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Study of the Effect of Processing on the Chemical Quality of Soft Unripened Cheese Made from Camel Milk

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Abstract: This study was carried out to produce and observe the effect of processing on the chemical quality of soft unripened cheese made from skimmed camel milk. Soft unripened cheese from camel milk was prepared by using conventional cheese-making methodology, a mesophilic starter culture, $CaCl_2$ and a calf rennet. A total of five experiments were included in the present investigation. While cheese from buffalo milk was kept as a control. Before making cheese all the milk samples were skimmed and analyzed for their physico-chemical composition. Cheese was prepared and analyzed for their physico-chemical properties. As a consequence of processing treatments during manufacturing of soft unripened cheese, the average concentration (on DMB) of fat, ash and chlorides of skimmed camel milk were slightly decreased (i.e. from 3.62 ± 0.93 to 2.96 ± 0.62%, 11.79 ± 0.94 to 7.30 ± 0.55% and 3.18 ± 0.15 to 2.29 ± 0.26%, respectively). While, total protein and casein contents were significantly increased (i.e. 44.72 ± 4.48 to 78.88 ± 1.64% and 21.17 ± 1.31 to 59.56 ± 2.60%, respectively) because during manufacturing of cheese drainage of whey liquid and dissolved particles which contains lactose, minerals and chlorides. While rest of the mass contain higher percentage of undissolved particles (total protein particularly casein content)

Key words: Camel milk, products, cheese-making, soft cheeses, effect of processing

Introduction

Cheese is a fermented milk product made from the curds produced when milk is coagulated. Fermentation is a chemical change caused by microbes. There are more than 500 kinds of cheese, and microbes play an important role in determining the type and quality of cheese that is made (Anonymous, 1998). Making cheese from the milk of cow, buffalo, sheep and goat is easy while making cheese from camel milk is difficult and complicated. Difficulties were encountered in making cheese from camel milk, due to the longer coagulation time and weak coagulum (Mohamed, 1990). Colonies of the culture organisms taken from camel milk were found to be smaller than those from cow milk, possibly indicating the presence of growth inhibiting factors in camel milk (Gran *et al*., 1991). Nevertheless, soft unripened cheese can be made from camel milk. The difficulty in making cheese most probably refers to the technique which is being used. Making cheese is a way to preserve milk, creating the potential for trade. Camel cheese has other advantages as well: It is high in vitamins, low in cholesterol, and low in lactose, making it suitable for people who are allergic to other dairy products (Abeiderrahmane, 2001). The present study was also conducted to investigate the effect of milk components on the quality of soft unripened cheese made from camel milk.

Materials and Methods

A total of five trials of cheese-making from camel milk, were conducted during the year 1999-2001 in the Department of Dairy Technology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam, Pakistan to achieve the results of the proposed objective. While parallel to this, cheese from buffalo milk was also prepared, and kept as control for comparison purpose. Camel milk was procured from the of lactating camel herd. Buffalo milk was obtained from Livestock Experimental Station, Sindh Agriculture University, Tandojam, and was used to make soft unripened cheese. All the samples were brought in the Laboratory of Dairy Technology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam for analysis and cheese manufacturing.

Starter culture was prepared in the Dairy Technology Laboratory and was used for cheese-making . Powder of rennet enzyme was used, it was purchased from a renowned firm Christan Hansen's Laboratorium Ltd., Copenhagen. Calcium chloride ($CaCl_2$) of laboratory grade (E. Merck Darmstadt Company) was used for soft

Table 1: Physical quality of skimmed camel milk

Milk Sample	pH values	Titrable acidity%	Sp. gravity
1	6.89	0.19	1.021
2	6.93	0.18	1.024
3	6.83	0.19	1.025
4	6.98	0.17	1.020
5	6.73	0.19	1.024
Mean	6.87	0.18	1.022
SE	0.043	0.004	0.009

Table 2: Chemical composition ($g100g^{-1}$) of skimmed camel milk

Milk Sample	Total solids%	SNF%	Fat %	Protein		Lactose %	Ash %	Chlorides %
				Total Protein%	Casein %			
1	8.28	7.83	0.45	4.46	1.85	2.37	1.00	0.285
2	7.85	7.70	0.15	4.46	2.0	2.58	0.66	0.242
3	8.63	8.43	0.2	3.57	1.53	3.87	0.99	0.276
4	6.99	6.84	0.15	2.45	1.44	3.43	0.96	0.246
5	7.92	7.42	0.50	2.89	1.56	3.48	1.05	0.211
Mean	7.93	7.64	0.29	3.56	1.67	3.14	0.93	0.252
SE	0.274	0.260	0.076	0.406	0.106	0.286	0.069	0.013

SE = Standard error of difference of mean. Reported results are considered here. %age = ($g100g^{-1}$)

Table 3: Physical quality of soft unripened cheese made from camel milk

Trials	pH values	Titrable acidity %
T1	5.57	1.01
T2	4.97	1.80
T3	5.49	0.86
T4	5.21	0.34
T5	4.91	1.04
Mean	5.23	1.01
SE	0.13	0.23

T1-T5 = Trials of soft unripened cheese. SE=Standard error of difference of mean.

unripened cheese-making.

Laboratory cream separator (Alfa Laval Ltd., MIDDX) was used to separate the cream. Two local made cheese vats were used in this experiment according to the volume of milk. Two stainless steel wire knives, one longitudinal and other transverse having ½ inch space between wires, locally made were used for cutting cheese curd.

Skimmed milk samples were analyzed for pH values by using pH meter (Hanna Instrument, model HI 8471, Italy), fat contents by Gerber method as described by James (1995), specific gravity as suggested by Aggarwalla and Sharma (1961), protein contents according to the method of British Standards Institution (BSI, 1990). Whereas, for titrable acidity, total solids, ash, casein and chloride contents according to the methods described by Association of Analytical Chemists (AOAC, 1990) and the solids not fat (SNF) and lactose contents were determined by difference using the following formulas:

i) S.N.F. content = TS% - Fat %

ii) Lactose %age = TS% - (Fat% + Protein% = Ash%)

Cheese was prepared according to the method described by Sadia (1994), with slight modification in appropriate experiments. The basic methodology used is illustrated in (Fig. 1).

After preparation of soft unripened cheese, samples from each trial were collected in plastic cups covered with lid and were kept in refrigerator at 8 °C. Analyzed for their physico-chemical properties. 100 Grams of cheese sample was mashed in a pestle mortar, prepared the samples, and cheese was analyzed for its titrable acidity, fat, total protein, casein, chlorides, total solids

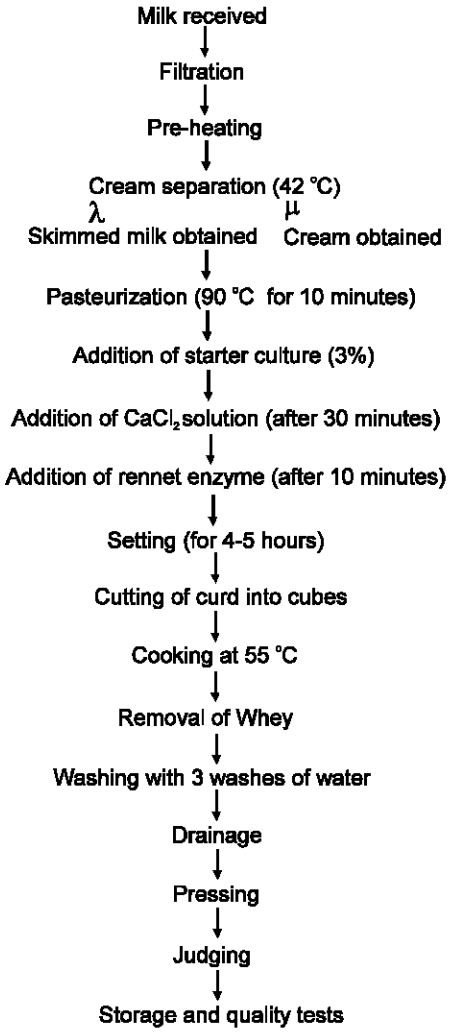

Fig. 1: Flow diagram showing different steps adopted in making soft unripened cheese from camel milk.

Table 4: Chemical composition ($g100g^{-1}$)of soft unripened cheese made from camel milk

Trails	Total solids%	SNF%	Fat%	Protein		Ash %	Chlorides %
				Casein%	Total protein%		
T1	29.46	28.86	0.60	24.79	19.64	2.24	0.53
T2	28.38	27.45	0.93	22.32	16.52	2.31	0.53
T3	29.11	28.61	0.50	22.88	18.75	2.49	0.90
T4	30.10	29.33	0.77	22.87	16.74	1.64	0.59
T5	30.69	29.09	1.60	22.87	16.24	2.08	0.83
Mean	29.54	28.66	0.88	23.14	17.57	2.15	0.67
SE	0.39	0.32	0.19	0.42	0.67	0.14	0.07

T1-T5 = Trials of soft unripened cheese. % age = ($g100g^{-1}$). SE= Standard error of difference of mean. Reported results are considered here.

Table 5: Effect of processing on the chemical quality ($g100g^{-1}$) of soft unripened cheese made from skimmed camel milk

Trails	Solids not fat (%)		Fat(%)		Total protein(%)		Casein(%)		Ash(%)		Chlorides(%)	
	SM	C	SM	C	SM	C	SM	C	SM	C	SM	C
Buffalo (Control)												
B	98.54	99.03	1.46	0.97	46.74	76.13	32.91	56.54	4.77	5.36	0.76	1.15
Camel cheese												
T1	94.57	97.96	5.43	2.04	53.86	84.15	22.34	66.67	12.08	7.60	3.44	1.81
T2	98.09	96.72	1.91	3.28	56.82	78.65	25.48	58.21	8.41	8.14	3.08	1.87
T3	97.68	98.28	2.32	1.72	41.37	78.60	17.73	64.41	11.47	8.55	3.20	3.09
T4	97.85	97.44	2.15	2.56	35.05	75.98	20.60	55.61	13.73	5.45	3.52	1.98
T5	93.69	94.79	6.31	5.21	36.49	74.52	19.70	52.92	13.26	6.78	2.66	2.71
Mean	96.38	97.04	3.62	2.96	44.72	78.38	21.17	59.56	11.79	7.30	3.18	2.29
SE	0.93	0.62	0.93	0.62	4.48	1.64	1.31	2.60	0.94	0.55	0.15	0.26
Significance	***	***	*	**	***	***	***	***	*	*	***	***
	ns		ns		***		***		*		ns	

SM = Skimmed milk C = Soft unripened cheese T1-T5 = Trials of soft unripened cheese. Significance: *** (P<0.001), ** (P<0.01), * (P<0.05) ns = not significant. SE= Standard error of difference of mean. The results are the average of two determinations. Data was calculated on dry matter basis.

and ash percentages according to the methods described by Association of Official and Analytical Chemists (AOAC, 1990).

Results and Discussion

Before cheese-making all the milk samples were skimmed and analyzed for their physico-chemical composition The pH values, acidity and specific gravity of skimmed camel milk ranged from 6.73 to 6.98%, 0.17 to 0.19% and 1.021 to 1.025%, respectively. Total solids content varied in between 6.99 and 8.63%, SNF content in between 6.84 and 8.43%, Fat content in between 0.15 and 0.50%, total protein in between 2.45 and 4.46%, casein in between 1.44 and 2.00%, lactose in between 2.37 and 3.87%, ash in between 0.66 to 1.00%, and chloride in between 0.28 and 0.21%. (Table 1 and 2).

Whereas physical attributes of soft unripened cheese ranged from 4.91 to 5.57 and 0.34 to 1.01% for pH and acidity, respectively (Table 3). Variation in chemical components of soft unripened cheese was also observed. TS content varied in between 30.69 to 28.38%, SNF in between 27.45 and 29.33%, fat in between 0.50 and 1.6%, total protein 22.32 and 24.79%, casein in between 16.24 and 19.64%, ash in between 1.64 and 2.49% and chlorides in between 0.60 and 0.90% (Table 4).

The effect of processing on the compositional quality of soft unripened cheese was analyzed Table 5. The average concentration of fat, ash and chlorides of skimmed camel milk were slightly decreased (i.e. from 3.62 ± 0.93 to 2.96 ± 0.62%, 11.79 ± 0.94 to 7.30 ± 0.55% and 3.18 ± 0.15 to 2.29 ± 0.26%, respectively), while protein and casein contents were significantly increased (i.e. from 44.72 ± 4.48 to 78.88 ± 1.64% and 21.17 ± 1.31 to 59.56 ± 2.60%, respectively) as a result of processing during preparation of soft unripened cheese. These results were expected because one of the steps during manufacturing of cheese is drainage of whey liquid, and dissolved particles such as lactose, minerals and chlorides could be drained off. While rest of the mass may contain higher percentage of undissolved particles such as total protein particularly

casein content. However, in case of fat the size of fat globules of camel milk is very small and most of it may retain in the whey liquid (Larsson-Raznikiewicz, 1990; Mohammad *et al.*, 1990).

Similar trend of increase and decrease in chemical components of soft unripened cheese from buffalo milk (as control) was observed except ash and chlorides content, which were increased instead of decreasing. The reason could be the addition of calcium chloride in cheese base during manufacturing of soft unripened cheese. Some of the mineral contents present in cheese base may found in ionic form and are not dissolved in whey liquid.

The other basic reason is that camel milk is saltish in nature whereas buffalo milk is sweetish and pleasant in flavour, there is a change in the physico-chemical composition of both milks. The results of the present study are supported by El-Bahay (1962) who reported that camel milk is rich in chloride contents and this would account for its salty taste.

Analysis of variance (ANOVA) performed on the data of skimmed camel milk showed highly significant difference ($P<0.001$) for SNF, total protein, casein and chloride contents. While difference between trials with a level of $P< 0.05$ was observed for fat and ash content of skimmed camel milk. However, the ANOVA of soft unripened cheese indicated the significant difference for SNF, protein, casein and chlorides content $P < 0.001$, for fat $P<0.01$ and for ash $P<0.05$.

Paired samples "T" Test performed on the data of skimmed camel milk and soft unripened cheese made from them revealed highly significant difference ($P < 0.001$) for total protein and casein contents, while the difference in ash contents were only significant with a level of $P < 0.05$. However, the differences were not significant ($P > 0.05$) for S.N.F, fat and chlorides content.

Conclusion: Significant increase in total protein and casein contents, and slight decrease in fat, ash and chloride contents were observed in soft unripened cheese as compared to the concentration of these components in skimmed camel milk.

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