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Evaluation of Soft Cheese Manufactured from Camel and Buffalo Milk

[1]M.R. Shahein, [2]A.M. Hassanein and [2]Abeer F. Zayan

[1]Faculty of Environmental Agric. Sci, El Arish, Suez Canal University, Egypt
[2]Food Tech. Res. Institute, Agric. Res., Center, Giza, Egypt

Abstract: Camel milk was mixed with buffalo milk at different ratios (90:10, 80:20, 70:30 and 60:40%), respectively. Renneting ability and rheological properties of resultant curd of different mixtures were evaluated in compare with control camel milk curd. Soft cheese made from these mixtures evaluated also sawin compare with that made from buffalo milk (control). Results indicated that mixing camel milk with buffalo milk reduced rennet coagulation time (RCT), whey syneresis and loss of milk content in resultant whey compared with control camel milk. This was associated with an increase in the curd tension (CT) which resulted in improving the curd firmness. Mixing camel milk with buffalo milk increased soft cheese yield, total solids (TS), fat, ash, protein contents and recovery of milk constitutes in resulted cheese as well as decreased the weight loss of cheese during the pickling period. Also, mixing of camel milk with buffalo milk improved the microbiological quality and organoleptic properties of resultant cheese during pickling of resultant cheese. This improvement was associated with the level of mixing both milk.

Key words: Soft Cheese Camel and Buffalo Milk

INTRODUCTION

Milk is considered the most important product obtained from camel milk being a complete food, helps to provide a nutritious and balanced diet to nomadic desert people under harsh conditions.

Camel's milk is a major source of protein and energy for desert inhabitants especially for those in the Middle East. Protein of camel milk contains all essential amino acids while, fat contain unsaturated aliphatic acids. Although, camel milk production in Egypt is still essentially following the old un- organized nomadic style, efforts are now focused on applying modern techniques in the production, transformation and marketing of camel milk in our country. Recently, camel milk was also reported to have other potential therapeutic properties, such as anti-carcinogenic, anti- diabetic [1] and anti-hypertensive [2] and has been recommended to be consumed by children who are allergic to bovine milk [3].

Cheese isdifficult to make from camel milk under natural condition, but success can beachieved when pH of milk is lowered and calcium chloride is added prior to rennet addition due to differences in availability of K-casein. Camel milk has more large casein micelles than that of does cow milk, which may relate to poor rennetability of camel milk [4]. It's also due to its low total solids contents. Its suitability for cheese making decreases significantly in the hot season, when camel milk production is influenced by water and feed availability, as under water shortage conditions camel milk contains abnormally low milk solids and its cheese processing ability is poor. Camel milk is used therapeutically against dropsy, jaundice, problems of the spleen, tuberculosis, asthma, anemia and piles [5]. Patients with chronic hepatitis had improved liver function after being treated with camel milk [6]. The camel milk works also as a laxative on people unaccustomed to drinking this milk [5].

This study aimed to evaluate the effect of mixing buffalo milk with camel milk on soft cheese curd properties, cheese yield as well as chemical and microbiological quality of resultant cheese.

MATERIALS AND METHODS

Materials: Fresh camel milk was obtained from two different private camel herds from Central region (Al-Arish) (Egypt). Buffaloes' milk was obtained from

Corresponding Author: Magdy R. Shahein, Faculty of Environmental Agric. Sci, El Arish, Suez Canal University, Egypt.

plant of Food Technology Research Institute, Agricultural Research Center, Giza, Egypt. Rennet enzyme powder (5N) was obtained from Chr. Hansen Laboratories, Copenhagen, Denmark. Salt was obtained from local market, Giza.

Rheological Tests:

Coagulation Time of Milk: Whole camel milk and its mixture with buffaloes' milk, cheese milk of all treatments were pasteurized at 72°C for 15 Sec. in a water bath and cooled immediately to 5 ± 1°C inan ice bath.

Milk was heated into 37°C, 0.04% calcium chloride and rennet at the rate of 4 g. / 100 k of milk was added. The milk of all samples was allowed to coagulate to measure the coagulation time (min).

Curd Tension: The curd tension was determined by using the method of Chandrasekhara *et al.* [7] as follows:

Milk was heated into 37°C, 0.04% calcium chloride and rennet at the rate of 4 g. / 100 k of milk was added. Ciurd tension of all milk samples was measured usingan apparatus consisted of knives of constant weight (5 g) has H shaped with a needle in the middle ending with a hook and a wire crossing a freely rotating wheel attached to the knife at one end a pan (5 g) at the other end.

The knife was placed in a 100 ml beaker. The milk was inoculated with starter and then it was added to the beaker and incubated at 37°C until coagulation. The curd tension was measured after holding the curd in the refrigerator overnight. It is expressed as weight in grams required to remove the knife from the prepared curd.

Curd Syneresis: The rate of curd syneresis at room temperature (25-30°C) was measured as given by Mehanna and Mehanna [8] by putting exactly 100 g of curd on an performed aluminum screen placed on the top of suitable size aluminum dish. The increase in the weight of the dish was recorded after 10, 30 and 60 min. This was the index of curd syneresis.

Methods:

Soft Cheese Manufacture: The soft cheese manufacture was carried out according to method applied by Fahmi and Shrara [9] dan modified by El-Safty *et al.* [10]. Milk was heated to 37°C, 0.04 % calcium chloride and rennet at the rate of 4 g. / 100 kg of milk were added. Soft cheese was manufactured from buffalo and camel milk at different ratios as following:

Control = 100% buffaloes milk
Treatment 1 =100% Camel milk
Treatment 2 =10% buffalo milk +90% camel milk
Treatment 3 =20% buffalo milk +80% camel milk
Treatment4 =30% buffalo milk +70% camel milk
Treatment5 =40% buffalo milk +60% camel milk

Chemical and microbiological analyses were determined in soft cheese at different storages periods (fresh, 30, 45and 60 days). Resultant cheese of all treatments was stored in plastic boxes of polystyrene (1 k capacity) in whey syneresis for 60 days at 5 ± 1°C

Cheese Yield and Recovery: Cheese yields were calculated as a weight of cheese divided by weight of milk expressed as a percentage. Recovery of component TS, fat, protein was calculated as the component in the cheese divided by the original weight of component in the milk expressed as a percentage [11].

Chemical Analysis: Total solids, fat, total protein, ash, salt and moisture contents of cheese were determined according to the method described by AOAC [12].

Microbiological Analysis: Total viable bacterial count (TVBC) was carried out according to Berrang *et al.* [13].

Lactic acid bacterial count was carried out according to Wehr and Frank [14].

Extraction and quantification of aflatoxin M1 (AFM1): the method used to extract AFM1 from cheese was carried out by Dragacci *et al.* [15].

Caloric Value: The caloric value expressed as kj/100 g was calculated using the equation of Walstra and Jenness [16].

$$E = 370 F + 170 P + 168 L + 18$$

Where: E = Total energy (kj/ k)
F = Fat content (%)
P = Protein content (%)
L = Lactose content (%)

Sensory Evaluation: The cheese was organolepticaly assessed by 10 trained panelists for flavor (50), body and texture (35) and appearance & color (15) according to Nelson and Trout [17] where the total score was 100 degrees.

RESULTS AND DISCUSSION

Milk Composition: Mean composition of milk used in cheese making is showed in Table (1). Camel milk had mean total solids content of 11.07 %. The mean fat, protein, lactose and ash contents were 3.10, 3.11, 4.8 and 0.90 %, respectively. Buffaloes' milk had mean total solids (T.S.) content of 17.60 %. The mean fat, protein, lactose and ash contents were 6.0, 4.0, 5.3 and 0.80 %, respectively. The mixtures of camel milk and buffaloes' milk showed that the T.S., fat and protein were increased with increasing the percentage of buffaloes' milk added, but moisture and ash were decreased with increasing the percentage of buffaloes' milk.

Rheological Properties of Curd and Whey Contents: Data presented in Table (2) summarizes rennet clotting time (RCT), curd tension (CT) of cheese milk and whey syneresis and composition of all treatment.

It could be noticed that mixing buffalo milk with camel milk improved the rennet ability and firmness of resultant curd.

Mixing of buffalo milk with camel milk resulted in decreasing the RCT and increasing the CT and this was more noticed with increase the level of mixing. Also decreased when buffaloes milk was mixed with camel milk and this was associated with the level of mixing. Shamas *et al*. [18] these results could be explained on the basis that addition of buffaloes milk to camel milk resulted in increasing the casein content of resultant mixtures which improved the rennet ability and cured properties. These results are in agreement with those reported by Shamas *et al*. [18].

Cheese Yield and Recovery of Milk Constituents in Cheese: Result presented in Table (3) showed the yield and weight loss of soft cheese made from buffalo milk (as a control), camel milk and camel milk mixed with buffalo milk during storage period. It could be noticed thatthe cheese made from camel milk had lower yield and higher weight loss during storage than cheese made from other treatments. Addition of buffalo milk to camel milk increased cheese yield and decreased the cheese weight loss during pickled. These results could be explained on

Table 1: Chemical analysis of buffalo, camel milk and their mixtures.

Type of milk	T.S%	Fat %	Protein %	Lactose %	Ash %	Total energy (kj/ k)
Buffaloes' milk	17.60	6.00	4.00	5.3	0.80	38.4
T 1 (camel milk)	11.07	3.10	3.11	4.8	0.90	29.5
T 2	13.85	3.60	3.62	4.6	0.84	32.6
T 3	14.28	4.20	3.73	4.8	0.83	33.8
T4	14.71	4.80	3.80	4.9	0.82	35.0
T5	15.15	5.30	3.90	5.1	0.81	36.5

Table 2: Rheological properties of buffalo camel milk curds and their mixture.

				Whey syneresis (min)			Composition of whey		
Type of milk	RCT (min)	CT (g)	Remarks of curd coagulation	10	30	60	T.S %	Fat %	Protein %
Buffalo milk	2.10	31	Very firm	23	23	36	5.6	0.5	0.5
T 1 (camel milk)	4.52	7	Very soft firm	45	45	67	8.1	1.5	0.9
T 2	4.30	10	soft firm	40	40	62	7.4	1.3	0.8
T 3	4.10	14	soft	36	36	56	6.9	1.0	0.7
T 4	3.37	17	Sine soft	32	32	48	6.4	0.8	0.7
T 5	2.50	22	Less firm	29	29	44	5.9	0.7	0.6

Table 3: Cheese yield and recovery of cheese made from buffalo camel milk and mixture ther.

	Yield of cheese				Weigh loss			Recovery		
Type of milk	Fresh	30 days	45 days	60 days	30 days	45 days	60 days	T.S %	Fat %	Protein %
Buffalo milk	24.7	23.6	22.0	21.2	4.5	10.9	14.1	65.28	88.6	88.9
T1 (camel milk)	13.5	11.2	10.6	9.8	17.0	24.5	27.3	41.50	70.1	51.3
T 2	14.7	12.6	12.0	11.5	14.3	18.4	21.8	43.77	71.4	53.2
T 3	17.1	14.8	14.1	13.6	13.4	17.3	20.4	51.27	76.1	61.6
T 4	19.3	17.9	16.7	16.1	7.8	12.9	17.9	57.77	76.8	70.6
T 5	20.1	18.9	17.8	17.0	5.9	11.4	15.4	60.14	77.7	72.3

Table 4: Chemical composition of pickled soft cheese made from buffalo, camel milk and their mixture.

Samples	T.S. %	Fat%	Protein%	Salt%	Ash%	Moisture %
			Fresh			
Buffalo milk	46.70	21.60	14.40	2.61	2.70	53.30
Treatment 1 (camel milk)	34.03	16.10	11.80	2.71	3.10	65.97
T 2	41.24	17.50	13.10	2.66	3.10	58.76
T 3	42.81	18.70	13.43	2.68	3.00	57.19
T 4	44.03	19.50	13.90	2.63	2.90	55.97
T 5	45.33	20.50	14.03	2.70	2.80	54.67
			30 days			
Buffalo milk	47.30	22.00	14.71	2.55	2.75	52.70
Treatment 1 (camel milk)	35.50	16.25	12.10	2.75	3.18	64.50
T 2	42.11	18.20	13.40	2.60	3.21	57.89
T 3	43.66	19.10	13.72	2.63	3.10	56.34
T 4	44.92	20.00	14.17	2.58	2.86	55.08
T 5	46.31	21.00	14.65	2.65	2.87	53.69
			45 days			
Buffalo milk	48.05	22.70	15.01	2.50	2.81	51.95
Treatment 1 (camel milk)	36.57	16.84	13.65	2.8	3.22	63.43
T 2	42.89	18.50	13.67	2.55	3.36	57.11
T 3	44.27	19.60	13.95	2.58	3.28	55.73
T 4	45.58	20.70	14.45	2.53	3.31	54.42
T 5	47.24	22.10	14.94	2.60	2.98	52.76
			60 days			
Buffalo milk	48.83	23.50	15..31	2.43	2.91	52.17
Treatment 1 (camel milk)	37.78	17.54	14.00	2.86	3.25	62.22
T 2	42.80	19.30	13.94	2.49	3.43	57.20
T 3	43.95	20.00	14.23	2.52	3.39	56.05
T 4	45.23	21.10	14.74	2.48	3.38	54.77
T 5	47.12	22.30	15.24	2.53	3.10	52.88

Table 5: Microbiological of raw buffalo and camel milk (cfu ml^{-1}).

Microorganism		
Kind of milk	TVBC	LAB
Buffaloes' milk	$8X10^5$	$1X10^2$
Camels' milk	$7X10^6$	$3X10^2$

TVBC: Total viable bacterial counts

LAB: Lactic acid bacteria

the basis that mixing camel milk with buffalo milk resulted in increasing the casein content of the mixture. This increased the curd firmness and reduced the loss of milk constituents during cheese making process and increased the recovery of these constituents in the curd [18].

Chemical Composition of Pickled Soft Cheese: Table (4) shows mean composition of white soft cheese made from camel milk and their mixtures. Results showed that the total solids, buffalo fat and protein contents were increased with increasing buffaloes' milk percentage. While, ash and moisture were increased with camel milk increased, during storage period. On other hand, moisture decreased during storage period. Salt content of soft cheese decreased during storage period. This may be due to the loss of moisture during storage period. The results are in agreement with those stated by Mehaia and Qassim [19] and Hassanein [20].

Microbiological Characters: The data recorded in Table (5) clearly showed that raw camel milk contained 7 X 10^6 and $3X10^2$ cfu / ml^{-1} for TVBC and LAB respectively. Also, raw buffalo milk contained $8X10^5$ and $1X10^2$ cfu /ml^{-1} for TVBC and LAB respectively. Higherresults were recoded [21].

Table 6: Microbiological of processing cheese during storage period at 5 ± 1°C

Microorganism		
Kind of cheese	TVBC	LAB
	Fresh	
Buffalo milk	$5X10^6$	$2X10^3$
Treatment 1(camel milk)	$1X10^6$	$6x10^3$
Tt 2	$2X10^6$	$7x10^3$
T 3	$4X10^6$	$8X10^3$
T 4	$4X10^6$	$5X10^3$
T 5	$5X10^6$	$3X10^3$
	30 Days	
Buffalo milk	$9X10^5$	5x10
Treatment 1(camel milk)	$1X10^5$	$5X10^2$
T 2	$2X10^5$	$8X10^2$
T 3	$2X10^5$	15X10
T 4	$4X10^5$	13X10
T 5	$7x10^5$	10x10
	45 Days	
Buffalo milk	$15X10^4$	$10x10^2$
Treatment 1(camel milk)	$2X10^4$	$5X10^3$
T 2	$3X10^4$	$9X10^3$
T 3	$6X10^4$	$7x10^3$
T 4	$8X10^4$	$4X10^3$
T 5	$11x10^4$	$4x10^3$
	60 Days	
Buffaloes milk	$10X10^5$	5X10
Treatment 1(camel milk)	$6X10^4$	$3X10^3$
T 2	$24X10^4$	$3X10^3$
T 3	$39X10^4$	$8X10^2$
T 4	$1X10^5$	$6X10^2$
T 5	$8X10^5$	$3X10^2$

TVBC: Total viable bacterial counts
LAB: Lactic acid bacteria
Control =cheese made from Buffaloes' milk

Lore *et al.* [22] found that the total lactic acid bacteria (LAB) was 6.8 $\log_{10}$ cfu/ml^{-1} of camel milk. While the mean log count per ml camel milk for aerobic total count, was 5, 2.7 [23]. Zeki *et al.* [24] found that total bacterial count and lactic acid bacteria ($\log_{10}$ cfu/ml^{-1}) levels in the buffalo milk samples were 6.36 and 1.10, respectively. In another study carried out in China, TVBC and LAB ($\log_{10}$ cfu/ml^{-1}) level in 120 buffalo milk samples were determined as 5.59 and 4.62 respectively Han *et al.* [25]. As in study on raw buffalo milk samples, TVBC ($\log_{10}$ cfu/ml^{-1}) were determined between $3.4X10^5$ - $4X10^7$ [26].

Table (6) showed that highest decrease in microbial count, were at concentrate 10%B +90% camel milk as varied counts from fresh buffalo's milk cheese cfu/g^{-1} for TVBC.

The same Table shows that cheese treatments made with buffalo and camel milk after storage at 5 ± 1°C for 30 days induced decreasing in TVBC cfu/g^{-1} from milk only (control).

Table (6) evidenced that continuance storage of cheese treatments at 5 ± 1°C for 45 days increased microbial counts but addition the different concentrations of camel milk especially 40 % concentrate paid to decreasing their TVBC comparison with control.

LAB has shown to posses inhibitory activities mostly towards Gram negative of protease sensitive bacteriocins [27]. Still LAB were also able to control the growth of Gram negative pathogens including food borne pathogens by the production of organic acids and hydrogen peroxide [28].

Determination of Aflatoxin M_1 in the White Cheese Samples: All the examined cheese processing samples were free from aflatoxin M_1. These results are accepted by Egyptian Regulation [29] which demonstrated that products such as cheese should be free aflatoxin M_1.

Sensory Evaluation: Average of organoleptic score recorded in white soft cheese made from camel milk and their mixtures with buffalo milk are presented in Table (7). The flavour cheeses of treatments were inferior to that

Table 7: Effect of adding buffalo milk to camel milk on the organoleptic properties of Domiati like cheese.

		organoleptic properties			
Cheese treatments	Storage period (days)	Flavour (50)	Body & Texture (35)	Appearance & colour (15)	Total (100)
Buffalo milk	Fresh	45	33	13	91
	30	46	32	13	91
	45	47	33	14	94
	60	47	33	14	94
Treatment 1 (camel milk)	Fresh	35	25	11	71
	30	37	27	12	76
	45	39	29	13	81
	60	42	30	13	85
T 2	Fresh	39	29	12	80
	30	41	30	12	83
	45	43	31	13	87
	60	45	32	13	90
T 3	Fresh	41	31`	12	84
	30	42	32	12	86
	45	45	33	13	91
	60	46	33	14	93
T 4	Fresh	44	30	12	86
	30	45	32	12	89
	45	46	33	13	92
	60	46	33	14	93
T 5	Fresh	45	31	12	88
	30	46	32	13	19
	45	47	33	13	93
	60	47	33	14	94

made with buffalo milk. After 45 days of pickling improvement has been happened in the flavour and body and texture. After 60 days of pickling, flavour as well as body and texture improved, these treatments acquired a full flavour for all treatments, these points nearly from cheese made with buffalo milk. These results arein agreement with that reported by Mehaia *et al.* [19].

CONCLUSION

From the obtained results, mixing camel milk with buffalo milk increased soft cheese yield. Also, improved the microbiological quality and organoleptic properties of resultant cheese, the beast mixed ration was 70% camel milk : 30% buffalo milk.

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