Study on the production and quality improvement of soft unripened cheese made from buffalo milk as compared with camel milk

S. Inayat¹, M.A. Arain², M. Khaskheli², A.A. Farooq³

¹ Department of Animal Products Technology, University of Veterinary and Animal Sciences, Lahore
² Department of Dairy Technology, Sindh Agriculture University, Tando Jam, Sind, Pakistan
³ Buffalo Research Institute, Rakh Bhunikey, District Kasur, Pakistan

Corresponding author: S. Inayat. Department of Animal Products Technology, University of Veterinary and Animal Sciences, Lahore-54000, Pakistan - Tel. +92-42-9211449 - Fax: +92-42-9211461 - Email: sai-ma_as_dairy@yahoo.com

ABSTRACT: The study was carried out to produce and improve the quality of soft unripened cheese made from buffalo milk as compared to cheese made from camel milk using conventional cheese-making technique. Before making cheese all the milk samples were skimmed and analyzed for their physico-chemical composition. Mean values for pH, acidity, specific gravity, total solids, SNF, fat percentages of raw and skimmed camel milk samples, respectively were 6.87±0.03 and 6.87±0.04, 0.17±0.01 and 0.18±0.01, 1.015±0.001 and 1.023±0.001, 11.69±0.33 and 7.93±0.27, 7.59±0.26 and 7.64±0.26, 4.09±0.36 and 0.29±0.08, and total protein, casein, lactose, ash and chlorides percentages of raw and skimmed milk samples respectively were 3.16±0.20 and 3.56±0.41, 2.21 ±0.23 and 1.67±0.11, 3.48±0.27 and 3.14±0.29, 0.94±0.03 and 0.93±0.07, and 0.26±0.01 and 0.25±0.01, whereas the mean values of buffalo raw milk were 6.53, 0.17%, 1.032, 15.78%, 9.23%, 6.55%, 5.35%, 4.01%, 3.24%, 0.64%, 0.07%, and skimmed milk were 6.55, 0.18%,1.035, 10.27%, 10.12%,0.15%, 4.80%, 3.38%, 4.74%, 0.49% and 0.078% respectively. The cheese samples were analyzed for their physico-chemical properties. The mean values for pH, acidity in terms of lactic acid (1.01± 0.23%), total solids (29.54±0.39%), solids not fat (28.66± 0.33%), fat (0.88±0.19%), total proteins(23.14±0.42%), casein(17.57±0.68%), ash(2.15±0.14%) and chloride contents(0.67± 0.08%) whereas the values of physico-chemical quality of soft unripened cheese made from buffalo milk for pH, acidity, total solids, SNF, fat, total protein, casein, ash and chlorides percentages were respectively 5.47, 0.45, 30.79, 30.49, 0.3, 23.44, 17.41, 1.65,0.355. Trial 1 yielded the highest percentage (7.68) of cheese followed by Trial 2 (7.38), Trial 3 (7.22) and Trial 5 (5.68). While Trial 4 yielded the lowest percentage (5.49). Whereas cheese yielded from buffalo milk was 12.22 %. Samples from each trial were presented to the panel of five judges for sensory evaluation. Trial 4 rated highest score for physical appearance, body and texture and taste/ flavor followed by Trial 3, Trial 2, Trial 1 and Trial 5. In contrast to camel milk cheese, buffalo milk cheese significantly showed the highest score in all aspects.
**INTRODUCTION** - Camel milk is extremely popular in many countries of the world and is an important component of the human diet of the people of Sudan, Somalia and Saudi Arabia. It is widely consumed both as fresh and soured but very little portion is converted into milk products like butter, butter oil, yogurt and cheese (Mehaia, et al., 1995). It may be due to its high resistance to bacterial growth, which may create a problem in making such type of products (Kamoun, 1990). Pakistan possesses 1.12 million heads of camel and rank 4th in the world (Anonymous, 2000). These camels are mostly reared in the desert and hilly areas of the country. The female camel yields 7 to 10 liters of milk per day with lactation length varying from 220-450 days (Yasin and Wahid, 1957). However, there is no commercial value or marketing of camel milk in Pakistan but it is only consumed locally by the family members of the producers as fresh and/or soured. Present study was, therefore, designed to produce and improve the quality of soft unripened cheese and also to develop cheese acceptability profile made from camel milk.

**MATERIAL AND METHODS** - An experiment was conducted to prepare soft unripened cheese from camel milk by using conventional cheese-making methodology. Milk was procured from lactating camel herds maintained by the farmers of district Hyderabad and district Badin. While for cheese from buffalo milk, milk was procured from Livestock Experimental Station, S.A.U, Tandojam. Fresh starter culture was prepared in the laboratory of Dairy Technology, Faculty of Animal Husbandry & Veterinary Sciences, Sindh Agriculture University, Tandojam. A total of five trials of cheese-making from camel milk, were conducted. While parallel to this, cheese from buffalo milk was also prepared and kept as control for comparison purpose. Cheese was prepared according to the method described by Sadia (1994), with slight modification in appropriate experiments. Skimmed milk was analysed for its physico-chemical analysis; pH values, fat contents by Gerber method James (1995), protein contents by British Standards Institution (BSI, 1990), specific gravity Aggarwalla and Sharma (1961) whereas for titrable acidity, total solids, ash, casein and chloride contents (AOAC, 1990) and SNF and lactose contents were determined by difference.

- **S.N.F content** = TS % - Fat%
- **Lactose %age** = TS% - (Fat% + Protein % + Ash %)

Rest of the milk was used for the production of soft unripened cheese, all the milk samples were pasteurized at 90°C for 10 min. in a cheese vat, and cheese was prepared by using conventional cheese-making methodology then finally cheese was weighed, kept under refrigeration and analyzed for its physico-chemical properties. Samples were also presented to the panel of judges for organoleptic examination. The data for physico-chemical quality was analyzed by analysis of variance (ANOVA), Post Hoc Multiple comparisons Test and Paired Samples T-Test using the SPSS Release 7.5 computer programme.
**RESULTS AND CONCLUSIONS** - In the present study, skimmed buffalo milk had the highest concentration of all the chemical components except ash and chloride contents whereas a wide variation in the gross composition of camel skimmed milk was observed. The pH values of the skimmed camel milk were ranged between 6.73 to 6.98, titrable acidity (%age) from 0.17 to 0.19 and specific gravity was recorded in between 1.021 to 1.025 whereas for buffalo milk the values of pH, acidity and specific gravity were 6.55, 0.18% and 1.035 respectively.

| Milk sample | Total solids | SNF | Fat | Total Prot. | Casein | Lactose | Ash | Chlorides |
|-------------|--------------|-----|-----|-------------|--------|---------|-----|-----------|
| Buffalo     | 10.27        | 10.12 | 0.15 | 4.80        | 3.38   | 4.74    | 0.49 | 0.078     |
| Camel       | 8.28         | 7.83  | 0.45 | 4.46        | 1.85   | 2.37    | 1.00 | 0.28      |
|             | 7.85         | 7.70  | 0.15 | 4.46        | 2.00   | 2.58    | 0.66 | 0.24      |
|             | 8.63         | 8.43  | 0.20 | 3.57        | 1.53   | 3.87    | 0.99 | 0.27      |
|             | 6.99         | 6.84  | 0.15 | 2.45        | 1.44   | 3.43    | 0.96 | 0.24      |
|             | 7.92         | 7.42  | 0.50 | 2.89        | 1.56   | 3.48    | 1.05 | 0.21      |
| Mean        | 7.93         | 7.64  | 0.29 | 3.56        | 1.67   | 3.14    | 0.93 | 0.25      |
| SE          | 0.27         | 0.26  | 0.07 | 0.40        | 0.10   | 0.28    | 0.06 | 0.01      |

\( \text{g} \ 100g^{-1} = \text{Percentage} \)

SE = Standard error of difference of mean

Results are the average of two determinations.

In contrast to camel milk as shown in (Table-2) the buffalo milk cheese acquired 3 hrs. to obtain firm and uniform coagulum. The cutting, cooking and washing steps were performed without facing any difficulty. The yield of soft unripened cheese was also measured. \( T_1 \) yielded the highest percentage of cheese (7.68) and \( T_4 \) the lowest (5.49%), while the recovery of cheese in trial \( T_2, T_3 \) and \( T_5 \) was 7.38, 7.22 and 5.68%, respectively. Whereas the buffalo milk yielded 12.22% of soft cheese.

**Physico–Chemical quality of soft unripened cheese made from Buffalo and Camel milk:**

The pH and titratable acidity for buffalo milk cheese were 5.47 and 0.45%. Whereas for camel milk cheese the highest pH value (5.57) was recorded for \( T_1 \) followed by \( T_3 \) (5.49), \( T_4 \) (5.21), \( T_2 \) (4.97) and \( T_5 \) (4.91). The overall mean values of pH were recorded as 5.23±0.13. However, the minimum percentage (0.34) of titrable acidity was observed for \( T_4 \) and the maximum (1.8) for \( T_2 \). While the titratable acidity for \( T_1, T_3 \) and \( T_5 \) were recorded as 1.01, 0.86 and 1.04%, respectively and the mean value was computed as 1.01±0.23%.
In the present study raw and skimmed camel milk were analyzed and wide variation was observed in the composition and properties. In preliminary trials some difficulties particularly in the formation of curd for cheese making were experienced. Similar problem was also faced by Kamoun (1990) and the fact he reported in his study was the lower concentration of protein (total and casein), dry matter and fat and/or lower viscosity, higher acidity and lower density than cow milk. While in an other study the possible reason indicated, was the

**Table 2.** Various operational steps during manufacturing of soft unripened cheese from camel milk.

| Batches | 0 hr. (S+) | 0.5 hr. C+R | 2 hr. Syneresis | 3 hr. Whey separation | 4 hr. Cutting/ incubation | 5 hr. Cooking | 6 hr. Washing |
|---------|------------|-------------|----------------|-----------------------|-------------------------|-------------|--------------|
| T1      | S+         | ++          | +              | +                     | Cutting                | +           | -            |
| T2      | S+         | ++          | +              | +                     | Cutting                | -           | +35, +25, +20 |
| T3      | S+         | ++          | +              | +                     | Incubation             | Cutting/+   | -            |
| T4      | S+         | ++          | +              | +                     | Incubation             | Cutting/+   | +35, +25, +20 |
| T5      | S+         | ++          | +              | +                     | Incubation             | Cutting/+   | +35, +25, +20 |

$T_1-T_5 =$ Trials of soft unripened cheese.
$S+$ = Starter culture addition.
++ = Calcium chloride + rennet enzyme solution addition.
- = Negative
+++ = Three washings at 35°C, 25°C and 20°C.

**Table 3.** Chemical composition (g 100g⁻¹) of soft unripened cheese made from buffalo and camel milk.

| Trails | Total solids | SNF | Fat | Total Protein | Casein | Ash | Chlorides |
|-------|--------------|-----|-----|---------------|--------|-----|-----------|
| Buffalo (Control) | 30.79 | 30.49 | 0.30 | 23.44 | 17.41 | 1.65 | 0.35 |
| Camel  | 29.46 | 28.86 | 0.60 | 24.79 | 19.64 | 2.24 | 0.53 |
| T1     | 28.38 | 27.45 | 0.93 | 22.32 | 16.52 | 2.31 | 0.53 |
| T2     | 28.61 | 27.45 | 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 |

$T_1-T_5 =$ Trials of soft unripened cheese. g 100g⁻¹= Percentage.
SE = Standard error of difference of mean. Results are the average of two determinations.

Ital.J.Anim.Sci. vol. 6, (Suppl. 2), 1115-1119, 2007
presence of growth inhibiting factor present in camel milk (Gran et al., 1991). Kurylev and Shakhanova (1989) produced fresh cheese by adding rennet or sour milk to heated milk. Whereas Gran et al. (1991) had heated fresh camel milk at slightly lower temperature (84°C) for longer time (15 min.) agreed with the present study (i.e. 90°C for 10 min.). In the results of present study the highest yield was obtained in sample T1 which was (7.68%) followed by T2 (7.38%), T3 (7.22%), T5 (5.68%) and T4 (5.49%). The results are supported by Kamoun (1990) who reported cheese yields from camel milk were satisfactory, but not as high as those from cow milk. However, the results in present study were not agreed with the reported results by Gran et al. (1991) that milk failed to reach a gel-like structure (typical of cow milk) even after 18 hours of incubation.

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