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INCORPORATION OF UNSALTED SOUR BUTTERMILK WITH OTHER MILKS IN RAS CHEESE PRODUCTION: III. AD.M.IXTURE OF BUFFALOE'S AND GOAT'S MILK USING LIQUID CALF RENNET OR FORMASE.

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ABSTRACT

Adding 10, 15 or 20% unsalted sour buttermilk to buffaloe's or goat's milk proportionally increased acidity and decreased pH, T.S., fat and T.N. contents.

Rennet coagulation time (R.C.T.) and curd tension of buffaloe's or goat's milk were reduced by adding 10, 15 and 20% unsalted buttermilk, whereas curd syneresis increased.

Ras cheese made from 85% admixture milk (buffaloe's and goat's milk 1:1) and 15% buttermilk had lower values of yield, pH, fat and T.N. than those of control cheese. Adding buttermilk to admixture milk increased moisture, salt, salt / D.M., acidity, S.N., S.N./T.N., N.P.N., N.P.N./T.N., S.Tyr, S.Try and T.V.F.A. values of Ras cheese. Adding 15% buttermilk to admixed milk decreased saturated fatty acids (S.F.A.) and increased unsaturated fatty acids (U.S.F.A.) values of Ras cheese.

Yield, moisture and S.F.A. values of Ras cheese made using Formase were lower and acidity, fat, S.N., N.P.N., S.Tyr, S.Try and U.S.F.A. contents were higher than those of Ras cheese made using liquid calf rennet. Type of rennet had no clear effect on salt, T.N. and T.V.F.A. contents of cheese. Protein recovery did not change when liquid rennet or Formase was used in cheese production, whereas fat recovery decreased in Formase cheese.

Fat and protein losses in whey increased and fat and protein recoveries in cheese decreased in Ras cheese containing buttermilk.

Adding buttermilk to Ras cheese milk improved the chemical and organoleptic properties of the resultant cheese. Organoleptic sensory scores slightly decreased by using Formase rennet in Ras cheese manufacture.

INTRODUCTION

Buttermilk is a by-product in the production of butter from cream. It has a high nutritioned value due to its high contents of fat (2%), protein (3.5%), lactose (4.4%), and ash (0.7%) (Gonc, 1977). Evidence for a cholesterol lowering effect of buttermilk has been also presented (Metwally *et al.*, 1988 and Abdel-Gawad *et al.*, 1988).

Buttermilk is produced in large quantities worldwide. In Egypt, more than 200.000 tons of buttermilk are produced per year as a by-product during butter processing (Mohran *et al.*, 1990). These quantities are almost produced and consumed in the production localities without organization or updating systems. This may be due to difficulties of transportation for such small individual quantities to regular markets by an economic way. In many cases, a part of the by-product, buttermilk could not be economically used and is eliminated as a waste in many dairy plants causing pollution of the natural environment, so its utilization in preparing Ras cheese may help in

solving the problem of environment pollution, as well as the economical benefits, which could be obtained. It is well known that the production of every 200 kg butter would yield 166 kg buttermilk as a by-product (El-Hofi *et al.*, 1999).

Goat's milk is used in production of vary types of cheeses. Davide *et al.* (1986) stated that goat's milk clotted faster and therefore, required a shorter curd manufacturing time than cow's milk. The goat Cheddar and Edam cheese curds were firmer, but paler than the cow curds although both showed similar smooth texture. Gross composition of both goat and cow ripened cheese were comparable, but yield was significant for the goat Edam cheese.

Formase rennet (protease enzyme produced from *Mucor miehei*) was used in Halloumi cheese making by El-Zoghby and Abdel-Kader (2000). Formase Halloumi cheese had higher levels of S.N., N.P.N. and T.V.F.A. as compared with liquid calf rennet cheese.

Ras cheese is usually made using liquid calf rennet, whereas Formase rennet did not experimentally try in Ras cheese processing. This research was done to study the effect of Formase as a rennet on the quality of Ras cheese produced from (buffaloe's + goat's milk 1:1) partly replaced by 15% unsalted sour buttermilk.

MATERIALS AND METHODS

Fresh buffaloe's milk was obtained from El-Gemmeza Animal Production Research Station, while fresh goat's milk was obtained from El-Serw Animal Production Research Station, Ministry of Agriculture. Unsalted buttermilk was supplied by Misr Dairy Company of Domiatta and some private farms, Dakahlia Governorate. The chemical composition of milk for cheese making was showed in table 1.

Table 1. Composition of milk for cheese making.

Type of milk	Acidity (%)	pH	T.S. (%)	Fat (%)	T.N. (%)	T.P. (%)	Ash (%)	Calcium (%)
50% Buffaloe's milk + 50% goat's milk	0.17	6.61	14.080	4.6	0.617	3.934	0.769	0.155
85% mixed milk (buffaloe's and goat's milk 1:1) + 15% Unsalted buttermilk	0.20	6.37	13.161	4.0	0.551	3.513	0.691	0.152
Unsalted buttermilk	0.68	4.78	8.05	1.9	0.316	1.979	0.557	0.144

Yoghurt starter culture was obtained from Ch. Hansen's Laboratories, Denmark. The starter culture 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. It was added to the milk at a rate of 25 ml/100 kg milk. Formase prepared from pure culture of the fungi *Mucor miehei* produced by Gist-brocades of Holland, was added at a rate of 3 gm/100 L of milk. It was dissolved in distilled water before being used.

Food grade salt was obtained from El-Nasr company of Alexandria was used. For coating the cheese, a mixture containing paraffin wax + honey wax + soft paraffin wax (Vaslin) at the ratio of 1:1:0.2 was applied.

Ras cheese was made as described by Hofi *et al.* (1970) from (buffaloe's + goat's milk 1:1) replaced by 15% unsalted buttermilk. Liquid calf rennet or Formase rennet was added to milk 5% salt may added to the cheese vat at 20 min before hoping. The curd was hoped into 2 kg stainless steel hoops. 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, 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. Four treatments of Ras cheese were manufactured as follows:-

Treatment A: Buffaloe's and goat's milk (1:1) + Liquid rennet.

Treatment B: Buffaloe's and goat's milk (1:1) + Formase.

Treatment C: 85% mixed milk (control A) + 15% unsalted buttermilk + Liquid calf rennet.

Treatment D: 85% mixed milk (control B) + 15% unsalted buttermilk + Formase.

Samples of milk and whey were chemically analyzed for acidity, pH, T.S., fat, T.N., ash and calcium contents where as fresh, 30, 60, 90, 120, 150 and 180 days old cheese were analyzed for yield, moisture, acidity, pH, salt, fat, T.N., S.N., N.P.N., soluble tyrosine (S.Tyr), tryptophane (S.Try) and T.V.F.A.. Organoleptic properties were tested at 60, 90, 120, 150 and 180 days. Free fatty acids were measured at 90 and 180 days.

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 was determined 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 were calculated as follows:-

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

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

RESULT.S. AND DISCUSSION

Data given in Table (2) showed that the addition of unsalted buttermilk (10, 15 and 20%) to buffaloe's or goat's milk proportionally increased the acidity percentages. In contrary, pH, T.S., fat and T.N. of buffaloe's or goat's milk decreased by adding buttermilk. Acidity of goat's milk alone or mixed with 10 or 20% buttermilk were 0.16, 0.23 and 0.30%, respectively. Similar results were found by Farag *et al.* (1993).

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

Samples	Acidity (%)	pH	T.S. (%)	Fat (%)	T.N. (%)	T.P. (%)
Unsalted buttermilk	0.88	4.78	8.05	1.9	0.316	2.016
Buffaloe's milk	0.15	6.92	16.04	6.4	0.624	59
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	3.764
goat's milk	0.16	6.60	12.54	3.50	0.440	2.807
Buttermilk	0.69	4.77	7.23	1.70	0.316	2.016
90% goat's milk + 10% buttermilk	0.23	6.32	11.94	3.10	0.419	2.673
85% goat's milk + 15% buttermilk	0.27	6.21	10.89	2.80	0.389	2.481
80% goat's milk + 20% buttermilk	0.30	6.09	10.01	2.50	0.378	2.417

Results in Table (3) showed some rehological properties of buffaloe's or goat's milk replaced by 10, 15 or 20% buttermilk and by using liquid calf rennet. Rennet coagulation time (R.C.T.) and curd tension of buffaloes and goat's milk decreased, while curd syneresis increased when buttermilk was added R.C.T. of buffaloe's milk alone or mixed with 10 or 15% buttermilk were 159, 101 and 88 sec., respectively.

Farag *et al.* (1993) stated that replacement of buffaloe's milk by sour cream buttermilk decreased both the beginning coagulation time and

complete coagulation time. This effect could be referred to the higher acidity content of sour cream buttermilk.

Table 3: Effect of adding 10, 15 or 20% unsalted buttermilk to the other milks on the 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	4.650	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
Cow's milk	161	40.33	3.035	5.360	6.675	7.955
Buttermilk	No coagulation					
90% cow's milk + 10% buttermilk	116	29.80	3.890	6.160	7.495	8.735
85% cow's milk + 15% buttermilk	88	24.39	3.995	6.350	7.735	9.125
80% cow's milk + 20% buttermilk	81	21.05	4.815	6.965	8.250	9.470

Table (4) showed that the chemical composition of Ras cheese whey, the whey was collected after adding 5% salt to cheese vat and 20 minutes before hoping. Acidity of whey resulting from manufacturing buttermilk Ras cheese was higher than that of control cheese whey. This is may be due to the high acidity of buttermilk. Also, whey of Ras cheese containing buttermilk had higher levels of T.N., ash and salt as compared with control cheese whey. No marked differences in T.S., fat and calcium contents of whey were observed between whey of buttermilk or control Ras cheese. Acidity of whey of A and C treatments were 0.18 and 0.24%, respectively.

Values of acidity, T.S., fat, ash, salt and calcium were higher in whey of Ras cheese made using microbial rennet (Formase) as compared with whey of Ras cheese made using liquid calf rennet, whereas T.N. content was similar in both type of cheese whey.

From Table (4), it is observed that adding 15% buttermilk yo admixed cheese milk increased fat and protein losses in whey and decreased fat and protein recoveries in cheese. Fat recovery of B and D treatments were 89.40 and 85.56%, respectively. Using Formase rennet in Ras cheese making increased fat loss in whey and decreased fat recovery into cheese. No marked effect on protein loss in whey or protein recovery into cheese was noticed when Formase used as a rennet in Ras cheese making.

El-Zoghby and Abdel-Kader (2000) reported that Formase Halloumi cheese had higher values of fat and protein losses in whey than that liquid rennet Halloumi cheese.

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

Treatment	A	B	C	D
Acidity (%)	0.18	0.24	0.25	0.27
pH	6.11	5.82	5.70	5.68
T.S. (%)	9.020	10.309	9.327	10.043
Fat (%)	0.50	0.60	0.50	0.60
T.N. (%)	0.159	0.158	0.175	0.174
T.P. (%)	1.017	1.012	1.116	1.113
Ash	4.053	4.356	4.841	4.426
Salt	3.489	3.755	4.360	3.838
Calcium	0.132	0.148	0.126	0.140
Amount of whey (kg)	49.50	33.00	50.50	33.750
Amount of fat in milk (kg)	2.760	1.840	2.400	1.600
Fat loss in whey (%)	8.95	8.97	10.54	12.62
Fat recovery (%)	89.35	89.40	88.42	85.56
Amount of protein in milk (kg)	2.360	1.579	21.08	1.405
Protein loss in whey (%)	21.31	21.22	21.22	26.69
Protein recovery	77.63	77.57	71.77	72.10

A: Buffaloe's and goat's milk (1:1) + Liquid rennet.
B: Buffaloe's and goat's milk (1:1) + Formase.
C: 85% mixed milk (control A) + 15% unsalted buttermilk + Liquid calf rennet.
D: 85% mixed milk (control B) + 15% unsalted buttermilk + Formase.

Results in Table (5) showed effect of adding 15% unsalted buttermilk to admixture of (buffaloe's + goat's milk 1:1) on some chemical properties of Ras cheese made using liquid calf or Formase rennet.

Slight decrease in yield and moisture content, whereas increase in acidity and fat found when Formase was used in Ras cheese making. No marked effect on salt, salt / D.M., T.N. and T.N./D.M. of Ras cheese was found when Formase was used as a rennet.

Kandeel *et al.* (1991) found that types of rennet (calf rennet extracts, Hannilase, HALA and HABO) did not markedly affect the total nitrogen of Domiatti cheese.

On the other hand, adding 15% buttermilk to admixture milk led to marked decrease of yield. This was expected since the T.S. of buttermilk was low (6.387%) and as a sequence the T.S. of the cheese milk decrease.

Incorporation of 15% buttermilk to admixture milk increased moisture, salt and salt / D.M. values of Ras cheese during ripening period. The moisture content of cheese increased by 2.031% for D treatment. Madsen *et al.* (1966) and Mayes *et al.* (1994) found that adding buttermilk increased moisture content of low fat Cheddar cheese.

Also from Table (5), it is noted that replacement of cheese milk by 15% buttermilk raised titratable acidity and decreased pH values of Ras cheese. Acidity values of A and C treatments after 120 days were 1.90 and 1.95%, respectively. These results are in agreement with those reported by Abou-Zeid (1992), who used buttermilk in Domiati cheese making.

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

Treatments	Ripening period (days)	Yield (%)	Moisture (%)	Salt (%)	Salt/D.M. (%)	Acidity (%)	pH	Fat (%)	Fat/D.M. (%)	T.N. (%)	T.N./D.M. (%)
(A) Buffaloe's + goat's milk (1:1) + Liquid rennet	0	15.68	36.949	3.188	5.06	0.59	5.85	28.0	44.41	3.260	5.17
	30	13.11	33.279	3.974	5.95	1.48	5.29	29.6	44.36	3.616	5.42
	60	12.40	32.079	4.201	6.18	1.62	5.15	30.1	44.32	3.671	5.40
	90	12.11	31.939	4.333	6.37	1.77	5.08	30.4	44.66	3.709	5.45
	120	11.29	31.677	4.398	6.44	1.90	5.00	30.9	45.23	3.818	5.59
	150	11.25	31.082	4.451	6.46	1.99	4.94	31.6	45.85	3.888	5.64
	180	11.21	30.747	4.533	6.54	2.07	4.87	32.1	46.35	3.931	5.68
(B) Buffaloe's + goat's milk (1:1) + Formase	0	15.23	34.200	3.162	4.80	0.54	5.80	27.0	41.03	3.143	4.78
	30	12.85	29.253	4.021	5.68	1.70	5.20	28.8	40.71	3.640	5.15
	60	12.20	28.230	4.435	6.18	1.79	5.10	29.5	41.10	3.654	5.09
	90	12.83	27.490	4.519	6.26	1.91	5.01	30.3	41.96	3.731	5.17
	120	11.12	26.909	4.595	6.30	2.05	4.92	31.2	42.80	3.836	5.26
	150	11.07	26.589	4.684	6.40	2.15	4.82	31.9	43.57	3.865	5.28
	180	11.07	26.003	4.744	6.44	2.23	4.70	33.6	45.41	3.931	5.34
(C) 85% mixed milk (control A) + 15% unsalted buttermilk + Liquid rennet	0	13.03	38.867	3.221	5.27	0.70	5.73	27.0	44.16	3.018	4.94
	30	10.79	35.513	3.990	6.19	1.59	5.14	28.4	44.04	3.501	5.43
	60	10.74	34.483	4.260	6.50	1.71	5.10	28.9	44.11	3.524	5.38
	90	10.72	34.058	4.399	6.67	1.83	5.05	29.3	44.43	3.587	5.44
	120	10.68	33.258	4.452	6.67	1.95	4.97	29.9	44.80	3.628	5.43
	150	10.64	32.617	4.509	6.69	2.09	4.86	30.2	44.82	3.688	5.47
	180	10.61	32.121	4.587	6.76	2.15	4.81	31.0	45.67	3.709	5.46
(D) 85% mixed milk (control B) + 15% unsalted buttermilk + Formase	0	13.06	36.213	3.247	5.09	0.57	5.75	26.0	40.76	3.017	4.73
	30	10.58	31.304	4.163	6.20	1.80	5.18	28.0	41.72	3.568	5.32
	60	10.21	30.816	4.508	6.61	1.97	4.97	28.7	42.09	3.604	5.29
	90	10.05	30.174	4.691	6.81	2.12	4.80	29.2	42.42	3.668	5.33
	120	9.50	29.507	4.738	6.82	2.21	4.73	30.1	43.31	3.717	5.35
	150	9.18	29.137	4.798	6.77	2.32	4.61	30.9	43.60	3.754	5.35
	180	9.17	28.391	4.861	6.79	2.41	4.50	32.3	45.11	3.890	5.43

Table 6: Effect of adding 15% unsalted buttermilk to admixture milk on some nitrogenus fractions and T.V.F.A. of Ras cheese during ripening period.

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 + goat's milk (1:1) + Liquid rennet	0	0.165	5.06	0.105	3.22	34.35	15.62	9.4
	30	0.193	5.34	0.133	3.68	47.14	19.00	14.9
	60	0.217	5.91	0.158	4.30	55.49	20.69	20.4
	90	0.245	6.60	0.168	4.53	67.49	21.66	23.6
	120	0.257	6.73	0.194	5.08	72.92	23.27	27.9
	150	0.260	6.69	0.227	5.84	78.02	24.36	29.6
	180	0.303	7.71	0.250	6.36	84.57	26.44	32.8
(B) Buffaloe's + goat's milk (1:1) + Formase	0	0.213	6.78	0.126	4.00	41.38	18.63	9.1
	30	0.303	8.32	0.169	4.64	52.20	23.57	14.4
	60	0.336	9.19	0.191	5.23	59.96	24.29	18.2
	90	0.383	10.26	0.214	5.73	65.92	25.63	22.6
	120	0.411	10.71	0.235	6.13	74.88	27.37	26.0
	150	0.446	11.54	0.271	7.01	80.21	30.25	28.4
	180	0.471	11.98	0.295	7.50	85.07	34.40	32.2
(C) 85% mixed milk (control A) + 15% unsalted buttermilk + Liquid rennet	0	0.170	5.63	0.102	3.37	43.82	17.20	10.6
	30	0.196	5.60	0.130	3.71	52.83	20.70	15.9
	60	0.217	6.16	0.158	4.48	60.18	22.09	22.0
	90	0.242	6.75	0.171	4.77	75.03	23.32	24.4
	120	0.258	7.11	0.192	5.29	81.40	25.11	29.9
	150	0.270	7.32	0.233	6.32	87.37	27.26	31.2
	180	0.309	8.33	0.255	6.87	93.15	28.72	35.3
(D) 85% mixed milk (control B) + 15% unsalted buttermilk + Formase	0	0.222	7.36	0.129	4.27	44.82	22.67	10.0
	30	0.304	8.52	0.171	4.79	56.51	26.75	16.2
	60	0.330	9.16	0.195	5.41	64.74	27.66	20.1
	90	0.385	10.50	0.220	5.99	70.91	29.03	24.5
	120	0.414	11.14	0.239	6.43	78.88	30.13	29.1
	150	0.450	11.86	0.280	7.46	86.68	32.92	30.6
	180	0.476	12.24	0.305	7.84	94.07	34.15	35.6

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

As it is expected, addition of buttermilk to cheese milk decreased fat, fat / D.M., T.N. and T.N. / D.M. percentages. Similar results were found by Mistry *et al.* (1996).

Table (6) represent data of some nitrogenous fractions of Ras cheese. Replacement of Ras cheese milk by 15% buttermilk had very slight effect on S.N. and N.P.N. of cheese, while slight increase was observed in S.N./T.N. and N.P.N./T.N. of Ras cheese containing buttermilk at zero time and during ripening. S.N./T.N. of 180 days old cheese were 7.71 and 8.33% for A and C treatments, respectively. Also, soluble tyrosine (S.tyr) and soluble tryptophane (S.Try) increased in Ras cheese containing buttermilk. Similar results were found by Abdel-Nabi *et al.* (1994).

As shown from Table (6) using Formase in Ras cheese making increased S.N., N.P.N., S.Tyr and S.Try contents of cheese as compared with liquid calf rennet. Similar results were found by El-Zoghby and Abdel-Kader (2000). Type of rennet had no clear effect on T.V.F.A. of cheese.

Results of FFA after 90 and 180 days of ripening period of Ras cheese were shown in Table (7). Adding buttermilk to admixture of (buffaloe's + goat's milk) decreased the amount of saturated fatty acid (S.F.A.) and increased the amounts of unsaturated fatty acids (U.S.F.A.) of Ras cheese. This might be attributed to the stimulation action of buttermilk on the microbial lipolytic activity. The amount of U.S.F.A. for A and C treatments at 90 days were 26.882 and 29.579 (as percent of total fat), respectively. Farag *et al.* (1993) stated that addition of sour cream buttermilk increased proportionally the total free fatty acids as the percent of buttermilk increase in the treated Domiatti cheese compared with the control.

Using Formase in Ras cheese manufacturing decreased S.F.A. and increased U.S.F.A. during ripening period. S.F.A. of A and B treatment after 180 days of ripening were 69.374 and 59.602%, respectively.

The volatile free fatty acids ($C_2 - C_5$) except butyric acid (C_4) were not detected in 90 and 180 days old cheese. Butyric acid was detected in A and B treatments after 180 days. The absence of these acids may be due to consumed them by some organisms in the cheese (Kosikowski, 1978 and Foster *et al.*, 1983) or to transformation of them to another fatty acids.

Table (8) showed the organoleptic judging of Ras cheese sensory evaluation scores of different treatments of Ras cheese increased as ripening period progressed. Good flavour and aroma with milk salt taste were scored for Ras cheese containing buttermilk at 90, 120, 150 and 180 days of ripening. At the beginning of ripening, the judgers could easily recognized the goaty flavour, which gradually decreased up to the end of ripening period. Substitution of 15% buttermilk decreased the intensity of goaty flavour. No clear differences were noticed in color and appearance of cheese by adding buttermilk. Improvement of organoleptic of Ras cheese by adding buttermilk may attributed to the increasing of nitrogenous compounds and total free fatty acids in the treated cheese than control.

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			
		A	B	C	D	A	B	C	D
Saturated fatty acids (S.F.A.S)									
Bytyric	4	--	--	--	--	3.150	1.229	--	--
Caproic	6	5.664	5.616	5.662	5.130	5.135	4.804	4.078	4.218
Caprylic	8	4.093	3.700	3.380	3.645	4.100	2.124	3.549	2.699
Capric	10	6.761	6.659	6.940	6.026	5.694	5.213	6.424	5.799
Lauric	12	3.982	2.710	3.760	2.379	4.011	3.875	4.607	3.207
Myristic	14	12.992	12.632	11.420	8.876	11.324	10.151	9.175	12.156
	Iso 14	--	0.330	0.144	1.692	--	--	0.144	0.741
	15	0.931	0.866	0.620	1.283	1.759	2.258	1.579	1.038
Palmitic	16	38.695	29.711	35.810	27.667	29.201	29.948	29.650	27.059
	Iso 16	--	--	1.025	--	--	--	0.992	--
	17	--	--	1.660	2.724	--	--	0.771	--
Stearic	18	--	--	--	--	--	--	--	--
	Iso 18	--	--	--	--	--	--	--	--
Total		73.118	62.224	70.421	59.422	64.374	59.602	60.969	56.917
Unsaturated fatty acids (U.S.F.A.S)									
Myrisoleic	14:1	0.593	0.190	--	0.512	0.598	0.663	0.444	--
	15:1	--	1.038	1.329	1.467	--	--	1.015	0.929
Palmitoleic	16:1	1.068	2.180	1.500	2.756	1.545	4.611	1.701	3.021
Oleic	18:1	16.830	14.980	15.460	15.129	12.968	14.393	12.668	12.897
Linoleic	18:2	8.391	19.388	11.290	20.714	20.515	20.731	21.127	16.236
Linolenic	18:3	--	--	--	--	--	--	2.076	--
Total		26.882	37.776	29.579	40.578	35.626	40.398	39.031	43.083

Abdel-Nabi *et al.* (1994) stated that Ras cheese containing buttermilk gained higher organoleptic scores. This is probably due to the stimulation of the microbial growth and their enzymes actions by the added buttermilk on the breakdown and hydrolysis of the cheese protein, yielding smooth and acceptable consistency.

Also, it is noticed from the results of organoleptic properties of Ras cheese that cheese made by using liquid rennet possessed higher scores for sensory evaluation than those of cheese made by using microbial rennet (Formase). Yetismeyen *et al.* (1995) reported that sensory properties were better for Turkish white pickled cheese made with calf rennet compared to that made with *Mucor miehi* preparation.

Table 8: Effect of adding 15% unsalted sour buttermilk to admixture milk on the organoleptic properties of Ras cheese

Treatments	Ripening period (day)	Score					Consistency	Flavour
		Flavour (45)	Body & Texture (40)	Color (5)	Appearance (10)	Total (100)		
(A) Buffaloe's + goat's milk (1:1) + Liquid rennet	60	35	34	3	8	80	Slight soft	Slight aroma-pronounced
	90	36	35	4	8	83	Soft	salt & acidity
	120	35	33	3	9	80	Soft	Full ripened
	150	36	35	3	9	83	Soft - smooth	Good flavour
	180	38	36	3	8	85	Firm soft	Good falvour and aroma
(B) Buffaloe's + goat's milk (1:1) + Formase	60	21	23	3	8	55	Slight soft	Salt - Fatty taste
	90	25	30	3	8	66	Good body	Salt
	120	35	31	3	8	77	Good body	Acidity
	150	36	32	3	8	79	Slight soft	Salt and acidity
	180	37	32	3	8	80	Slight soft	Salt and acidity
(C) 85% mixed milk (control A) + 15% unsalted buttermilk + Liquid rennet	60	36	35	3	9	83	Slight soft	Mild salt and acidity
	90	36	35	3	9	83	Soft	Fatty-pronounced acidity
	120	36	34	3	8	81	Soft	More salt
	150	36	35	3	8	82	Soft -smooth	Mild salt and acidity
	180	40	38	3	8	89	Soft -smooth	Good falvour-salt and acidity
(D) 85% mixed milk (control B) + 15% unsalted buttermilk + Formase	60	20	24	3	8	55	Slight soft	Salt
	90	23	33	3	8	67	Slight soft	Crimp taste
	120	37	32	3	8	80	Good body	Acidity
	150	38	32	3	8	81	Slight soft	Salt and acidity
	180	39	33	3	8	83	Slight soft	Salt and acidity

CONCLUSION

Adding 15% buttermilk to Ras cheese milk improved the chemical and organoleptic properties of Ras cheese made from (buffaloe's + goat's milk) admixture. Slight decrease in yield was found in Ras cheese containing buttermilk. Using Formase rennet in Ras cheese production decreased the organoleptic properties scores of the resultant cheese.

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إضافة اللبن الخض لألبان أخرى مستخدمة فى صناعة الجبن الراس
٣- خليط اللبن الجاموسى والماعز بإستخدام منفحة العجول السائلة أو Formase

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تم فى هذا البحث دراسة تأثير إضافة ١٠ ، ١٥ ، ٢٠% لبن خض غير مملح على بعض الخواص الكيماوية والريولوجية لكل من اللبن الجاموسى أو لبن الماعز.

وتشير النتائج المتحصل عليها إلى:-

زيادة حموضة اللبن الجاموسى والماعز بإضافة اللبن الخض إليهم فى حين إنخفضت نسب المواد الصلبة والدهن والبروتين بإضافة التركيزات المختلفة من اللبن الخض لكلا النوعين من اللبن.

لوحظ كذلك إنخفاض فى وقت التجبن بالمنفحة وكذلك إنخفاض الجذب الخثرى لكل من اللبن الجاموسى أو لبن الماعز بإضافة اللبن الخض وعلى العكس فقد لوحظ زيادة فى التشرش للبن الجاموسى والماعز بإضافة اللبن الخض إليهم.

وبناء على النتائج السابقة فقد تم تصنيع جبن راس من ٨٥% لبن جاموسى وماعز (١:١) و ١٥% لبن خض غير مملح وبإستخدام منفحة العجول السائلة أو المنفحة الميكروبية الفورميز. وتشير النتائج إلى:-

إنخفاض نسبة التصافى و pH والدهن والنيتروجين الكلى بالجبن الراس المحتوى على اللبن الخض بالمقارنة بجبنة الكنترول. فى حين أن إضافة اللبن الخض إلى لبن الجبن أدت إلى زيادة فى الرطوبة والملح والملح / المادة الجافة والحموضة والنيتروجين الذائب / النيتروجين الكلى والنيتروجين الغير بروتينى / النيتروجين الكلى والأحماض الدهنية الطيارة بالجبن الراس فى حين أن إضافة اللبن الخض لمخلوط اللبن الجاموسى ولبن الماعز فى صناعة الجبن أدت إلى إنخفاض فى نسبة الأحماض الدهنية المشبعة وزيادة فى الأحماض الدهنية الغير مشبعة. كذلك لوحظ أن نسبة التصافى والرطوبة والأحماض الدهنية المشبعة كانت منخفضة وكانت نسبة الحموضة والدهن والنيتروجين الذائب والنيتروجين الذائب / النيتروجين الكلى والنيتروجين الغير بروتينى والنيتروجين الغير بروتينى / النيتروجين الكلى والتيروسين والتربتوفان والأحماض الدهنية الغير مشبعة كانت مرتفعة فى الجبن الراس المصنع من خليط اللبن الجاموسى والماعز وبإستخدام منفحة الفورميز بالمقارنة بالجبن المصنع من نفس الخليط ولكن بإستخدام منفحة العجول السائلة ولم يوجد إختلافات ملحوظة بين كلا النوعين من الجبن فى المحتوى من الملح والنيتروجين الكلى والنيتروجين الكلى / المادة الجافة والأحماض الدهنية الطيارة.

ولقد وجدت زيادة فى نسبة الدهن والبروتين المفقودة فى الشرش وإنخفاض فى نسبة الدهن والبروتين المنتقلة للجبن الراس المحتوى على لبن خض. وقد كانت نسبة الدهن المفقودة فى الشرش مرتفعة فى الجبن الراس المصنع بإستخدام الفورميز فى حين لم تتأثر نسبة البروتين المفقودة فى الشرش أو المتبقية بالجبن بإستخدام هذا الإنزيم فى صناعة الجبن الراس. إضافة اللبن الخض إلى اللبن المستخدم فى صناعة الجبن الراس أدى إلى تحسين واضح فى الخواص الكيماوية والحسية للجبن الناتج. إلا أن إستخدام الفورميز فى صناعة الجبن أدى لإنخفاض طفيف فى الخواص الحسية للجبن الناتج.