50% buffalo milk
T_3 - 40% camel milk + 60% buffalo milk

Sensory Evaluation
The samples of different treatments camel and buffalo milk khoa prepared as per the formulations were subjected to sensory evaluation on 8 point hedonic scale by a panel of eight semi-trained members from academic staff and students of the department for various sensory attributes viz., appearance & colour, flavour, body & texture and overall acceptability using 8 point descriptive scale (Keeton, 1983) [12], where '8' denotes 'Excellent' and '1'denotes 'extremely poor'. Camel and buffalo milk khoa samples were presented in plastic plates. All samples were marked with digital code, and the order of presentation of samples was randomized for each panelist.

Proximate Analysis
Proximate analysis of camel and buffalo milk khoa was done according to method described by A.O.A.C. (2000) [1] (Official methods of analysis), including estimation of moisture content, crude protein (CP), ether extract (EE), crude fibre (CF) and total ash.

Cost evaluation of the developed khoa
The cost evaluations of the developed camel and buffalo milk khoa have been worked from prevalent market prices of all the ingredients required for preparation of treatment khoa.

Statistical analysis
All the experiments of study were repeated three times and samples were drawn in duplicate. Data collected during the present investigation were subjected to statistical analysis by adopting appropriate methods of analysis of variance as described by Snedecor and Chochran (1994) [23].

Results and Discussion
Yield and Production Cost of Khoa prepared from different ratio of camel and buffalo milk
In Table 1 the manufacturing cost of khoa calculated on the basis of prevailing market rates of raw milk. The yield of khoa prepared from 60% camel milk and 40% buffalo milk (T_1) was 193.84 gm/kg mix milk and cost of production was 226.99₹/Kg. The yield and cost of production of khoa prepared from 50% camel milk and 50% buffalo milk (T_2) was 199.20 gm/kg and 225.90₹/Kg respectively. The yield and cost of production of khoa prepared from 40% camel milk and 60% buffalo milk (T_3) was 203.02 gm/kg and 226.57₹/Kg respectively. Mal and Pathak (2010) [16] reported 15 to 20 per cent yield of khoa from camel milk.

Table 1: Yield and Production Cost of Khoa prepared from admixture of camel and buffalo milk in different ratio

Type of Milk	Ratio of Milk		Price of mixed milk (₹/Kg) (Camel milk- 40₹/Kg Buffalo milk-50₹/Kg)	Yield (gm/kg milk)	Yield (%)	Total cost of Production for Khoa (₹/Kg)
	Camel (g)	Buffalo (g)				
T_1	600	400	44	193.84	19.38	226.99
T_2	500	500	45	199.20	19.92	225.90
T_3	400	600	46	203.02	20.30	226.57

Note- T_1 - 60% camel milk + 40% buffalo milk, T_2 - 50% camel milk + 50% buffalo milk, T_3 - 40% camel milk + 60% buffalo milk

Similar results were obtained by Jashubhai (2013) [10] who reported average yield of khoa obtained from camel, cow and buffalo milk was 17.24, 20.04 and 25.52 per cent, respectively. De and Ray (1952) [6, 7] also reported an average yield of 21.5 per cent from buffalo milk. Average yield of khoa from camel milk is 10% -20% per cent.

Sensory evaluation of camel milk khoa, buffalo milk khoa and khoa by mixing of camel and buffalo milk
Sensory evaluation is the science related to the senses. Human senses include touch, smell, vision, hearing and taste. These organoleptic characteristics are judged by different organs of our body. In this evaluation product is judged for different sensory attributes such as flavour, color and appearance, body and texture as well as overall acceptability. All the samples of khoa were prepared in four replications of the present study and were evaluated for their sensory attributes on eight point hedonic scale by a panel of judges.
The camel milk, buffalo milk and by mixing of camel and buffalo milk khoa prepared was evaluated for sensory attributes and result obtain have been presented in Table 2 and in figure 2.

Table 2: Sensory quality score of khoa prepared from camel milk, buffalo milk and mixing of camel and buffalo milk

Parameters	Camel milk khoa	Buffalo milk khoa	Camel and Buffalo mix milk khoa
Flavour	$6.5^{a} \pm 0.289$	$7.5^{b} \pm 0.289$	$7.6^{b} \pm 0.204$
Body and texture	$6.0^{a} \pm 0.408$	$7.0^{ab} \pm 0.408$	$7.5^{b} \pm 0.289$
Appearance and colour	7.0 ± 0.408	7.5 ± 0.289	7.4 ± 0.239
Overall acceptability	$6.5^{a} \pm 0.231$	$7.3^{b} \pm 0.188$	$7.5^{b} \pm 0.152$

Note– Means bearing different superscript in a row (small letter) differ significantly.

Mean score for sensory quality of khoa prepared from camel milk and buffalo milk for flavour, body & texture, appearance & colour and overall acceptability was 6.5 ± 0.289, 6 ± 0.408, 7 ± 0.408, 6.5 ± 0.231 and 7.5 ± 0.289, 7 ± 0.408, 7.5 ± 0.289, 7.34 ± 0.188 respectively. Mean score for sensory quality of khoa prepared from combination of 50% camel milk and 50 % buffalo milk for flavour, body & texture, appearance & colour and overall acceptability was 7.62 ± 0.204, 7.5 ± 0.289, 7.38 ± 0.239 and 7.5 ± 0.152 respectively.

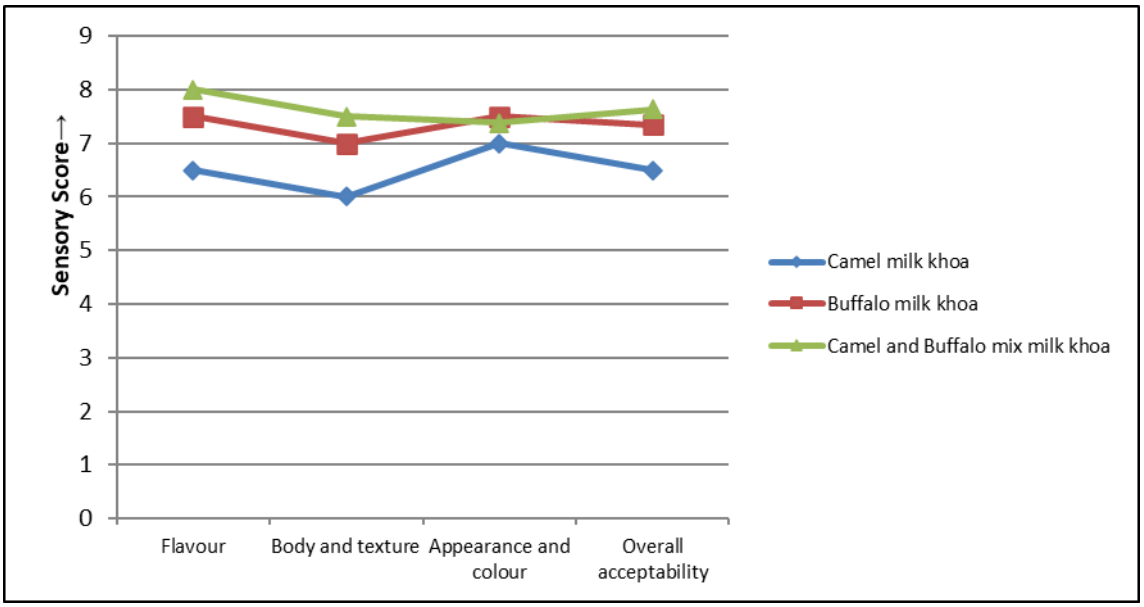

Fig 2: Sensory quality of khoa prepared from camel milk, buffalo milk and mixing of camel and buffalo milk

A highly significant difference ($p<0.01$) was observed between treatment of khoa prepared from camel milk, buffalo milk and mix milk of camel and buffalo for all parameter of sensory evaluation except appearance and colour. Thus it may be interpreted that the milk of camel, buffalo and mix milk of camel and buffalo significantly affect the sensory quality of khoa.

The results related to sensory evaluation of khoa prepared from camel milk, buffalo milk and mix milk of camel and buffalo were in conformity with Jashubhai (2013) [10]. The khoa obtained from camel milk had very loose and highly sticky body and smooth texture. Thus, consistency of khoa obtained from camel resembled to Dhap variety of khoa. The khoa obtained from buffalo milk was having hemispherical pat with smooth and homogenous body and texture, thus falling under the category of Pindi type.

Thus it may be concluded that amongst khoa prepared from camel milk, buffalo milk and mix milk of camel and buffalo, the khoa obtained from camel milk had the lowest overall acceptability score, followed by khoa from buffalo milk whereas the highest overall acceptability score was obtained in khoa prepared from mix milk of camel and buffalo.

Proximate analysis of camel milk khoa, buffalo milk khoa and khoa by mixing of camel and buffalo milk

Proximate analysis of camel milk khoa, buffalo milk khoa and khoa by mixing of camel and buffalo milk was done according to method described by A.O.A.C. (2000) [1] (Official methods of analysis). The data of proximate analysis of khoa presented in table 3 and in figure 3.

The moisture content in camel milk khoa, buffalo milk khoa and khoa by mixing of camel and buffalo milk was observed to be 36.47 ± 0.229, 22.14 ± 0.066 and 31.29 ± 0.037 respectively. The ether extract percentage in camel milk khoa, buffalo milk khoa and khoa by mixing of camel and buffalo milk was observed to be 23.45 ± 0.034, 31.24 ± 0.034 and 26.99 ± 0.078 respectively. The crude protein and total ash percentage in camel milk khoa, buffalo milk khoa and khoa by mixing of camel and buffalo milk was observed to be 19.31 ± 0.022, 20.82 ± 0.03, 20.06 ± 0.032 and 5.14 ± 0.029, 3.68 ± 0.028, 4.55 ± 0.027 respectively.

A highly significant difference ($p<0.01$) was observed between treatment of camel milk khoa, buffalo milk khoa and khoa by mixing of camel and buffalo milk was observed for moisture, ether extract, crude protein and total ash as shown in table 3.

Table 3: Proximate analysis of khoa prepared from camel milk, buffalo milk and mixing of camel and buffalo milk

Constituent (%)	Camel milk khoa	Buffalo milk khoa	Camel and Buffalo milk khoa
Moisture	$36.47^{c} \pm 0.229$	$22.14^{a} \pm 0.066$	$31.29^{b} \pm 0.037$
Ether extract	$23.45^{a} \pm 0.034$	$31.24^{c} \pm 0.034$	$26.99^{b} \pm 0.078$
Crude Protein	$19.31^{a} \pm 0.022$	$20.82^{c} \pm 0.03$	$20.06^{b} \pm 0.032$
Total ash	$5.14^{c} \pm 0.029$	$3.68^{a} \pm 0.028$	$4.55^{b} \pm 0.027$

Note– Means bearing different superscript in a row (small letter) differ significantly.

The results related of proximate analysis of khoa prepared from camel and buffalo milk were in conformity with Jashubhai (2013) [10]. The average moisture content was 36.43, 30.05 and 22.22 per cent, fat content was 24.0, 23.2 and 31.6 per cent, protein content was 19.34, 21.52 and 20.88 per cent and ash content was 5.18, 3.69 and 3.63 per cent of khoa prepared from camel, cow and buffalo milk, respectively.

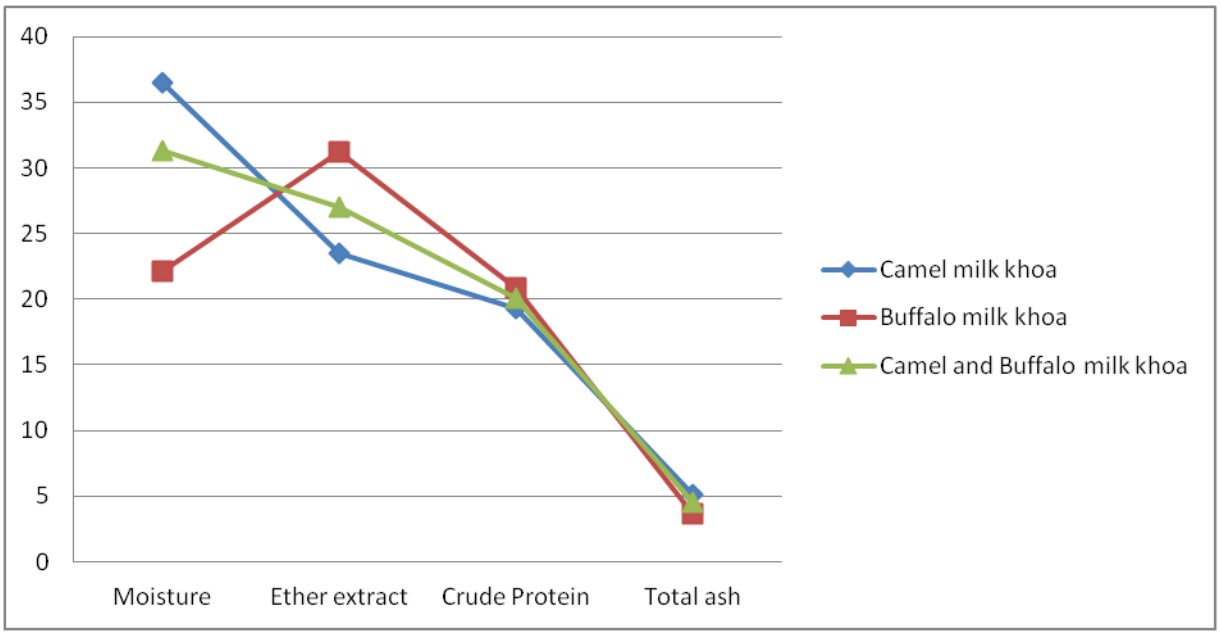

Fig 3: Proximate analysis of khoa prepared from camel milk, buffalo milk and mixing of camel and buffalo milk

The moisture content in khoa prepared from buffalo milk vary from 19.3 (Srinivasan and Anantakrishnan, 1964) [24] to 33.22 per cent (Miyani, 1988) [17]. Ether extract content vary from from 20.08 (Miyani, 1988) [17] to 39.11 per cent (Hemavathy and Prabhakar, 1983). The crude protein content in market sample of khoa was reported in the range of 17.86 (Gothwal and Bhavdasan, 1992) [8] to 27.24 per cent (Dastur and Lakhani, 1971) [3]. The ash content in khoa prepared from buffalo milk vary from 3.70 (Miyani, 1988) [17] to 4.56 per cent (Narain and Singh, 1981) [19]. The data obtained in present study for average per cent moisture, ether extract, crude protein and ash content of khoa prepared from buffalo milk was in agreement with those reported in the literature.

Conclusion

In this study, best result obtained on the basis of yield, production cost and consistency of Khoa by combination of 50% camel milk and 50 % buffalo milk with optimum sensory and nutritional properties as well as good storage stability. Increasing camel milk into the ratio made the khoa consistency inappropriate and decreases the yield whereas decrease camel milk ratio decreases its properties into product.

References

1. AOAC. Official methods of analysis, 17th edition, Association of Official Analytical Chemists, Washington, D.C 2000.
2. Agrawal RP, Swami SC, Beniwal R, Kochar DK, Sahani MS, Tuteja FC *et al*. Effect of camel milk on glycemic control, lipid profile and diabetes quality of life in type-1 diabetes: a randomised prospective controlled cross over study. Indian Journal of Animal Science 2003;73:1105e1110.
3. Dastur NN, Lakhani AG. Chemical composition of khoa. Indian J. Dairy Sci 1971;24(4):220.
4. Dave CN. Poona Agril. College J., (Cited from De and Ray, 1952). 1938;30:49.
5. Davies WL. Indian indigenous milk products." Thacker Spink and Co., Calcutta 1940, 19.
6. De S, Ray SC. The studies on the indigenous method of khoa making. Part-1. The influence of the conditions of dehydration and the type of milk on the production of khoa. Indian J Dairy Sci 1952;5:47-60.
7. De S, Ray SC. Studies on the indigenous method of *Khoa* making. Part I. The influence of the conditions of dehydration and the type of milk on the production of Khoa. India J Dairy Sci 1952;5:147-151.
8. Gothwal PP, Bhavadasan MK. Studies on the browning characteristics in dairy products. Indian J Dairy Sci. 1992;45:146.
9. Hemavathy J, Prabhakar JV. Changes in the carbonyl compostion of milk based sweetmeat – burfi during preparation and storage. J Food Sci. Technol. India. 1983;10:56.
10. Jashubhai CM. Characterization of Khoa Prepared From Camel Milk And Evaluation of Its Suitability For Preparation of Selected Sweets. M.Tech. (Dairy Technology). Thesis submmited to Anand Agricultural University, Anand 2013.
11. Karray N, Lopez C, Ollivon M, Attia H. La matière grasse du lait de dromadaire: composition, microstructure et polymorphisme. Une revue Ol. Corps Gras Lipides 2005;12:439-446.
12. Keeton JT. Effects of fat and NaCl/phosphate levels on the chemical and sensory properties of pork patties. J. of Food Sci, 1983;48(3):878-88.
13. Khaskheli M, Arain MA, Chaudhry S, Soomro AH, Qureshi TA. Physico chemical quality of camel milk. J. Agri. Soci. Sci 2005;2:164-166.
14. Konuspayeva G, Lemarie E, Faye B, Loiseau G, Montet D. Fatty acid and cholesterol composition of camel's (*Camelus bactrianus*, *Camelus dromedarius* and hybrids) milk in Kazakhstan. Dairy Sci. Technol 2008;88:327-340
15. Magjeed NA. Corrective effect of milk camel on some cancer biomarkers in blood of rats intoxicated with aflatoxin B1. Journal of the Saudi Chemical Society, 2005;9:253e263.
16. Mal G, Pathak KML. Camel milk and milk products, SMVS' DAIRY YEAR BOOK 2010;97:103
17. Miyani RV. Evaluation of Influence of Various Processing Parameters on the Rehological Properties of

Khoa and Penda. Ph. D thesis. Gujarat Agricultural University, Gujarat 1988.
18. Moulik S, Ghatak PK. Khoa- A review. J. Dairy Foods and Home Sci 1997;16(2):73-86.
19. Narain N, Singh GS. The qualities of khoa marketed in Varanasi city. Indian J Dairy Sci 1981;34:91.
20. Rajorhia GS, Srinivasan MR. Technology of Khoa- A review. Indian J. Dairy Sci 1979;32:209-216.
21. Ramet JP. The technology of making cheese from camel milk (*Camelus dromedarius*). FAO Animal Production and Health 2001, 113 ISBN: 92-5-103154- 1
22. Shabo Y, Barzel R, Margoulis M, Yagil R. Camel milk for food allergies in children. Immunology and Allergies, 2005;7:796e798.
23. Snedecor GW, Cochran WG. Statistical methods, 8th Edn 1994.
24. Srinivasan MR, Anantakrishnan CP. Milk products of India. Indian Council of Agricultural Research, New Delhi 1964, 88-92.