Effect of salt level on some physical and chemical properties and acceptability of camel milk cheese

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Abstract

The objective of this study was to investigate the effect of different salt levels on camel milk cheese. The cheese was made from camel milk, using Camifloc enzyme as a coagulant with different levels of salt (0.0%; 0.5%; 1.0%), then refrigerated for four days. The cheese yield was estimated as 10.3%. There were significant ($P<0.05$) differences in pH, acidity, total solids content and fat content between the cheeses treated with different levels of salt. There were no significant ($P>0.05$) differences in total proteins and ash percentages, and in total bacterial, coliform, yeast and mould, and psychrotropic counts. However, there were significant ($P<0.05$) differences during the storage period. Sensory evaluation conducted showed that the cheese made from camel milk containing 1.0% salt was more acceptable than cheese containing 0.5% salt, which was moderately acceptable, and the least acceptable was the unsalted cheese It was concluded that cheese made from camel milk could be accepted by consumers in Sudan, provided that suitable salt concentration (1.0%) was added.

Key words: camel milk, Camifloc enzyme, cheese yield, salt level composition, sensory properties

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Introduction

Making cheese from camel milk is difficult and complicated, due to longer coagulation time and weak coagulum (Ramet, 2001). Hard cheese was successfully made from camel milk when whey culture was included (Kamoun, 1990; Mehaia, 1993a; Ahmed and Kanwal, 2004). The average cheese yield obtained from camel milk is lower than that from cow milk (Mehaia, 1993a). However, Mehaia (1993b) found that yield, component recovery and overall acceptability of cheeses were significantly improved by increasing the ratio of cow to camel milk in cheese. Also, manufacturing cheese from camel milk can be improved by using ultrafiltration techniques (Mehaia, 1996) and Camifloc enzyme with the addition of calcium chloride (El Zubeir and Jabreel, 2008).

Saima et al. (2003) reported that, as a consequence of the processing treatment during manufacture of soft unripened cheese, the concentration of fat, ash and chloride of skimmed milk was slightly decreased, while total protein and casein content was significantly increased.

Kamoun (1990) reported the possibility of the development of a small-scale camel milk cheese industry in Sudan, using starter culture and calf rennet. Making cheese is a way to preserve milk,

creating the potential for trade (Saima et al., 2003). Camels represent the economical backbone of *abbala* (camel herders) in Sudan, either by the sale of male camels in local markets or by exportation. However, the milk produced by *abbala* is not processed into products (Sheuip and El Zubeir, 2008), even though cheese is one of the popular milk products in the country. As the common popular type of cheese is the one that contains a suitable amount of salt, the present study aimed to estimate the effect of salt levels on the physico-chemical, microbiological properties and acceptability of camel milk, using Camifloc enzyme.

Material and methods

Source of milk, Camifloc and salt

Fresh camels' milk was obtained from the University of Sudan farm. Camifloc powder (Bio Serae Laboratories, Bram, France), which was recommended by FAO for coagulating camel milk, was obtained from the Ministry of Animal Resources. Commercial grade salt was sourced from the local market.

Cheese processing and chemical analysis

Processing, chemical analysis and microbiological examination were carried out at the laboratory of the Department of Dairy Production, Faculty of Animal Production, University of Khartoum. Three different batches; each of five litres, were used during the present study. Milk was heated to 62°C for 15 minutes before processing the cheese. Then the steps described for using Camifloc enzyme were followed according to the manufacturer's instructions, which were described by El Zubeir and Jabreel (2008). The cheese was salted after draining the whey (24 hours after the addition of the enzyme) using three different salt concentrations (1.0; 0.5; and 0.0%). It was kept in the refrigerator and evaluated daily for up to four days, as per the manufacturer's instructions. The cheese used in this study was soft cheese. The camel cheese made with 1% salt kept for more than four days.

The pH values were measured using a pH-meter (Hanna Instrument-model 98107). Titratable acidity, total solids, fat, protein and ash contents were determined according to the method of the AOAC (1990).

Microbiological and sensory evaluation

Sterilisation, examination of culture, culturing methods and preparation of the serial dilution for the microbiological examination of the samples were done according to Houghtby et al. (1992). Plate count agar (No74065**,** S.D Fine Chem LTD, India) was used for the total bacterial and psychotropic counts (Houghtby et al., 1992). MacConkey agar (B 06987-International diagnostics group, UK) was used for enumeration of coliform (Christen et al., 1992). Yeast extract agar (B 821-Biomark laboratories, India) was used for yeast and mould counts (Frank et al., 1992).

Ten untrained panelists were asked to judge on the quality of the cheese using a sensory evaluation sheet.

Statistical analysis

Data were analysed statistically by Sthe PSS program (Statistical Package for Social Science) using Complete Randomized Design. The analysis was carried out by ANOVA test and Dunken multiple ranges test. A chi-square test was used to analyse the panel's evaluation sheets.

Results

Physical, chemical and micro-biological properties of camel milk and cheese whey

Before cheese making the milk samples were analysed for their physico-chemical characteristics. The mean of parameters were: 6.5, 0.21%, 9.9%, 0.97%, 3.4% and 3.3% for pH, acidity, total solids, ash, fat and protein, respectively. After cheese making, the whey of the cheeses were analysed. The mean values were 5.4, 0.3%, 3.3%, 0.9%, 0.4% and 1.5%, respectively (Table 1). The log_{10} total bacterial count of milk and whey of the cheeses samples revealed 13.8 and 14.7 and the log coliform count was 10.6 for both milk and whey. Also the logs for yeast and mould count were estimated as 10.0 and 10.9, while logs psychrophiles counts were 10.6 and 10.2 for milk and whey, respectively (Table 1).

Table 1. Mean values of some of the physical, chemical and microbiological properties of camel milk and whey separated from camel cheese

Parameters	**Milk**	**Whey**
pH	6.5	5.4
Acidity (%)	0.21	0.3
Total solids (%)	9.9	3.3
Ash (%)	0.97	0.9
Fat (%)	3.4	0.4
Protein (%)	3.3	1.5
Log_{10} total bacterial count (cfu/ml)	13.8	14.7
Log_{10} coliform count (cfu/ml)	10.6	10.6
Log_{10} yeast count (cfu/ml)	10.0	10.9
Log_{10} Psychrophiles (cfu/ml)	10.6	10.2

Physical, chemical and microbiological properties of camel cheese

The overall means of pH, acidity, total solids content, ash content, fat content and protein content of camel milk cheese were 5.83, 1.03%, 35.72%, 1.74%, 16.34% and 16.12%.

Moreover pH, titratable acidity and fat content revealed significant differences (P<0.05) between camel cheese with the different levels of salt and storage periods (Tables 2 and 3).

Table 2. Effect of salt level on some of the physical and chemical properties of camel cheese

Level of salt (%)	pH	Acidity (%)	Chemical composition (%)			
			Total solids	Ash	Fat	Protein
0	5.55[a]	0.93[a]	34.58[a]	1.69[a]	17.29[b]	15.29[a]
0.5	5.93[b]	1.09[b]	35.93[ab]	1.69[a]	15.76[a]	15.39[a]
1	6.00[b]	1.07[b]	36.64[b]	1.85[a]	15.96[a]	17.69[a]
Overall mean	5.83*	1.03*	35.72*	1.74[N.S]	16.34*	16.12 [N.S]
S.E ±	0.05	0.03	0.29	0.09	0.19	0.71

[a, b] Values in the same column bearing different letters are significantly different (P<0.05); N.S = Not significant; * = P<0.05; S.E = Standard error.

Table 3. Effect of the storage period on some of the physical and chemical properties of camel cheese

Storage period (days)	pH	Acidity (%)	Chemical composition (%)			
			Total solids	Ash	Fat	Protein
1	6.16[c]	0.93[a]	35.53[a]	1.56[a]	16.34[a]	16.92[a]
2	5.98[bc]	0.95[a]	35.68[a]	1.59[a]	16.84[a]	16.45[a]
3	5.74[ab]	1.02[a]	35.83[a]	1.89[a]	17.14[a]	16.16[a]
4	5.47[a]	1.23[b]	35.99[a]	1.93[a]	15.02[b]	14.97[a]
S.L	*	*	**N.S**	**N.S**	*	**N.S**

[a, b] Values in the same column bearing different letters are significantly different (P<0.05); N.S = Not significant; * = P<0.05; S.L = Significance level.

Total solids content showed significant differences (P<0.05) between camel cheeses made with three levels of salt and non significant differences during storage period. Also non significant differences (P>0.05) were found with different concentration of salt and storage period in ash and protein contents of camel cheeses (Tables 2 and 3).

Means of total bacterial count, coliform count, yeast and mould count and psychrotropic bacterial count of camel cheese were found to be log 9.20, log 5.98, log 9.28 and log 7.22 (Table 4).

Table 4. Effect of salt level on the microbiological properties of camel cheese

Level of salt (%)	**Log_{10} total bacterial count (cfu/gm)**	**Log_{10} coliform count (cfu/gm)**	**Log_{10} yeast count (cfu/gm)**	**Log_{10} Psychrophiles counts (cfu/gm)**
0	9.07^{a}	5.64^{a}	9.64^{a}	7.45^{a}
0.5	9.07^{a}	5.41^{a}	8.81^{a}	6.58^{a}
1	9.43^{a}	6.89^{a}	9.39^{a}	7.57^{a}
Overall mean	$9.20^{N.S}$	$5.98^{N.S}$	$9.28^{N.S}$	$7.2^{N.S}$
S.E	0.194	0.468	0.237	0.458

$^{a, b}$ Values in the same column bearing different letters are significantly different (P<0.05) ; N.S = Not significant; * = P<0.05; S.E = Standard error

Significant differences (P<0.05) were obtained during the storage period in total bacterial count, coliform count and yeast and mould count, but not in psychrotropic bacterial count (Table 5). However, insignificant differences (P>0.05) were reported among camel cheeses with different levels of salt in all microbiological quality measured (Table 4).

Table 5. The effect of storage period on microbiological properties of camel cheese

Storage period (days)	Log_{10} total bacterial count (cfu/gm)	Log_{10} coliform count (cfu/gm)	Log_{10} yeast count (cfu/gm)	Log_{10} Psychrophiles (cfu/gm)	SL
1	8.46[a]	4.21[a]	9.55[b]	7.46[a]	*
2	9.13[ab]	8.48[b]	8.16[a]	7.o7[a]	*
3	9.72[b]	6.58[ab]	9.48[b]	6.51[a]	*
4	9.49[ab]	4.59[a]	9.57[b]	7.81[a]	NS

[a, b] Values in the same column bearing different letters are significantly different (P<0.05);N.S = Not significant; * = P<0.05; S.L = Significant level

Sensory evaluation

Results from the sensory evaluation of camel milk cheese with different salt levels showed that scores varied significantly for flavour, taste, saltiness and overall acceptability (P<0.001), while colour and body results revealed insignificant differences (Table 6). Camel cheeses with 1.0% salt received the highest scores for flavour, most acceptable taste, desirable saltiness level and overall acceptability compared with cheese containing 0.5% and 0.0% salt. Moreover, camel milk cheese containing no salt was totally unacceptable.

Table 6. Effect of salt level on the acceptability of camel cheese

Traits	**Acceptability**	**Level of salt (%)**			**Significance**
		0	**0.5**	**1**	
Colour	Not acceptable	0.0	0.0	0.0	N.S
	Moderately acceptable	6.6	3.3	4.4	
	Slightly acceptable	26.7	10	16.6	
	Acceptable	66.7	86.7	80.0	
Flavour	Bland	46.7	0.0	20.0	0.001
	Slightly intense	43.3	50.0	36.7	
	Moderately intense	6.7	50.0	6.6	
	Extremely intense	3.3	0.0	36.7	
Taste	Absent	70	3.33	16.7	0.001
	Moderately acid	6.7	60.0	43.3	
	Acid	23.3	33.33	30.0	
	Extremely acid	0.0	3.33	10.0	
Body	Smooth	46.6	43.3	23.3	N.S
	Slightly smooth	16.7	6.7	26.7	
	Harsh	16.7	20.0	6.7	
	Pasty	20.0	30.0	43.3	
Saltiness	Moderate	6.7	96.7	16.7	0.001
	Salted	3.3	3.3	76.7	
	Over salted	0.0	0.0	0.0	
	Absent	90.0	0.0	6.6	
Overall acceptability	Not acceptable	40.0	13.3	23.3	0.001
	Moderately acceptable	33.3	30.0	31.1	
	Slightly acceptable	26.7	50.0	27.8	
	Acceptable	0.0	6.7	17.8	

N.S = Not significant

Discussion

The present study supported the previous report of El Zubeir and Jabreel (2008), who demonstrated the usefulness of Camifloc enzyme in processing camel cheese. Hence camel owners could preserve their milk into cheese as it was difficult to coagulate camel milk with most of the clotting enzyme used (Ramet, 2001). The cheese yield obtained using camel milk was found to be 10.3%, which was similar to that of Mehaia (1993a), who obtained 10.5–11.5%; yet it was lower compared with that using the mixture of camel and cow milk (19.0–19.2%) reported by Mehaia (1993b). On the other hand, El Zubeir and Jabreel (2008) obtained higher yield (11.3%) using Camifloc enzyme and calcium chloride, against 10.2% without addition of calcium chloride. The low yield of camel milk cheese obtained may have been caused by a high temperature which affected dry matter intake that reduced total solids in milk, which is the main factor in cheese processing (Ramet, 2001).

Variations in chemical component, pH and acidity of camel cheese were observed during the storage period (Table 3). Also the data indicated that there was a ratio of milk total solids retained in the whey which was white in colour; this result was in agreement with that of Mehaia (1993a). Camel milk cheese showed lower bacterial counts than that estimated in milk, especially in the cheese containing 1.0% salt (Table 4). The high bacterial counts in camel milk were in accord with the findings of Semereab and Molla (2003); Khedid et al. (2003) and Sheuip et al. (2007). This might be due to either insufficient heating of milk and/or the lower initial survival rate of bacteria in cheese, which increased during cheese storage.

According to the panelists the most acceptable cheese was that containing 1.0% salt, followed by 0.5% salt. The least acceptable cheese contained no salt; it deteriorated and became bitter at Day 3, while the cheese containing 1.0% salt maintained a shelf life of more than four days.

Based on the data presented, the best cheese was the one containing 1.0% salt. This result leads to a recommendation that it may be possible to process camel milk into cheese for commercial purposes. Improvement of the hygienic quality of camel milk and using some spices to improve shelf life of camel milk products should be considered. Further research is needed to improve the technique of cheese processing and utilisation of the whey into a nutritious diet.

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