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INCORPORATION OF UNSALTED BUTTERMILK WITH OTHER MILKS IN RAS CHEESE PRODUCTION: II. ADMIXTURE OF BUFFALOE'S AND COW'S MILK USING LIQUID RENNET OR FORMASE.

Abdel-Kader, Y. I.; El-Tahra M. Ammar; 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

Incorporation of 10, 15 and 20% unsalted sour buttermilk into buffaloe's or cow's milk or into mixture of buffaloe's and cow's milk (50% : 50%) was chemically and rheologically studied.

Acidity of buffaloe's or cow's milk or milk mixture increased proportionally as buttermilk was increased, while pH, TS, fat and TN of milk decreased.

Replacement of buffaloe's or cow's milk or the milk mixture by 10, 15 or 20% buttermilk decreased rennet coagulation time (RCT) and curd tension and increased curd syneresis. Buttermilk alone was not coagulated by liquid calf rennet.

The above results showed the possibility of making Ras cheese by adding 15% unsalted buttermilk to the mixture of buffaloe's + cow's milk (50% : 50%).

Adding 15% buttermilk to the mixture of milk decreased yield, pH, fat, fat / DM, TN, and TN/DM of Ras cheese during ripening, while acidity, moisture, salt, salt / DM, soluble nitrogen (SN), SN/TN, non-protein nitrogen (NPN), NPN /TN, soluble tyrosine (S.Tyr.), soluble tryptophane (S.Try) and TVFA of Ras cheese increased. Incorporation of 15% buttermilk into a mixture of buffaloe's + cow's milk decreased saturated fatty acids (SFA) and increased unsaturated fatty acids (USFA) in Ras cheese.

Using microbial rennet (Formase) in Ras cheese making decreased yield, moisture, and SFA contents and increased acidity, fat, TN, SN, NPN, S.Tyr, S.Try, TVFA and USFA in resultant cheese as compared with liquid calf rennet cheese.

Fat and protein losses in whey were higher in Ras cheese containing buttermilk as compared with control cheese. Fat and protein recoveries were lower in Ras cheese made using Formase than that made from liquid calf rennet.

Incorporation of 15% unsalted sour buttermilk improved the organoleptic properties of Ras cheese made from buffaloe's + cow's milk, but organoleptic properties were slightly lower in Formase cheese than those cheese made with liquid calf rennet.. Also, adding 15% buttermilk to cheese milk increased the economic profit of the resultant Ras cheese.

INTRODUCTION

Buttermilk is produced as a by-product during butter manufacturing from either normal or sour cream (Mahran *et al.*, 1990). Buttermilk does not consider as a waste, it contains most of milk components, but with different levels depending on the butter making level beside, it contains of many viable flavouring components, which is produced during cream frementation (El-Hofi *et al.*, 1999).

Reisfeld and Harper (1954) used up to 30% buttermilk to make soft low fat cheese. Madsen *et al.* (1966) reported that moisture content of a Brick-type low fat cheese was increased by added buttermilk. With 20 and 30% buttermilk, cheese quality were undesirable after 3 months of ripening. Ibrahim *et al.* (1990) utilized sweet buttermilk in making Kareish cheese fortified by adding skim milk powder and stored the cheese for 3 weeks. Joshi and Thakar (1993) concluded that substituting 25% of skim milk with buttermilk produced an acceptable Cheddar cheese, but above 25% buttermilk cheese was not acceptable. Mayes *et al.* (1994) used various combinations of buttermilk and cream in low Cheddar cheese and noted that buttermilk incorporated by homogenization with cream slightly improved the sensory properties of the cheese. Abdel-Nabi *et al.* (1994) stated that adding buttermilk to cow's milk improved the falvour, body and texture of Ras cheese. Mistry *et al.* (1996) found that sweet buttermilk contained a large amount of the milk fat globule membrane and may be useful for low fat cheese making.

Different microorganisms are used for production of coagulation enzymes as rennet substitutes. In this respect, Formase and Rennilase from *Mucor miehes* are used in cheese production.

The aim of this study is to examine the effect of adding 10, 15 or 20% of unsalted sour buttermilk to a mixture of buffaloe's + cow's milk (1:1) to find out the acceptable portion, then adding this portion to the mixture of buffaloe's + cow's milk to process Ras cheese using liquid calf rennet or Formase and studying the physiochemical and organoleptic properties of the resultant cheese, paralely to study the economic value of using the buttermilk in Ras cheese production.

MATERIALS AND METHODS

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

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

Local commercial liquid calf rennet was obtained from local market, was added to the milk at the rate of 40 ml/100 L. Microbial powder rennet prepared from pure culture of the fungi *Mucor miehei* (commercially named Formase) produced by Gist-brocades of Holland, was added at a rate of 3 gm/100 L of milk . It was also dissolved in tap water before being used.

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

The material for coating cheese are 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) from (buffaloe's + cow's milk 1:1) replaced by 15% unsalted buttermilk. The mixted milk was warmed to 33°C, then 1% active yoghurt starter was added. 5% salt

was added to the cheese vat. Stirring before hooping the curd into 2 kg stainless steel hoops, then pressed. Salting and coating of cheese were 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 mixture 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. 4 treatments were made as follows:-

Treatment 1: Buffaloe's + cow's milk (1:1) + Liquid calf rennet.
Treatment 2: Buffaloe's + cow's milk (1:1) + Formase.
Treatment 3: 85% treatment 1+15% unsalted buttermilk + liquid calf rennet.
Treatment 4: 85% treatment 2 + 15% unsalted buttermilk + Formase.

Table 1: Composition of milk for cheese making.

Type of Milk	Acidity (%)	pH	TS (%)	Fat (%)	TN (%)	TP (%)	Ash (%)	Calcium (%)
50% buffaloe's + 50% cow's milk	0.17	6.61	13.689	4.5	0.631	4.026	0.761	0.152
Unsalted buttermilk	0.22	6.11	6.387	1.8	0.282	1.799	0.557	0.144
85% mixed milk (buffaloe's and cow's (1:1) + 15% unsalted buttermilk	0.19	6.38	12.096	3.9	0.579	3.694	0.584	0.150

Samples of milk and whey were chemically analyzed, whereas fresh, 30, 50, 90, 120, 150 and 180 days old cheese were chemically and organoleptically analyzed. Free fatty acids were measured at 90 and 180 days.

Rennet coagulation time (RCT) was tested according to Davies and White (1958), curd tension was determined as described by Chandrasekhara *et al.* (1957). Curd syneresis was determined according to Mehanna and Mehanna (1989). Titratable acidity, pH value, total nitrogen (TN), soluble nitrogen (SN), non-protein nitrogen (NPN) and ash were determined according to 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 (TVFA) 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 polyethylene glycoladepate PEGA supported on an alkali-acid washed and silanized Diatomite C (100-120 mesh) was used. Organoleptic properties score of the cheese was measured according to Nawar (1996). The yield of cheese calculated 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 or 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

Results in table (2) showed that adding 10, 15 and 20% unsalted buttermilk to buffaloe's or cow's milk or to buffaloe's, and cow's milk admixtures increased acidity and reduced pH, TS, fat and TN. The increase or decrease in milk components was proportional to buttermilk added. Fat content of buffaloe's milk and buffaloe's milk replaced by 10 and 20% buttermilk were 6.4, 6.2 and 5.9%, respectively. This might be due to the low fat content of buttermilk (1.9%). Similar results were found by Abdel-Fattah (1966).

Effect of adding unsalted buttermilk to buffaloe's, cow's or mixture milk on some rheological properties and by using liquid rennet was shown in table (3). Adding 10, 15 or 20% unsalted buttermilk decreased RCT and curd tension and increased curd syneresis of buffaloe's, cow's and mixture milk. Curd tension of cow's milk alone or mixed with 15 or 20 buttermilk were 42.48, 25.73 and 23.17 gm, respectively. These results are in accordance with Farag *et al.* (1993). Buttermilk did not coagulate by liquid calf rennet.

Table (4) showed the chemical composition of Ras cheese whey collected before hooping of the curd. The high TS of whey is owing to the salting the cheese curd to 40 minutes before hooping. Buttermilk Ras cheese whey had the highest acidity percentages and the lowest pH values. This might be due to the higher acidity and high microbial counts of buttermilk (Abou-Zeid, 1992). On the other hand, the addition of buttermilk to mixture milk slightly increased total protein, and salt contents of extracted whey. Formase cheese whey had higher values of acidity, TS, fat, ash, salt and calcium content and lower values of pH and TN contents than those of whey produced from liquid rennet cheese.

Table 2: Effect of adding 10, 15 and 20% unsalted buttermilk to the other milks on the chemical composition.

Samples	Acidity (%)	pH	TS (%)	Fat (%)	TN (%)	TP (%)
Buffaloe's milk	0.15	6.92	16.04	6.4	0.624	3.980
Buttermilk	0.68	4.78	7.95	1.9	0.282	1.799
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
cow's milk	0.18	6.69	12.71	3.80	0.486	3.102
Buttermilk	0.58	4,77	7.95	2.10	0.474	3.026
90% cow's milk + 10% buttermilk	0.28	6.29	11.85	3.30	0.485	3.092
85% cow's milk + 15% buttermilk	0.31	6.18	11.01	3.00	0.477	3.041
80% cow's milk + 20% buttermilk	0.34	6.06	10.79	2.80	0.478	3.047
50% buffaloe's milk + 50% cow's milk	0.17	6.66	14.79	5.5	0.552	3.521
85% mixed milk (50% buffaloe's + 50% cow's milk) + 15% unsalted buttermilk	0.25	6.39	14.04	5.4	0.494	3.153
8o% mixed milk (50% buffaloe's + 50% cow's milk) + 20% unsalted buttermilk	0.29	6.32	13.66	5.1	0.478	3.051

Table 3: Effect of adding unsalted buttermilk with other milks on their rheological properties.

Samples	RCT	Curd	Curd syneresis (g)*			
	(Sec.)	tension (g)	10 min.	30 min	60 min.	120 min
Buffaloe's milk	159	76.65	1.595	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
Goat's milk	218	42.48	2.565	4.670	5.520	6.525
Buttermilk	No coagualtion					
90% cow's milk + 10% buttermilk	87	28.25	4.215	6.645	7.595	8.800
85% cow's milk + 15% buttermilk	78	25.73	4.295	6.695	7.735	9.040
80% cow's milk + 20% buttermilk	73	23.17	5.065	7.130	7.955	9.230
50% buffaloe's milk + 50% cow's milk	273	44.91	3.350	5.030	6.155	7.225
85% mixed milk (50% buffaloe's + 50% cow's) + 15% buttermilk	91	26.29	4.265	6.105	7.010	7.660
80% mixed milk (50% buffaloe's + 50% cow's + 20% Buttermilk	81	21.11	4.670	6.615	7.720	8.385

* Whey excluded (g) from 15g of curd kept at room temperature after 10, 30, 60 and 120 min.

Results in table (4) revealed that adding 15% unsalted buttermilk to milk led to an increase in fat and protein losses into the whey and decreased fat and protein recoveries into the cheese. Fat loss percentages were higher when Formase rennet was used in Ras cheese making as compared with cheese produced by using liquid calf rennet. Protein recovery was higher in Formase Ras cheese without adding buttermilk than that liquid calf rennet cheese without adding buttermilk. On contrary, Formase cheese containing buttermilk had lower protein recovery than that of liquid calf rennet cheese and containing buttermilk.

Table 4: Effects of adding 15% unsalted buttermilk to milk admixtures on the chemical composition of Ras cheese whey and fat and protein recoveries of Ras cheese.

Properties	Treatments			
	1	2	3	4
Acidity (%)	0.18	0.22	0.22	0.25
pH	6.14	5.93	5.95	5.75
TS (%)	9.570	10.099	9.851	10.357
Fat (%)	0.5	0.7	0.5	0.8
TN (%)	0.206	0.168	0.210	0.208
TP (%)	1.316	1.074	1.340	1.326
Ash (%)	4.072	4.178	4.219	4.384
Salt (%)	3.513	3.513	3.716	3.831
Calcium (%)	0.126	0.136	0.115	0.141
Amount of whey (kg)	50.50	34.00	50.50	34.750
Amounts of fat in milk (%)	2.700	1.800	2.340	1.560
Fat loss in whey (%)	9.33	13.22	10.81	17.82
Fat recovery (%)	88.11	84.33	87.65	76.79
Amount of protein in milk (%)	2.416	1.610	2.216	1.478
Protein loss in whey (%)	27.48	22.67	30.55	31.19
Protein recovery (%)	71.19	75.53	68.14	67.12

Data given in table (5) showed the chemical composition of Ras cheese made from (buffaloe's + cow's milk) mixture replaced by 15% unsalted buttermilk cheese. Adding of buttermilk to the above mixture decreased the yield of fresh cheese by 6.01% for 2 treatment. Also treatment 1 (buffaloe's + cow's milk + liquid rennet) gave higher yield than treatment 2 (buffaloe's + cow's milk) + Formase.

Adding of 15% buttermilk to admixtures of cheese milk increased moisture, salt and salt / DM values of the resultant Ras cheese. Formase Ras cheese had lower moisture contents than that of liquid rennet cheese during the riprning period. There is no clear differences between salt and salt / DM values of fresh Ras cheese and during the ripening period were noticed when liquid rennet or Formase was used in cheese production. Our results are in agreement with the results of Josh and Thakar (1993), who used unsalted buttermilk in Cheddar cheese making.

Farag *et al.* (1993) stated that salt contents increased in Domiati cheese replaced with sour cream buttermilk compared with control.

It is clear from the same table (5) that the addition of 15% buttermilk to mixture (buffaloe's + cow's milk) raised the values of acidity and lowered pH values of Ras cheese at zero time and during ripening. The percentages of acidity for 30 days old chees were 1.50 and 1.62% for 1 and 3 treatments, respectively. Abdel-Nabi *et al.* (1994) stated that the rate of acid production peaked faster with Ras cheese contained buttermilk than that control cheese (cow's milk) indicating the stimulatory action of buttermilk on the activity of the bacteria. Acidity of fresh Ras cheese made using liquid calf rennet (control 1) was slightly higher than that cheese made using microbial rennet (Formase) (control 2). During ripening period, Formase cheese had higher levels of acidity than that of liquid rennet cheese.

Table 5: Effect of adding 15% unsalted buttermilk to the mixture milk on some chemical properties of Ras cheese during ripening period (180 days).

Treatments	Ripeing period (days)	Yield (%)	Moisture (%)	Salt (%)	Salt/DM (%)	Acidity (%)	pH	Fat (%)	Fat/DM (%)	TN (%)	TN/DM (%)
(1) Buffaloe's + cow's milk (1:1) + Liquid rennet	0	13.81	36.700	3.232	5.10	0.55	6.01	28.7	45.34	3.252	5.14
	30	10.5510.4	32.352	3.968	5.86	1.50	5.29	30.0	44.35	3.710	5.48
	60	9	30.207	4.153	5.95	1.63	5.16	30.2	43.27	3.752	5.37
	90	10.47	28.887	4.263	5.94	1.71	5.12	30.5	42.89	3.808	5.35
	120	10.44	28.499	4.411	6.17	1.83	5.06	31.1	43.49	3.906	5.46
	150	10.41	27.552	4.563	6.30	1.91	4.96	31.6	43.62	4.032	5.56
	180	10.36	27.099	4.717	6.47	2.03	4.93	33.5	45.95	4.145	5.68
(2) Buffaloe's + cow's milk (1:1) + Formase	0	13.09	33.716	3.281	4.95	0.51	5.85	29.0	43.75	3.641	5.49
	30	10.47	28.975	4.031	5.67	1.65	5.28	30.7	43.22	3.864	5.44
	60	10.42	28.032	4.440	6.17	1.71	5.15	31.1	43.21	3.920	5.45
	90	10.22	27.408	4.603	6.34	1.83	5.10	31.8	43.81	3.976	5.48
	120	10.12	27.089	4.715	6.47	1.94	5.03	33.6	44.71	4.074	5.59
	150	10.11	26.509	4.823	6.56	2.07	4.90	33.4	45.45	4.101	5.58
	180	10.09	25.792	4.916	6.57	2.15	4.81	34.1	45.58	4.158	5.56
(3) 85% mixed milk (control 1) + 15% unsalted buttermilk + liquid rennet	0	12.98	38.348	3.398	5.51	0.69	5.70	26.0	42.17	3.012	4.88
	30	10.07	34.693	4.142	6.34	1.62	5.19	28.3	43.33	3.402	5.21
	60	9.95	33.462	4.302	6.46	1.75	5.10	28.9	43.43	3.500	5.26
	90	9.91	32.256	4.379	6.46	1.86	5.01	29.3	43.25	3.528	5.21
	120	9.87	31.643	4.480	6.55	1.96	4.94	29.9	43.74	3.584	5.24
	150	9.84	31.039	4.606	6.68	2.04	4.90	30.4	44.08	3.738	5.42
	180	9.78	30.599	4.814	6.88	2.15	4.84	31.9	45.96	3.969	5.53
(4) 85% mixed milk (control 2) + 15% unsalted buttermilk + Formase	0	11.01	34.666	3.457	5.29	0.55	5.76	28.1	43.01	3.531	5.40
	30	8.61	29.166	4.111	5.80	1.70	5.17	29.3	41.36	3.750	5.29
	60	8.55	28.468	4.589	6.43	1.78	5.10	30.0	42.06	3.850	5.40
	90	8.43	27.827	4.690	6.52	1.91	5.00	30.9	42.99	3.934	5.47
	120	8.28	27.508	4.799	6.64	1.99	4.92	31.4	43.48	3.984	5.47
	150	8.04	26.737	4.889	6.67	2.10	4.83	32.2	43.95	4.051	5.54
	180	8.03	26.019	4.971	6.72	2.20	4.75	33.4	45.01	4.115	5.56

In the beginning of ripening period marked increase in TN values of Ras cheese was found when Formase was used in cheese making. At the end of ripening period, slight increase was observed in TN content of Formase Ras cheese as compared with these values of liquid rennet cheese. On the other hand, the addition of buttermilk to admix 1 and admix 2 slightly decreased the fat and TN contents of resultant Ras cheese.

In general, yield and moisture content decreased, while salt, acidity, fat and TN of Ras cheese increased during ripening period.

Table (6) showed the effect of adding 15% unsalted buttermilk to the mixed milk on some ripening indices of Ras cheese during ripening. Soluble nitrogen (SN), SN/TN, non-protein nitrogen (NPN), NPN/TN, soluble tyrosine (S.Tyr) and soluble tryptophane (S.Try) contents were higher in Ras cheese containing buttermilk or made using Formase than those of control or made using liquid calf rennet. S.Tyr contents of 180 days old cheese were 80.99 and 93.51 mg/100gm cheese for 2 and 4 treatments, respectively. Ibrahim *et al.* (1990) and Farag *et al.* (1993) reported that cheese made by adding buttermilk possessed high SN% compared with that without adding buttermilk. Also, Abd El-Kader and El-Zoghby (1999) stated that Formase Halloumi cheese had higher values of SN and NPN than those of liquid calf rennet cheese.

Replacement of cheese milk by 15% unsalted buttermilk increased TVFA contents of fresh cheese (Table 7). TVFA contents of all Ras cheese increased after 180 days being 32.2 and 34.6 ml NaOH N/10 / 100 gm cheese for 1 and 3 treatments, respectively. Also, it is noticed that values of TVFA were the highest for Formase treatment and were the lowest for calf liquid rennet treatment.

Addition of 15% buttermilk to the mixture milk slightly decreased SFA content of the Ras cheese fat. In all treatments SFA markedly decreased as ripening period progressed. This decrease might be attributed to the decrease or increase occurred in the lower fatty acids or unsaturated fatty acids during ripening (Shendy *et al.*, 1999). On the other hand, replacing 15% buttermilk in mixture milk increased USFA contents of the resultant cheese.

All treatments showed increase in USFA as ripening time advanced being 32.042 and 34.917% for 1 and 3 samples at 90 days and become 42.270 and 45.174 for 180 days old cheese, respectively.

SFA values decreased whereas USFA increased when Formase rennet was used in cheese making.

Butyric acid was absent in all 90 days old cheese, while it appeared in most of 180 days old cheese, except 2 treatment. Palmitic acid (C_{16}) was the predominant one of SFA followed by myristic acid (C_{14}) in various cheese treatments during ripening.

Table 6: Effect of adding 15% unsalted buttermilk to the mixture milk on some nitrogenus fractions and TVFA of Ras cheese during ripening period (180 days).

Treatments	Ripeing period (days)	SN (%)	SN/TN (%)	NPN (%)	NPN/TN (%)	S.Tyr*	S.Try*	TVFA** (%)
(1) Buffaloe's + cow's milk (1:1) + Liquid rennet	0	0.168	5.17	0.109	3.35	33.02	14.57	9.6
	30	0.196	5.28	0.137	3.69	45.27	17.98	15.6
	60	0.231	6.16	0.154	4.10	55.40	19.86	19.1
	90	0.252	6.62	0.175	4.59	65.64	20.97	23.8
	120	0.266	6.81	0.210	5.38	71.73	21.23	27.4
	150	0.289	7.17	0.224	5.55	75.63	23.14	29.1
	180	0.318	7.67	0.252	6.08	80.15	25.24	32.2
(2) Buffaloe's + cow's milk (1:1) + Formase	0	0.188	5.16	0.112	3.08	38.66	17.74	10.8
	30	0.210	5.43	0.154	3.98	50.32	21.77	16.6
	60	0.238	6.07	0.169	4.31	56.81	22.93	20.1
	90	0.255	6.41	0.182	4.58	63.22	24.75	24.0
	120	0.291	7.14	0.215	5.27	72.62	26.09	29.4
	150	0.317	7.73	0.231	5.63	76.42	28.11	30.2
	180	0.378	9.09	0.264	6.34	80.99	30.21	33.8
(3) 85% mixed milk (control 1) + 15% unsalted buttermilk + liquid rennet	0	0.176	5.84	0.111	3.68	40.78	16.93	10.1
	30	0.197	5.79	0.136	3.99	51.14	20.18	17.6
	60	0.235	6.71	0.158	4.51	60.00	21.95	20.9
	90	0.256	7.26	0.165	4.68	73.11	23.73	25.1
	120	0.270	7.53	0.216	6.03	80.22	24.14	29.3
	150	0.298	7.97	0.229	6.13	85.61	25.87	31.4
	180	0.322	8.32	0.255	6.59	90.55	27.90	34.6
(4) 85% mixed milk (control 2) + 15% unsalted buttermilk + Formase	0	0.192	5.44	0.114	3.23	42.48	21.96	11.6
	30	0.208	5.55	0.156	4.16	55.91	24.28	18.2
	60	0.240	6.23	0.166	4.31	62.20	25.16	22.6
	90	0.258	6.56	0.183	4.65	70.78	27.77	26.1
	120	0.289	7.25	0.230	5.77	79.57	28.07	30.2
	150	0.320	7.88	0.242	5.97	87.54	30.71	33.3
	180	0.382	9.28	0.268	6.51	93.51	32.30	36.5

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

Table 7: GLC composition of free fatty acids (FFA) contents (as percent of total fat) in Ras cheese.

Fatty Acids	C	Treatments							
		90 days				180 days			
		1	2	3	4	1	2	3	4
Saturated fatty acids (SFAS)									
Bytyric	4	--	--	--	--	2.111	--	2.173	1.051
Caproic	6	4.512	2.845	4.707	4.188	1.648	2.414	1.605	2.911
Caprylic	8	2.516	2.123	2.422	1.816	1.052	1.502	1.147	1.665
Capric	10	4.280	3.177	3.854	3.019	2.869	3.380	2.057	3.406
Lauric	12	3.578	3.437	3.091	3.152	3.981	3.338	3.352	3.539
Myristic	14	12.839	10.873	12.344	12.019	10.411	10.653	10.701	8.853
	Iso 14	--	0.351	0.680	0.317	0.170	0.724	0.173	--
	15	1.408	1.181	1.134	1.655	0.926	0.960	1.407	0.982
Palmitic	16	38.825	31.780	36.851	27.398	32.943	28.686	30.321	27.775
	Iso 16	--	0.482	--	--	0.448	--	0.480	0.402
	17	--	--	--	--	1.171	1.557	1.410	--
Stearic	18	--	--	--	--	--	--	--	--
	Iso 18	--	--	--	--	--	--	--	--
Total		67.958	56.249	65.083	53.564	57.730	53.214	54.826	50.584
Unsaturated fatty acids (USFAS)									
Myrisoleic	14:1	0.966	0.382	1.098	--	0.186	--	0.200	0.224
	15:1	--	1.143	--	1.200	0.876	0.955	1.040	1.076
Palmitoleic	16:1	--	2.532	3.942	2.018	4.604	--	2.352	2.996
Oleic	18:1	16.122	15.917	17.593	14.538	13.611	15.991	14.251	15.776
Linoleic	18:2	14.954	23.777	12.284	28.680	22.993	29.840	27.331	29.344
Linolenic	18:3	--	--	--	--	--	--	--	--
Total		32.042	43.751	34.917	46.436	42.270	46.786	45.174	49.416

Table (8) shows the organoleptic evaluation of various treatments of resultant cheese. The effect of buttermilk was more pronounced on body & texture and flavour than clour and appearance. The buttermilk cheese had slight softy and smooth consistency after 60 days of ripening. The addition of 15% buttermilk to (buffaloe's + cow's milk) the mixture improved the Ras cheese quality mainly through body & texture.. Improvement of organoleptic properties of Ras cheese by adding buttermilk may be due to enhance protein degradation as measured by SN, S.Tyr and S.Try values.

Ras cheese produced by using liquid rennet scored the highest score for cheese quality, while microbial rennet (Formase) treatment gained lower score. It is observed that two types of coagulant had no clear effect on the cheese colour and appearance, while their effects were on body & texture and flavour. Consistency of liquid rennet cheese were firm and smooth, while it was harsh for Formase cheese at the end of ripening period. This is may be due to the high proteolytic activity of Formase.

Table 8: Effect of adding unsalted buttermilk to the mixture milk on the organoleptic properties of Ras cheese

Treat.	Score						Consistency	Flavour
	Ripening period (day)	Flavour (45)	Body & Texture (40)	Color (5)	Appearance (10)	Total (100)		
(1) Buffaloe's + cow's milk (1:1) + Liquid rennet	60	35	35	4	9	83	Firm- compact	Slight aroma - Mild salt and acidity
	90	38	35	5	9	87	Firm- compact smooth	Good flavour - More acidity
	120	35	35	5	9	84	Firm-smooth	Full ripened - Mild salt and acidity
	150	36	37	4	9	86	Firm-smooth	More pronounced and aroma
	180	38	37	5	9	89	Firm-smooth	Good flavour and aroma
(2) Buffaloe's + cow's milk (1:1) + Formase	60	20	25	4	8	57	Harsh	Salt
	90	23	30	4	8	65	Harsh	Salt and acidity
	120	33	30	5	8	76	Harsh	More salt
	150	36	30	5	9	80	Harsh	Good flavour
	180	38	32	4	8	82	Harsh	Good flavour
(3) 85% mixed milk (control 1) + 15% unsalted buttermilk + liquid rennet	60	35	36	4	8	83	Slight smooth	Mild salt and acidity
	90	38	36	4	9	87	Soft smooth	Good flavour - Mild salt and acidity
	120	35	35	4	9	83	Soft smooth	Good flavour - More acidity-full ripened
	150	38	37	4	9	88	Soft smooth	Full ripened - More aroma
	180	42	38	5	9	94	Soft smooth	Full ripened - Goof flavour & aroma
(4) 85% mixed milk (control 2) + 15% unsalted buttermilk + Formase	60	22	25	5	9	61	Slight tough	Salt
	90	28	31	5	9	73	Tough	Good aroma
	120	36	32	5	9	82	Tough	Mild salt
	150	38	33	5	9	85	Tough	Mild salt
	180	40	33	4	9	86	Tough	Mild salt

Table (9) shows cheese costs produced from incorporation of 15% buttermilk, the profit of Ras cheese increased by L.E. 8.41 / 100 kg milk.

Table 9: Economic* study when buttermilk is used in Ras cheese manufacture.

Item	Buffaloe's milk cheese	Admixture milk cheese
Inputs:		
1. Price of buffaloe's milk	50 kg x 1.3 L.E = 65 L.E.	42.5 kg x 1.3 L.E = 55.25 L.E.
2. Price of cow's milk	50 kg x 80 P.T = 40 L.E.	42.5 kg x 80 P.T = 34.0 L.E.
2. Price of buttermilk	--	15 kg x P.T. 8 = 1.2 L.E.
3. Processing cost**	100 kg x 5% = 5.25 L.E.	100 kg x 5% = 5.25 L.E.
4. Total cost	110.25 L.E.	95.7 L.E.
Outputs:		
1. Yield	10.36%	9.78%
2. Total organoleptic scoring points (out of 100 point)	89	94
3. Cost of one kg of cheese***	110.25 / 10.36 = 10.64	95.70 / 9.78 = 9.78
4. The difference in cost/kg of cheese****	10.64 - 9.78 = 0.86	
5. The total difference in cost of producing 100 L milk***** / 9.78 kg of cheese	9.78 x 0.86 = L.E. 8.41	

* 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 and cow's milk cheese - Cost of 1 kg of mixture milk cheese.

***** The total difference in cost of producing 100 L milk 9.78 kg of cheese = Yield x difference in cost / kg cheese

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إضافة اللبن الخض غير المالح لألبان أخرى مستخدمة فى صناعة الجبن الراس
٢- خليط اللبن الجاموسى والبقرى باستخدام المنفحة الحيوانية ومنفحة Formase.

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

*** قسم الألبان - كلية الزراعة - جامعة المنصورة**

**** معهد بحوث الإنتاج الحيوانى - الدقى - القاهرة.**

الهدف من هذا البحث هو دراسة التركيب الكيماوى وبعض الخواص الريولوجية لكل من اللبن الجاموسى أو البقرى أو خليط اللبن الجاموسى والبقرى (١:١) المضاف إليهم ١٠ ، ١٥ ، ٢٠% لبن خض غير مملح. لوحظ زيادة فى حموضة اللبن الجاموسى أو البقرى أو خليط اللبن الجاموسى والبقرى بإضافة اللبن الخض الغير مملح إليهم فى حين إنخفضت نسبة المواد الصلبة والدهن والنيتروجين الكلى فى هذه الألبان بإضافة اللبن الخض إليهم وقد تناسب ذلك مع النسبة المضافة من اللبن الخض. ولقد وجد إنخفاض فى وقت التجبن بالمنفحة الحيوانية وفى الجذب الخثرى للألبان بإضافة ١٠ ، ١٥ ، ٢٠% لبن خض فى حين زادت قيم التشرش لهذه الألبان بإضافة اللبن الخض إليهم هذا ولم يلاحظ حدوث تجبن بالمنفحة للبن الخض.

وبناء على النتائج السابقة فلقد وجد أنه من الممكن صناعة جبن راس من خليط اللبن الجاموسى والبقرى (١:١) المضاف إليه ١٥% لبن خض غير مملح . ولقد وجد أن إضافة اللبن الخض إلى اللبن الخليط السابق والمستخدم فى صناعة الجبن الراس أدى إلى إنخفاض فى تصافى الجبن وكذلك إنخفاض فى pH والدهن والدهن / المادة الجافة والنيتروجين الكلى والنيتروجين الكلى / المادة الجافة فى حين أن إضافة اللبن الخض إلى الألبان السابقة أدى إلى زيادة فى النيتروجين الذائب والنيتروجين الذائب / النيتروجين الكلى والنيتروجين الغير بروتينى وكذلك النيتروجين الغير بروتينى / انيتروجين الكلى والتيروسين والتربتوفان والأحماض الدهنية الطيارة بالجبن الراس الناتج . لوحظ كذلك إنخفاض فى الأحماض الدهنية المشبعة وزيادة الأحماض الدهنية الغير مشبعة فى الجبن المحتوى على اللبن الخض.

لوحظ كذلك أن إستخدام منفحة الفورميز فى صناعة الجبن الراس أدت إلى إنخفاض فى التصافى والرطوبة والأحماض الدهنية المشبعة. فى حين أدت إلى زيادة الحموضة والدهن والنيتروجين الكلى والنيتروجين الذائب والنيتروجين الغير بروتينى والتيروسين والتربتوفان والأحماض الدهنية الطيارة وكذلك الأحماض الدهنية الغير مشبعة بالمقارنة بالجبن المصنع بإستخدام المنفحة الحيوانية السائلة.

إنخفضت نسبة إسترجاع الدهن والبروتين بالجبن الراس المحتوى على اللبن الخض وذادت نسبة الدهن والبروتين المفقود بالشرش بهذا الجبن. كذلك فقد كانت نسبة الدهن والبروتين المنتقلة للجبن مرتفعة بالجبن الراس المصنع بإستخدام المنفحة الحيوانية السائلة بالمقارنة بالجبن المصنع بإستخدام منفحة الفورميز. وجد تحسن ملحوظ فى الخواص الحسية للجبن الراس بإضافة ١٥% لبن خض إلى اللبن المستخدم فى صناعة الجبن. فى حين كانت هذه الخواص منخفضة قليلا بجبن منفحة الفورميز.