J. Agric. Sci. Mansoura Univ., 27 (6): 3953 - 3966, 2002

INCORPORATION OF BUTTERMILK WITH OTHER MILKS IN RAS CHEESE PRODUCTION.
I. BUFFALOE'S MILK USING TWO TYPES OF RENNET.

Ammar, El-Tahra M.A.*; Y.I. Abdel-Kader; A.A. El-Shazly* and M.M. Ismail**.**

*** Dairy Dept., Fac. of Agric., Mansoura Univ., Egypt.**

**** Animal Prod. Res. Inst., Agric. Res. Center, Ministry of Agric.**

ABSTRACT

Effect of adding 10, 15 and 20% unsalted sour buttermilk to buffaloe's milk on some chemical and rheological properties was studied.

Results showed that acidity increased and pH, T.S., fat and T.N. of buffaloe's milk proportionally decreased by adding an increased volume of buttermilk. Incorporation of 10, 15, and 20% unsalted buttermilk to buffaloe's milk decreased rennet coagulation time (R.C.T.) and curd tension and increased curd syneresis. Buttermilk alone was not coagulated by rennet.

Ras cheese was made from buffaloe's milk replaced by 15% sour buttermilk using liquid calf rennet or HALA rennet. Addition of 15% buttermilk to buffaloe's milk decreased yield, pH , fat, fat / D.M. and T.N. contents and raised moisture content, salt / D.M., acidity, soluble nitrogen (S.N.), S.N./T.N., N.P.N./T.N. soluble tyrosine (S.Tyr) and tryptophan (S.Try) and T.V.F.A.

Adding buttermilk to buffaloe's milk increased unsaturated fatty acids (US.F.A.) and decreased saturated fatty acids (S.F.A.) of resultant Ras cheese.

Type of rennet had no clear effect on yield, salt, and salt / D.M. of Ras cheese. Fat and T.N. contents decreased while acidity, moisture, S.N., S.N./T.N., N.P.N., N.P.N./T.N. S.Tyr, S.Try, and T.V.F.A. increased in HALA Ras cheese as compared with liquid rennet cheese. US.F.A. were higher and S.F.A. were lower in Ras cheese made using liquid rennet than those cheese made using HALA.

Adding 15% unsalted buttermilk to buffaloe's milk improved the organoleptic properties and increased the economic profit of produced cheese.

INTRODUCTION

It is well known that buffaloe's milk caseinate contained higher mineral contents in calcium and phosphorus than cow's and ewe's milk (El-Sokkary and Hassan, 1949 and Amer *et al.*, 1978), which are responsible for the hardness and harshness of cheese body and texture. Other differences lie in the higher content of carboxylic amino acids namely aspartic, which increase the curd tension (Abdel-Salam *et al.*, 1964). On the other hand, the large size of both casein micelles and fat globukes of buffaloe's milk account for the crumbly texture as they would lead to slow ripening (Fahmi *et al.*, 1956 and Granikov *et al.*, 1962).

Buttermilk is the by-product of butter while making it from cream. It has a high nutritional, good emulsifying power and a powerful effect on lowering serum cholesterol (Metwally *et al.*, 1988). Using buttermilk in cheese making accelerated rennet coagulation and lactic acid production (Antila and Witting (1978) increased bacterial numbers, acidity and protein degradation (Ibrahim

et al., 1990), improved the flavour of the cheese and reduced the serum and liver cholesterol levels (Abou-Zeid, 1992).

The objective of this study was to evaluate the effect of adding unsalted sour buttermilk to buffaloe's milk and to compare the effect of two types of rennet (liquid calf rennet and HALA rennet) on the chemical composition and the quality of Ras cheese.

MATERIALS AND METHODS

Fresh buffaloe's milk was obtained from El-Gemmeza Animal Production Research Station, Ministry of Agriculture, Gharbiah Governorate. Unsalted buttermilk were supplied by Misr Dairy Company of Domiatt. The composition of milk for cheese making was shown in table 1.

Yoghurt starter was obtained from Ch. Hansen's Laboratories, Denmark. The starter containing *Streptococcus salivarius* subsp. *thermophillus* and *Lactobacillus delbruckii* subsp. *bulgaricus* (1:1) was used at a rate of 1%.

Local commercial liquid calf rennet was obtained from local market was added to the milk at a rate of 40 ml/100 L. HALA powder calf rennet (75% chymosin + 25% pepsin) was obtained from Hansen's Laboratories of Denmark, which was added at a rate of 3 gm/100 L of milk. It is dissolved in 100 ml distilled water before being used.

Table 1: Composition of milk for cheese making.

Type of milk	Acidity (%)	pH	T.S. (%)	Fat (%)	T.N. (%)	T.P. (%)	Ash (%)	Calcium (%)
Buffaloe's milk	0.17	6.62	15.922	5.9	0.688	4.387	0.804	0.162
Unsalted buttermilk	0.22	6.11	6.387	1.8	0.282	1.799	0.557	0.144
85% Buffaloe's milk + 15% Unsalted buttermilk	0.19	6.40	14.897	5.1	0.627	4.004	0.689	0.158

Dry course commercial food grade salt was obtained from El-Nasr company of Alexandria was used.

For coating a mixture consists of paraffin wax, honey wax and soft paraffin wax (Vaseline) at the ratio 1:1:0.2.

Ras cheese was made as described by Hofi *et al.* (1970). Buffaloe's milk Ras cheese represents control treatment, while buffaloe's milk mixed with 15% unsalted milk represents treatment II. After warming to 33°C, 1% active yoghurt starter was added, and after 30 minutes liquid rennet or HALA rennet was added to milk. After coagulation, vertical and horizontal knives were used to cut the curd into 1 cm cubes. Before hooping, 5% salt was added to the cheese vat. Salting and coating of cheese was done in ripening room at 23±3°C. After 45 days of processing, the cheese was cleaned, rubbed with 3% potassium sorbate, left 24 hours for drying, then coated with the wax admixture and left at ripening room temperature (23±3°C) up to 90 days. The 90 days old cheese were transferred into cold ripening room at 14±2°C and left for more 90 days. Samples of fresh cheese and after 30, 60, 90, 120, 150 and 180 days were chemically and organoleptically analyzed.

Rennet coagulation time (R.C.T.) was tested according to Davies and White (1958), curd tension was determined as described by Chandrasekhara

et al. (1957). Curd syneresis according to Mehanna and Mehanna (1989). Titratable acidity, pH value, total nitrogen (T.N.), soluble nitrogen (S.N.), non-protein nitrogen (N.P.N.) and ash were determined according Ling (1963). Moisture and fat as described by British Standard Institutions (BSI) method (1952). Soluble tyrosine (S.Tyr) and tryptophane (S.Try) were measured according to Vakaleries and Price (1959). Total volatile fatty acids (T.V.F.A.) and sodium chloride as described by Kosikowski (1966). Calcium content was determined according to Graham *et al.* (1962) and as modified by Abdel-Kader (1993). Free fatty acids as described by Vogel (1975). A GLC Pye Unicam Gas-Liquid Chromatograph equipped with flame ionization detectors and glass column (15 m x 4 mm) packed with 10% of poly ethylene glycoladepate PEGA supported on an alkali-acid washed and silanized Diatomite C (100-120 mesh) was used. Organoleptic properties score of the cheese were measured according to Nawar (1996). The yield of cheese was recorded as kg of cheese / kg of milk x 100. Fat or protein losses in whey was calculated as follows:-

$$\text{Fat loss in whey} = \frac{\text{Amount of fat in whey}}{\text{Amount of fat in milk}} \times 100$$

$$\text{Protein loss in whey} = \frac{\text{Amount of protein in whey}}{\text{Amount of protein in milk}} \times 100$$

While fat and protein recoveries was calculated as follows:

$$\text{Fat recovery} = \frac{\text{Amount of fat in cheese}}{\text{Amount of fat in milk}} \times 100$$

$$\text{Protein recovery} = \frac{\text{Amount of protein in cheese}}{\text{Amount of protein in milk}} \times 100$$

RESULTS AND DISCUSSION

Data given in table (2) showed that acidity of buffaloe's milk increased when 10, 15 and 20% unsalted buttermilk were added. Acidity values of buffaloe's milk alone or mixed with 15 or 20% buttermilk were 0.15, 0.21 and 0.25%, respectively. This might be due to the high acidity of buttermilk. In contrary, TS, fat and total nitrogen of buffaloe's milk decreased by adding buttermilk and this also related to the low T.S. content of buttermilk (6.387%). Similar results were obtained by Farag *et al.* (1993).

Fig 1. Changes in ewe body weight as a response to different barley radicle levels.

Table 2: Effect of admixing 10, 15 and 20% buttermilk to buffaloe's milk on the chemical composition.

Samples	Acidity (%)	pH	T.S. (%)	Fat (%)	T.N. (%)	T.P. (%)
Buffaloe's milk	0.15	6.92	16.04	6.4	0.624	3.980
Buttermilk	0.68	4.78	8.05	1.9	0.551	3.515
90% Buffaloe's milk + 10% buttermilk	0.17	6.61	15.78	6.2	0.605	3.861
85% Buffaloe's milk + 15% buttermilk	0.21	6.51	14.98	5.9	0.596	3.802
80% Buffaloe's milk + 20% buttermilk	0.25	6.30	14.11	5.3	0.590	3.765

Table 3 showed some rheological properties of buffaloe's and buttermilk admixture using liquid rennet. Replacing buffaloe's milk by buttermilk reduced R.C.T. and curd tension, but increased the curd syneresis and the increasing the replacing rates resulted in higher stimulating effect on the rennet action. R.C.T. of buffaloe's milk decreased by 36.48, 44.65 and 52.83% when 10, 15 and 20% unsalted buttermilk were added. This effect might be attributed to the increased activity of sour buttermilk. These results are in accordance to those reported by Antila and Witting (1978). No coagulation was found when liquid rennet or HALA was added to buttermilk alone.

Table 3: Effect of admixing 10, 15 and 20% buttermilk to buffaloe's milk on its rheological properties.

Samples	R.C.T. (Sec.)	Curd tension (g)	Curd syneresis			
			10 min.	30 min	60 min.	120 min
Buffaloe's milk	159	76.65	1.505	2.825	3.870	5.190
Buttermilk	**No coagulation**					
90% Buffaloe's milk + 10% buttermilk	101	73.01	2.095	3.460	4.660	5,910
85% Buffaloe's milk + 15% buttermilk	88	71.85	2.395	4.170	5.325	6.650
80% Buffaloe's milk + 20% buttermilk	75	68.29	2.400	4.380	5.475	6.910

Data given in table 4 showed that whey resulting from buttermilk Ras cheese making had higher values of acidity, total nitrogen, ash and salt contents than those of control cheese whey. While, calcium content was lower in buttermilk cheese whey than control cheese whey. T.S. and fat contents were similar in both types of whey. In general, T.S. of whey is very high (9.078 - 9.985%) because of the added salt to the scalded curd in whey (5% of milk amount). HALA cheese scored slight higher TS, fat and T.N. contents.

Table 4: Effect of adding buttermilk to buffaloes milk on the chemical composition of Ras cheese whey.

Tr.	Acidity (%)	pH	Total solids (%)	Fat (%)	T.N. (%)	T.P. (%)	Ash (%)	Salt (%)	Calcium (%)
A	0.17	6.36	9.078	0.6	0.121	0.775	4.481	3.861	0.137
B	0.18	6.30	9.335	0.7	0.138	0.881	4.692	4.169	0.129
C	0.21	6.16	9.330	0.7	0.156	0.997	4.992	4.471	0.131
D	0.25	5.77	9.958	0.9	0.164	1.048	4.830	4.287	0.124

A: Represents Ras cheese made from buffalo's milk + liquid rennet (Control).
B: Represents Ras cheese made from buffalo's milk + HALA rennet.
C: Represents Ras cheese made from 85% buffalo's milk + 15% unsalted buttermilk + liquid rennet.
D: Represents Ras cheese made from 85% buffalo's milk + 15% unsalted buttermilk + HALA rennet.

Data in table 5 stated that fat losses in whey were higher and fat recovery were lower in Ras cheese containing buttermilk than those of control cheese. This might be explained by the greater number of small fat globules in cheese containing buttermilk than those in control cheese because of the large amounts of these globules in buttermilk (Mistry *et al.*, 1996). Also, using HALA in Ras cheese making increased fat loss in whey and decreased fat recovery. Protein loss in whey and protein recovery into cheese took the same trend of fat loss in whey or fat recovery. Fat recovery values of A, C and D treatments were 91.14, 86.97 and 81.91%, respectively.

Data in table 6 showed the chemical composition of Ras cheese made from buffaloe's milk replaced by 15% unsalted buttermilk using liquid rennet or HALA. Yield values were lower in Ras cheese containing buttermilk than control. This may be due to the decreased of T.S. of the admixture buffaloe's milk with buttermilk used in cheese making as a result of adding buttermilk. Similar results were found by Reisfeld and Harper (1955) for brick-type cheese. The type of rennet had no clear effect on the yield of the cheese.

Table 5: Effects of adding buttermilk to buffaloe's milk on fat and protein recoveries during Ras cheese manufacturing.

Properties	Treatments			
	A	B	C	D
Amount of whey (kg)	24.500	24.500	25.000	25.200
Fat of whey (%)	0.60	0.90	0.70	0.90
Amounts of fat in milk (%)	1.829	1.829	1.581	1.581
Fat loss in whey (%)	8.04	12.03	11.07	14.36
Fat recovery (%)	91.14	86.11	86.97	81.91
Total protein of whey (%)	0.775	0.881	0.997	1.048
Amount of protein in milk (%)	1.360	1.360	1.241	1.241
Protein loss in whey (%)	13.97	16.40	17.73	21.27
Protein recovery (%)	85.44	82.79	80.98	76.15

Moisture, salt and salt / D.M. of Ras cheese increased when buffaloe's milk replaced by buttermilk. These results were for fresh and ripened cheese. Moisture contents of A and C samples at 90 days were 28.978 and 31.878%, respectively. The increase in moisture content of Ras cheese containing

buttermilk might be due to the increase in water holding capacity of the cheese and to the minimization of moisture loss during ripening as a result of buttermilk incorporation (Abdel-Nabi *et al.*, 1994a). Ras cheese made with HALA rennet had slight higher moisture content than those of cheese made with liquid rennet. No pronounced differences were detected in the salt and salt / D.M. of Ras cheese as a result of using liquid or HALA rennet. Similar results were found by El-Zoghby and Abdel-Kader (2000).

From table 6, it is observed that acidity of Ras cheese raised when buttermilk was added to buffaloe's milk. Acidity of 120 days old cheese were 1.64 and 2.55% for A and D treatments, respectively.

Joshi and Thakar (1993) stated that incorporation of buttermilk into buffaloe's milk increased acidity and reduced the pH values of Cheddar cheese.

HALA Ras cheese contained higher acidity than liquid rennet cheese. Acidity of A and B treatments at 180 days were 1.82 and 2.60%, respectively. Similar trend of results were obtained by Blassy (1999), who used different coagulant in Mozzarella cheese making . pH values took the opposite trend of acidity.

Fat, F/D.M., T.N. and T.N. /D.M. of Ras cheese containing buttermilk were lower than those of control cheese. Also HALA Ras cheese contained lower values of fat, fat / D.M. , T.N. and T.N. /D.M. than those of liquid calf rennet cheese.

In general during ripping, yield and moisture content decreased while salt, acidity, fat and T.N. of Ras cheese gradually increased.

Table 7 represents some ripening indices of Ras cheese as affected by adding buttermilk to buffaloe's milk or using liquid rennet or HALA in cheese making.

The addition of buttermilk to buffaloe's milk increased S.N. , S.N. /T.N., N.P.N./T.N. , S.Tyr and S.Try values of Ras cheese. S.N. /T.N. were 9.51, 15.65, 10.85 and 16.77 for 180 days old cheese A, B, C and D treatments, respectively. Respective values for S.Tyr were 81.78, 85.57, 91.46 and 96.83 mg/100 g cheese. The highest nitrogen fractions of Ras cheese made from buttermilk incorporation to other milk was explained by Jemes and Patton (1959) and El-Abbassy *et al.* (1991), who stated that buttermilk contained higher levels of moisture and fat globule membrane materials, which enhance the cheese microflora during ripening period.

Protein degradation as affected by type of rennet, HALA rennet cheese recorded higher rate of S.N., S.N. /T.N. , N.P.N., N.P.N./T.N. , S.Tyr and S.Try values as compared with calf liquid rennet cheese in Ras cheese either fresh or during ripening. N.P.N./T.N. of A and B treatments at 120 days were 4.43 and 10.61%, respectively. The obtained results are in agreement with those reported by Hamdy *et al.* (1980) and Nasr (1982), who used different types of rennet to make Romi and Edam cheese, respectively.

Ras cheese containing buttermilk had higher levels of T.V.F.A. than those in the control (Table 7). T.V.F.A. of 180 days old cheese were 34.4, and 36.2 ml NaOH N/10 / 100 g cheese for A and C treatments. Abdel-Nabi *et al.* (1994b) found that Ras cheese containing 10 and 20% sweet buttermilk had higher T.V.F.A. than that of control cheese made from buffaloe's milk.

HALA cheese had higher values of T.V.F.A. than those of liquid rennet cheese. T.V.F.A. of A and B treatment after 60 days of ripening were 23.8 and 24.2, respectively.

Results in table 8 showed that saturated fatty acids (S.F.A.) percentage are higher than unsaturated fatty acids (U.S.F.A.) for all 90 days old cheese treatments. Some changes in the F.F.A. were occurred after 180 days. Liquid rennet cheese possessed higher U.S.F.A. than S.F.A., while HALA rennet cheese had the same trend either for 90 or 180 days. S.F.A. in general, ~~content~~ decreased and U.S.F.A. ncreased as ripening period advanced. Mixing buttermilk to buffaloe's milk reduced S.F.A. content and increased U.S.F.A. after both 90 and 180 days old cheese. The addition of 15% unsalted buttermilk (C sample) to the buffaloe's milk reduced the total S.F.A. by 4.16%.

HALA Ras cheese contained higher S.F.A. and lower U.S.F.A. contents compared with liquid rennet cheese in both 90 or 180 days old cheese. At 180 days, S.F.A. contents of A and B treatments were 48.511 and 56.120%, respectively.

No marked differences in short chain fatty acids (C_6-C_{12}) of Ras cheese were noticed when buttermilk was incorporated to buffaloe's milk, while HALA cheese contained higher level of those acids than those in liquid rennet cheese either 90 and 180 days old cheese. The volatile free fatty acids (C_2 - C_5) were not detected in different cheese treatments at 90 and 180 days of ripening period, except butyric acid (C_4) which was detected in C sample of 90 days old cheese and in A treatment at 180 days. The absence of acetic, propionic and valeric acids in Ras cheese after 180 days of ripening reported by El-Shibiny *et al.* (1978) and Soliman *et al.* (1980), who found that the free volatile fatty acids of Ras cheese consisted of propionic, butyric, caproic, caprylic and traces of acetic acids.

Sensory evaluations of different Ras cheese treatments were tabulated in table 9. Most judgers highly complained about the very crumbly texture buffaloe's milk Ras cheese especially during the first four months. Another remark was the grayiny texture, which associated the commercial rennet cheese. The addition of buttermilk highly improved the body and texture of the cheese and secondly on the flavour. Body and texture of Ras cheese made from buffaloe's milk alone had 20 points over total score of 40 after 180 days (A treatment), while cheese containing buttermilk had 35 point for body and texture (C treatment). Improvement of organoleptic properties of Ras cheese containing buttermilk may be due to the high values of S.N. , S.Tyr, S.Try and U.S.F.A. as compared with control cheese. Similar results were found by Abdel-Nabi *et al.* (1994a). Similarly, HALA rennet highly improved the body and texture of the cheese and partly the flavour. No marked effect on the appearance and colour was observed as a result of adding the buttermilk to buffaloe's milk or using different types of rennet. Improvement of organoleptic properties of cheese by adding buttermilk may be attributed to the increase in the development of lactic acid, lactate and some minor components released from the protein decomposition and fat hydrolysis of cheese during ripening (Foster *et al.*, 1983).

Table 7: Effect of adding buttermilk to buffaloe's milk on some nitrogenus fractions and T.V.F.A. of Ras cheese by using two types of rennet during ripening.

Treatments	Ripening period (days)	S.N. (%)	S.N. /T.N. (%)	N.P.N. (%)	N.P.N./ T.N. (%)	S.Tyr*	S.Try*	T.V.F.A.** (%)
A Buffaloe's milk + liquid rennet (Control)	0	0.144	4.37	0.105	3.18	36.53	16.58	8.8
	30	0.210	5.50	0.147	3.85	47.67	20.27	21.4
	60	0.238	5.74	0.154	3.71	55.31	22.14	23.8
	90	0.286	5.83	0.161	3.84	66.05	23.17	25.4
	120	0.341	7.99	0.189	4.43	70.33	25.69	28.4
	150	0.379	8.85	0.196	4.58	75.87	28.05	30.6
	180	0.409	9.51	0.203	4.72	81.78	30.14	34.4
B Buffaloe's milk + HALA	0	0.280	8.93	0.123	3.92	38.70	17.15	9.2
	30	0.392	11.50	0.218	6.39	50.01	20.99	23.8
	60	0.490	13.46	0.305	8.38	57.46	23.83	24.2
	90	0.518	14.16	0.375	10.25	69.91	24.69	25.6
	120	0.532	14.39	0.392	10.61	74.02	25.97	29.1
	150	0.574	14.91	0.434	11.27	79.38	29.91	31.8
	180	0.623	15.65	0.462	11.61	85.57	31.27	36.8
C 85% Buffaloe's milk + 15% unsalted buttermilk + liquid rennet	0	0.151	4.72	0.108	3.38	41.91	19.42	9.6
	30	0.213	6.06	0.143	4.07	52.83	21.12	24.6
	60	0.240	6.47	0.160	4.31	62.07	24.70	26.2
	90	0.285	7.62	0.168	4.49	75.16	25.90	27.4
	120	0.346	9.11	0.191	5.03	81.74	27.16	31.9
	150	0.382	10.02	0.201	5.27	86.98	30.31	33.6
	180	0.415	10.85	0.207	5.41	91.46	33.52	36.2
D 85% Buffaloe's milk + 15% unsalted buttermilk + HALA rennet	0	0.307	10.13	0.127	4.19	44.24	20.53	11.2
	30	0.395	11.52	0.220	6.41	56.69	21.05	25.8
	60	0.487	13.95	0.208	8.83	64.31	25.00	28.0
	90	0.518	14.80	0.368	10.51	76.34	27.50	30.1
	120	0.539	15.09	0.399	11.17	83.25	28.92	32.2
	150	0.580	16.03	0.438	12.11	89.03	30.09	34.6
	180	0.620	16.77	0.465	12.58	96.83	33.97	39.2

* mg / 100 g cheese.

** ml NaOH N/10 / 100 g cheese.

Table 8: GLC composition of free fatty acids (F.F.A.) contents (as percent of total fat) in Ras cheese as affected by type of milk and type of rennet.

Fatty acids	C	Treatments							
		90 days				180 days			
		A	B	C	D	A	B	C	D
Saturated fatty acids (S.F.A.)									
Bytyric	4	--	--	1.944	--	1.483	--	--	--
Caproic	6	1.722	6.361	1.288	4.877	2.900	3.818	2.067	2.642
Caprylic	8	0.957	1.447	0.718	1.877	0.964	1.368	1.340	1.068
Capric	10	1.833	2.041	1.776	2.958	1.802	2.203	2.537	2.732
Lauric	12	2.306	3.081	2.265	3.015	2.811	2.334	2.963	2.609
Myristic	14	10.255	12.870	10.273	11.105	9.605	13.783	9.422	11.716
	Iso 14	0.151	--	0.202	0.181	--	0.624	--	0.355
	15	0.770	0.673	1.223	1.106	1.119	2.103	1.191	1.193
Palmitic	16	32.542	34.398	29.852	33.289	27.827	28.876	26.547	31.353
	Iso 16	0.414	--	--	--	--	1.011	--	--
	17	1.074	--	0.758	--	--	--	--	--
Stearic	18	--	--	--	--	--	--	--	--
	Iso 18	--	--	0.560	--	--	--	--	--
Total		52.024	60.871	50.859	58.408	48.511	56.120	46.067	53.668
Unsaturated fatty acids (US.F.A.)									
Myrisoleic	14:1	0.654	--	0.488	0.219	0.558	0.391	0.880	0.351
	15:1	--	1.764	1.064	1.035	0.963	1.040	--	1.252
Palmitoleic	16:1	3.161	1.164	3.145	3.726	1.807	4.914	2.321	3.690
Oleic	18:1	24.198	20.741	27.266	20.616	17.202	16.695	21.520	19.670
Linoleic	18:2	19.963	15.460	17.178	15.996	30.959	20.840	29.212	21.369
Linolenic	18:3	--	--	--	--	--	--	--	--
Total		47.976	39.129	49.141	41.592	51.489	43.880	53.933	46.332

El-Zoghby and Abdel-Kader (2000) stated that Halloumi cheese produced by using HALA rennet scored the highest score for cheese quality, while local liquid rennet treatment gained the lowest score.

From the economic point of view (Table 10), the addition of 15% buttermilk to 85% buffaloe's milk accomplished two profits, firstly, the quality of the cheese, secondly, profit of Ras cheese increase by the value of 5.876 L.E / 100 kg milk when the admixtured milk was used.

It is recommended to added 15% buttermilk to buffaloe's milk to improve the organoleptic properties of produced Ras cheese as well to reduce the production costs of the cheese. If HALA rennet is available, it is recommended with buffaloe's milk Ras cheese, since it posses high proteolytic activity as compared with local liquid rennet which led to high ripening indices.

Table 9: Effect of adding buttermilk to buffaloe's milk on the organoleptic properties of Ras.

Treat.	Ripening Period (day)	Flavour (45)	Body and Texture(40)	Color (5)	Appearance (10)	Total (100)	Consistency	Flavour
A Buffaloe's milk + liquid rennet (Control)	60	25	20	3	8	56	Tough	Mild salt and acidity
	90	27	20	3	8	58	Firm-tough	Good flavour
	120	30	20	3	8	61	Tough	Food flav.- Mild salt and acidity
	150	33	22	3	8	66	Tough	Good flavour - Crimp taste
	180	37	20	4	8	69	Very tough	Good flavour - Crimp taste
B Buffaloe's milk + HALA	60	27	22	3	8	60	Slight tough	Fatty taste - Mild salt and taste
	90	30	23	3	9	65	Slight tough	Good flavour
	120	32	27	3	9	71	Slight tough - smooth	Good aroma
	150	34	27	4	9	74	Slight tough - smooth	Good flavour
	180	37	30	4	9	80	Slight tough - smooth	Good falvour
C 85% Buffaloe's milk + 15% unsalted buttermilk + liquid rennet	60	35	32	3	8	78	Slight tough	Fatty taste - salt and acidity
	90	34	32	3	8	77	Slight tough	Crimp taste - salt and acidity
	120	37	32	3	8	80	Slight tough. - smooth	Good flavour
	150	40	33	4	8	85	Good body	High acidity
	180	41	35	4	8	88	Good body	Good flavour
D 85% Buffaloe's milk + 15% unsalted buttermilk + HALA rennet	60	30	32	3	7	72	Slight harsh	Salt and acidity
	90	33	32	3	8	76	Slight soft	High acidity
	120	35	34	3	8	80	Slight soft	Good falvour
	150	40	37	4	8	90	Slight soft	Good falvour
	180	43	38	4	8	93	Soft and smooth	Good falvour

Table 10: Economic calculation of using buttermilk in making Ras cheese*.

Item	Buffaloe's milk cheese	Admixture milk cheese
Inputs:		
1. Price of buffaloe's milk	100 kg x 1.3 L.E = 130 L.E.	85 kg x 1.3 L.E = 110.5 L.E.
2. Price of buttermilk	--	15 kg x 8 P.T = 1.2 L.E.
3. Processing cost**	100 kg x 5% = 6.5 L.E.	100 kg x 5% = 6.5 L.E.
4. Total cost	136.5 L.E.	118.20 L.E.
Outputs:		
1. Yield	12.5%	11.3%
2. Total organoleptic scoring points (out of 100 point)	69	88
	Badly score	Highly score
3. Cost of one kg of cheese***	136.5/12.5 = L.E. 10.92	118.20/11.3 = L.E. 10.40
4. The difference in cost/kg of cheese****	10.92 - 10.40 = 0.52	
5. The total difference in cost of producing 100 L milk*****	11.3 x 0.52 = L.E. 5.876.	

* The study is for processing 100 kg of milk.

** Processing cost = 5% of the price of buffaloe's milk.

*** Cost of one kg of cheese = Total cost / yield

**** The differens in cost / kg of cheese = Cost of 1 kg of buffaloe's milk cheese - Cost of 1 kg of admixture milk cheese.

***** The total difference in cost of producing 100 L milk = Yield x difference in cost between two cheese.

REFERENCES

Abd El-Kader, Y.I. (1993). Technological studies on the properties of Kachkaval like cheese as affected by direct acidification. Ph.D. Thesis, Dept. of Dairy Sci., Fac. of Agric., Alexandria Univ., Egypt.

Abdel-Nabi, A.A.; S.M. El-Dieb and S.I. Harby (1994a). Utilization of buttermilk in Ras cheese making made from buffaloe milk. J. Agric. Sci. Mansoura Univ., 19(1):287-297.

Abdel-Nabi, A.A.; S.M. El-Dieb and S.I. Harby (1994b). The use of buttermilk in making Ras cheese made from cow's milk. J. Agric. Sci. Mansoura Univ., 19(1):277-285.

Abdel-Salam, M.H.; J.D. Rifatt; A.H. Fahmi and A.M. El-Sokkary (1964). The amino acids composition of buffaloe's milk casein. J. Anim. Prod., (A.R.E.), 6:2.

Abou-Zeid, N.A. (1992). New type of Domiati cheese of potential benefit to people with high blood cholesterol. J. Dairy Res., 59:89.

Amer, S.N.; M.R. Naghmoush and S.M.K. Anis (1978). Studies of some changes in the calcium paracaseinate phosphate complex during cheddaring of Kachkaval cheese as affected by the kind of milk. Egyptian J. Dairy Sci., 7(1):17-24.

Antila, V. and O. Witting (1978). The use of buttermilk in cheese making. XX International Dairy Congress, E., 928.

Blassy, K.I. (1999). Technological studies on smoked cheese. Ph.D. Thesis, Dept. of Dairy Sci., Fac. of Agric., Suez Canal Univ., Egypt.

British Standard Institution B.S.I. No. 770 (1952). Methods for the Chemical Analysis of Cheese. Pub. British Standard House, London.

Chandrasekhara, M.R.; R.K. Bhagawan; M. Swaminathan and V. Subrahmanyan (1957). The use of mammalian milk and processed milk foods in the feeding of infants. Indian J. Child. Health, D, 70L.

Davies, D.T. and J.C.D. White (1958). The relation between the chemical composition of milk and the stability of the caseinate complexs. II. Coagulation by ethanoil. J. Dairy Res., 25:256.

Ek-Sokkary, A.M. and A.H. Hassan (1949). The composition of the milk of Egyptian cow's and buffaloe's. J. Dairy Res., 16:217.

El-Abbasy, M.Z. ; M.E. Aly and S.N. Taha (1991). Nahrung, 35:663.

El-Shibiny, S.; A. Soliman; M. El-Bagoury, A.E. Gad and M.H. Abdel-Salam (1978). Development of volatile fatty acids in Ras cheese. J. Dairy Res., 45:497.

El-Zoghby, A.S. and Y.I. Abdel-Kader (2000). Comparison between different types of coagulant for Halloumi cheese processing. J. Agric. Sci. Mansoura Univ., 25(9) :5701-5712.

Fahmi , A.H. ; I. Sirry and A. Safwat (1956). The size of fat globules and the creaming power of cow's, buffaloe's, sheep's and goat's milk. Indian J. Dairy Sci., 11(3):124.

Farag, A.A.; A.L. Okasha and E.A. Emara (1993). Coagulation of buffaloe's milk and resultant Domiati cheese characteristics as affected by salting and replacement with sour cream buttermilk. Die Nahrung, 37(5):440-448.

Foster, T.M.; F.E. Nelso; M.L. Speck; R.N. Doctsch and J.C. Olson (1983). Chap. 13. In: "Dairy Microbiology". Ridge view Publish. Ca, Independenece, Ohio, USA.

Graham, H.G.; Jr. T.C. Mcright and E.D. Frederick (1962). Determination of calcium in phosphate materials by titration with EDTA in the presence of calcium indicator. Agric. Food Chem., 10:447.

Granikov, D.; E.V. Shededushnov ; V. Palokaro and E. Yevko (1962). Effect of homogenization on the submicroscopic structure of protein. Dairy Indust., 23(8):10.

Hamdy, M.A.; M.M. Nasr and M.M. Attia (1980). Effect of different kinds of rennet on the properties of Romi cheese. III. Effect on ripening of cheese. Agric. Res. Rev., 58:287-298.

Hofi, A.A.; G.A. Tawan; E.H. Youssef and M.A. Ghoneim (1970). Ripening changes in Cephalotyre (Ras) cheese manufactured from raw and pasteurized milk with special reference to favour intensity. J. Dairy Sci., 53:1207.

Ibrahim, S.A.; M.A. El-Batawy and A.S. Fikry (1990). Utilization of buttermilk in making Kareish cheese. Egyptian J. Dairy Sci., 18:95..

Jennes, R. and S. Patton (1959). Principles of Dairy Chemistry. P. 319. Chapman and Hall, Limited, London.

Kosikowski, F.V. (1966). Cheese and Fermented Milk Foods. 2nd Printing. Published by the Author. New York, 1966.

Ling, E.R. (1963). A Textbook of Dairy Chemistry. Chapman and Hall, Ltd, 37 Esser Street V.C. 2, Practical 1963, 4th Edition, London.

Mehanna, N.M. and A.S. Mehanna (1989). Studies on the use of stabilizer for improving some properties of cow's milk yoghurt. Egyptian J. Dairy Sci., 17:289.

Metwally, M.M.; I.A. Abd El-Gawad; A.M. Mehriz and S.M. El-Dieb (1988). The hypocholesterolaemic effect of buttermilk. I. The effect of butter oil, buttermilk, casein and cream on rats serum and hepatic lipids. Egyptian J. Dairy Sci., 16:175.

Mistry, V.V.; L.E. Metzger and J.L. Maubois (1996). Use of ultrafiltered sweet buttermilk in the manufacture of reduced fat Cheddar cheese. J. Dairy Sci., 79(7):1137-1145.

Nasr, M.M. (1982). Effect of different types of rennet on the composition and properties of Edam cheese. Agric. Res. Rev., 60:181.

Nawer, M.A. (1996). Chemical and technological studies in dairy ingmanufacture of Ras cheese by ultrafiltration. Ph.D. Thesis, Alexandria Univ., Egypt.

Reisfeld, R.A. and W.J. Harper (1955). A new low fat soft ripened cheese. J. Dairy Sci., 38:7.

Soliman, M..; S. El-Shibiny; A. Mohamed and M. Abdel-Salam (1980). Effect of added proteolytic enzyme preparations on the development of volatile fatty acids in Ras cheese. Egyptian J. Dairy Sci., 8:49.

Vakaleries, D.G. and W.V. Price (1959). A rapid spectrophotometric method for measuring cheese ripening. J. Dairy Sci., 47:264.

Vogel, A.J. (1975). A Textbook of Practical Organic Chemistry. Published by English Language Book Society and Longmans Group Ltd. 3rd Ed. P. 973.

إضافة اللبن الخض لألبان أخرى مستخدمة فى صناعة الجبن الراس
١- اللبن الجاموسى مع إستخدام نوعان من المنفحة

الطاهرة محمد أحمد عمار* - يحيى إبراهيم عبد القادر -عبد الوهاب الشاذلى خليل* - مجدى محمد إسماعيل****

* قسم الألبان - كلية الزراعة - جامعة المنصورة

** معهد بحوث الإنتاج الحيوانى - الدقى - القاهرة

أجرى هذا البحث لدراسة تأثير إضافة ١٠ ، ١٥ ، ٢٠% لبن خض غير مملح للبن الجاموسى على بعض الخواص الكيماوية والريولوجية وإختيار أفضل النسب من الوجهة الريولوجية. وقد أوضحت النتائج مايلى:-

- زادت الحموضة وإنخفض كل من pH والمواد الصلبة والدهن والنيتروجين الكلى للبن الجاموسى بإضافة ١٠ ، ١٥ ، ٢٠% لبن خض غير مملح. وقد إرتبط الإنخفاض فى هذه المكونات بالنسبة المضافة من اللبن الخض.
- إضافة ١٠ أو ١٥ أو ٢٠% لبن خض غير مملح للبن الجاموسى أدت إلى إنخفاض كلا من وقت التجبن بالمنفحة والجذب الخثرى فى حين أدت إلى زيادة فى التشرش إلا أن اللبن الخض لم يتم تجبنه بالمنفحة.

وتبعا للنتائج السابقة فإنه يمكن تصنيع الجبن الراس من اللبن الجاموسى المضاف إليه ١٥% لبن خض وذلك بإستخدام المنفحة الحيوانية السائلة أو منفحة HALA المحتوية على (٧٥% كيموسين + ٢٥% ببسين). وتشير النتائج المتحصل عليها إلى:-

- الجبن الراس المحتوى على اللبن الخض الغير مملح أحتوى على قيم منخفضة من التصافى و pH والدهن والدهن / المادة الجافة والنيتروجين الكلى والنيتروجين الكلى / المادة الجافة فى حين إحتوى على قيم مرتفعة من الرطوبة والملح والملح / المادة الجافة والحموضة والنيتروجين الذائب والنيتروجين الذائب على النيتروجين الكلى والنيتروجين الغير بروتينى / النيتروجين الكلى والتيروسين والتربتوفان والأحماض الدهنية الطيارة بالمقارنة بالجبن الراس المصنع من لبن جاموس فقط. وقد إرتفعت نسبة الأحماض الدهنية الغير مشبعة وإنخفضت نسبة الأحماض الدهنية المشبعة بالجبن الراس المضاف إليه لبن خض.
- لم يلاحظ تأثير لنوع المنفحة على نسبة التصافى والملح والملح / المادة الجافة بالجبن الراس فى حين إنخفضت نسبة الدهن والنيتروجين الكلى وإزدادت نسبة الحموضة والرطوبة والنيتروجين الذائب والنيتروجين الذائب / النيتروجين الكلى والنيتروجين الغير بروتينى والنيتروجين الغير بروتينى / النيتروجين الكلى والتيروسين والتربتوفان والأحماض الدهنية الطيارة فى الجبن الراس المصنع بإستخدام منفحة HALA . وقد كانت نسبة الأحماض الدهنية الغير مشبعة مرتفعة والأحماض الدهنية المشبعة منخفضة فى الجبن المصنع بالمنفحة الحيوانية السائلة بالمقارنة بالجبن الراس المصنع بمنقحة HALA .
- إضافة ١٥% لبن خض غير مملح أو إستخدام منفحة HALA أدى إلى زيادة فى نسبة الدهن والبروتين المفقودين فى الشرش وإنخفاض فى نسبة الدهن والبروتين المتبقية بالجبن.
- أدت إضافة ١٥% لبن خض غير مملح للبن الجاموسى إلى تحسين واضح فى الخواص الحسية للجبن الراس وكذلك إدت إلى زيادة ملموسة فى الربح الناتج من هذا النوع من الجبن.