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Full Length Research Paper

Impact of cold storage and blending different lactations of cow's milk on the quality of Domiati cheese

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The present investigation studied the making of Domiati cheese from raw or pasteurized cow's milk stored at 4 - 5°C for 24 or 48 h as well as the effect of mixing equal amounts of evening and morning milk with cold stored cow's milk on some properties of Domiati cheese. Domiati cheese made from cooled stored cow's milk, either raw or pasteurized, had lower yields, TS, fat, TN and higher acidity, salt, salt in moisture, WSN, WSN/TN, NPN, NPN/TN and TVFA contents relative to the control. Adding of evening and morning milks to raw or pasteurized refrigerated stored milk decreased the yield, acidity, WSN, WSN/TN, NPN, NPN/TN and TVFA and raised TS, fat, salt, salt in moisture, TN and TN/DM values of cheese. Mixing of raw or pasteurized evening and morning milk with cold stored milk had no clear effect on free amino acids (FAA) contents of cheese. Cooling of cow's milk for 24 or 48 h decreased concentrations of the majority of FAA of Domiati cheese stored for 90 days. Adding evening and morning milks to cold stored milk or preservation of both raw and pasteurized cow's milk for 24 or 48 h at 4 - 5°C raised the numbers of various microbial groups.

Key words: Milk preservation - morning and evening milks- soft cheese.

INTRODUCTION

Milk's quality has high relevance to its chemical, microbiological, physical and organoleptic properties, as well as to its safety. To protect milk's quality, it should be handled under firm sanitary conditions, which results to low bacterial counts, good appearance as well as flavour. Keeping the quality satisfactorily can bring about high nutritive value of milk which is free from disease-producing organisms and foreign constituents. Preservation should not adversely affect the nutritional characteristics of raw milk. Refrigeration has long served as the preferred milk preservation method. Rate of cooling can influence the bacterial content of raw milk. As a result, cooling at 4°C or below soon after collection from udder as well as within 3½ h of the start of milking, are needful to help sustain the quality of milk in general.

In the desert areas of Nubaria town of Egypt, milk collection centers seem inadequate due to the pattern of scattered settlements. Extension services provided the area with expertise of cheese-making, mainly Domiati cheese. However, daily processing of 14 kg or less of milk was found not economical. Milk collected within three or four days (30 - 60 kgs), which was either refrigerated (48 h approximately) or frozen, was used to process Domiati cheese once or twice a week instead of daily (Abdel-Kader, 1999). To their knowledge, no study has investigated the properties of Domiati cheese useful with respect to cooling and the cooling time of milk and milk mixtures during its processing With the above information in mind, it was the objective of present work to determine the effect of cooling, mixing (morning milk with evening milk) and pasteurization of cow's milk on some chemical, microbiological and organoleptical properties of Domiati cheese.

MATERIALS AND METHODS

Materials

Fresh cow's milk from the herds of El-Serw Animal Production

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Research Station, Agriculture Research Center, Domiati Governorate was used. Liquid calf rennet (single strength) obtained from local market (Domiati city) was added to the milk at a rate of 1.5 mL kg^{-1} milk. Dry coarse commercial food grade salt was obtained from El-Nasr Salines Company, Egypt. Analytical grade calcium chloride was obtained from El-Gomhouria Company, Egypt. All chemicals used were analytical grade.

Methods

Cheese manufacture

Domiati cheese was made as described by Fahmi and Sharara (1950). Ten treatments of cheese were manufactured as follow:

(i) Domiati cheese made from raw morning cow's milk (Treatment A),
(ii) Domiati cheese made from raw mixed cow's milk (morning, evening and next morning day milkings- mixing between 3 milkings within 24 h) and stored at 4°C (Treatment B),
(iii) Domiati cheese made from raw mixed cow's milk (mixing between morning and evening 5 milkings within 48 h) and stored at 4°C (Treatment C),
(iv) Domiati cheese made from raw cow's milk stored at 4°C for 24 h (without mixing) (Treatment D),
(v) Domiati cheese made from raw cow's milk stored at 4°C for 48 h (without mixing) (Treatment E),
(vi) Domiati cheese made from pasteurized morning cow's milk (63°C/30 min) (Treatment F),
(vii) Domiati cheese made from pasteurized mixed cow's milk (morning, evening and next morning day milkings- mixing between 3 milkings within 24 h) and stored at 4°C (Treatment G),
(viii) Domiati cheese made from pasteurized mixed cow's milk (mixing between morning and evening 5 milkings within 48 h) and stored at 4°C (Treatment H),
(ix) Domiati cheese made from pasteurized cow's milk stored at 4°C for 24 h (without mixing) (Treatment I),
(x) Domiati cheese made from pasteurized cow's milk stored at 4°C for 48 h (without mixing) (Treatment J).

Cow's milk of treatments F to J were pasteurized before mixing and storing at 4°C. Raw or pasteurized milks of different treatments above were heated to 40°C, salted at 8% and then renneted. After complete coagulation, the resultant curds were ladled in wooden frames and then later lined with muslin cloth. After 24 h, the resultant cheese of all treatments were weighed and pickled into their own whey and stored in plastic jars at 5°C for 3 months. Fresh samples of cheese were analyzed and thereafter at 15, 30, 60 and 90 day period or ripening. Three replicates of each treatment were conducted.

Methods of analysis

Milk samples were analyzed for titratable acidity (TA), total solids (TS), fat, total protein and ash contents according to Ling (1963). The pH values were estimated using a pH meter type CG 710. Actual cheese yield was determined by dividing the weight of cheese by the weight of milk used to make cheese, multiplied by 100. Adjusted cheese yield was calculated using the formula presented by Metzger et al. (2000):

Adjusted yield = (actual yield × (100 – actual moisture + actual salt)) / (100 – (55 + 1.5)).

Cheese were analyzed for total solids (TS), titratable acidity (TA), pH, fat, total nitrogen (TN), water soluble nitrogen (WSN) and non-protein-nitrogen (NPN) contents according to Ling (1963). Salt contents of Domiati cheeses were estimated using Volhard method according to Richardson (1985). Total volatile fatty acids (TVFA) were determined as described by Kosikowski (1978) and expressed as ml of 0.1 N NaOH, / 100 g^{-1} cheese. Amino acids hydrolysis was achieved by taking 0.1 gram of the samples in the test tube containing 10 ml of 6 N hydrochloric acid; the tube was then sealed on a flame and heated in an air oven at 105 - 110°C for 24 h, after that it was cooled. The tip of tube was broken and contents were filtered and transferred to a porcelain dish. Evaporation to dryness was completed on a water bath at 50 - 60°C. Afterwards, the residue was dissolved in mobile phase and separated using amino acids analyzer (Flow rate: 0.2 ml/min., Pressure of buffer from 0 - 50 bar, Pressure of reagent from 0 - 150 bar and Reaction temperature 123°C). Cheese samples were analyzed for total viable bacterial count (TVBC), lactic acid bacteria (LAB), proteolytic, lipolytic, colifom, sporeformers, psychrophilic bacteria, moulds and yeast counts according to the methods described by the American Public Health Association (1992).

The cheese samples were sensorialy scored by the trained staff of the El-Serw Animal Production Research Station. The score points were 50 for flavour, 35 for body and texture, 15 for colour and appearance, which give a total score of 100 points. The obtained results were statistically analyzed using a software package (SAS, 1991) based on analysis of variance. When F-test was significant, least significant difference (LSD) was calculated according to Duncan (1955) for the comparison between means.

RESULTS AND DISCUSSION

Chemical properties of milk used in Domiati cheese manufacture

As shown in the Table 1, pH, TS, fat and total protein contents of fresh raw cow's milk (Treatment A) were lower whereas titratable acidity values were higher than those of pasteurized milk (Treatment F). Slight increase in TS, fat and total protein contents of cow's milk was found as a result of adding different lactations milks to cow's milk stored in cooling tank. Because of bacterial growth, especially psychrophilic bacteria during cooling storage of cow's milk, acidity of the stored milk increased, while pH values decreased. Acidity values of samples F, I and J were 0.14, 0.15 and 0.15%, respectively. TS, fat and total protein contents of cow's milk rose very slightly after 24 or 48 h of cold storage.

Yield of Domiati cheese

Yield is one of the most important economic parameters, which is searched by processes. From Table 2, it could be concluded that, pasteurization of cow's milk before cold storage significantly increased the actual and adjusted yield values of Domiati cheese comparing with those of cheese made from raw milk. Results shown in Table 5 show that the numbers of proteolytic bacteria were higher in raw milk cheese (sample A) compared to pasteurized milk cheese (sample F). Their growth in milk during cooling storage, or in cheese, leading to production of protease enzymes which affect on the

Table 1. Chemical properties of cow's milk used in Domiati cheese manufacture.

Treatment	Acidity %	pH values	TS %	FAT %	TP %
A	0.15	6.74	11.39	3.3	3.76
B	0.15	6.73	11.47	3.4	3.80
C	0.15	6.73	11.58	3.5	3.82
D	0.16	6.71	11.41	3.5	3.78
E	0.16	6.71	11.44	3.5	3.78
F	0.14	6.75	11.62	3.6	3.86
G	0.14	6.75	11.70	3.6	3.89
H	0.15	6.73	11.76	3.7	3.92
I	0.15	6.73	11.69	3.7	3.86
J	0.15	6.72	11.71	3.7	3.88

Table 2. Effect of cold storage of cow's milk on yield and chemical properties of Domiati cheese.

Treatments	Storage period (days)	Actual yield %	Adjusted yield* %	Acidity %	pH	TS %	Fat %	Fat/DM %	Salt %	Salt in moisture %
A	0	18.85	17.20	0.23	6.64	35.08	17.1	48.74	4.62	6.64
	15	-	-	1.06	5.52	38.78	20.1	51.8	5.38	8.07
	30	-	-	1.91	4.41	43.07	22.8	52.93	5.73	9.14
	60	-	-	2.16	4.19	44.94	23.4	52.06	6.11	9.98
	90	-	-	2.40	3.94	45.54	24.5	53.79	6.49	10.38
B	0	18.21	17.25	0.21	6.67	36.27	17.9	49.35	4.96	7.22
	15	-	-	1.01	5.61	39.64	21.1	53.22	5.45	8.28
	30	-	-	1.81	4.47	44.65	23.5	52.63	5.93	9.67
	60	-	-	2.04	4.32	45.80	24.9	54.36	6.23	10.30
	90	-	-	2.25	4.13	46.67	25.5	54.63	6.62	11.04
C	0	18.24	17.72	0.20	6.68	37.17	18.0	48.42	5.09	7.49
	15	-	-	0.98	5.66	40.16	21.8	52.28	5.55	8.48
	30	-	-	1.63	4.53	45.78	24.0	52.42	6.04	10.02
	60	-	-	1.91	4.40	46.17	25.3	54.79	6.42	10.65
	90	-	-	2.16	4.19	48.16	26.2	54.40	6.74	11.50
D	0	17.71	16.33	0.26	6.58	34.95	17.0	48.64	5.17	7.36
	15	-	-	1.17	5.42	38.53	20.2	52.42	5.61	8.36
	30	-	-	1.98	4.34	43.18	22.5	52.10	6.01	9.56
	60	-	-	2.23	4.18	44.39	23.1	52.03	6.34	10.23
	90	-	-	2.51	3.85	45.15	24.2	53.59	6.75	10.95
E	0	17.57	15.81	0.28	6.51	33.92	16.8	49.52	5.23	7.33
	15	-	-	1.30	5.35	37.88	20.0	52.79	5.74	8.45
	30	-	-	2.06	4.28	42.24	22.1	52.32	6.14	9.60
	60	-	-	2.31	4.05	43.87	22.8	51.97	6.44	10.29
	90	-	-	2.64	3.75	44.42	24.0	54.02	6.94	11.10
F	0	20.55	18.29	0.21	6.68	33.76	16.2	47.98	4.97	6.97
	15	-	-	0.59	6.10	37.74	19.3	51.13	5.59	8.23
	30	-	-	0.75	5.94	41.78	22.0	52.65	6.04	9.39
	60	-	-	0.89	5.70	43.61	23.1	52.96	6.35	10.12
	90	-	-	0.98	5.60	44.82	23.8	53.10	6.74	10.88

Table 2. Contd.

G	0	20.50	18.98	0.20	6.68	35.16	16.9	48.06	5.12	7.31
	15	-	-	0.53	6.18	40.85	20.2	49.44	5.62	8.67
	30	-	-	0.71	5.95	44.94	23.1	51.40	5.98	9.79
	60	-	-	0.84	5.79	48.03	23.9	49.76	6.43	11.01
	90	-	-	0.95	5.68	48.57	24.6	50.64	6.87	11.78
H	0	20.43	19.32	0.20	6.67	35.88	17.1	47.65	5.26	7.58
	15	-	-	0.48	6.29	41.54	21.0	50.55	5.63	8.78
	30	-	-	0.59	6.05	46.08	23.1	50.13	6.15	10.23
	60	-	-	0.80	5.87	48.43	24.5	50.58	6.59	11.33
	90	-	-	0.92	5.74	48.92	25.2	51.51	6.95	11.97
I	0	19.78	17.06	0.22	6.65	32.18	16.7	51.89	5.35	7.31
	15	-	-	0.62	5.98	36.98	19.5	52.73	5.77	8.38
	30	-	-	0.79	5.85	40.15	22.4	55.79	6.14	9.30
	60	-	-	0.90	5.75	42.45	23.3	54.88	6.61	10.30
	90	-	-	1.01	5.63	43.73	24.5	56.02	7.05	11.13
J	0	19.62	16.77	0.24	6.60	31.77	16.3	51.30	5.42	7.35
	15	-	-	0.70	5.95	35.58	19.3	54.24	5.90	8.39
	30	-	-	0.84	5.78	39.68	22.1	55.69	6.24	9.37
	60	-	-	0.96	5.65	41.95	23.1	55.54	6.74	10.40
	90	-	-	1.10	5.50	42.44	24.2	57.02	7.13	11.02

* moisture and salt adjusted cheese yield.

plasmin and plasminogen of the casein micelles, leads to slow cheese making and low cheese yield. This explains the relationship between the high proteolytic count and the low cheese yield in raw and heat treated milk cheese (Bastian et al., 1993; Kroll, 1995). Adding evening and morning milks with 12 and 24 h intervals to raw or pasteurized refrigerated stored milk and restoring at 4 - 5°C for 24 or 48 h slightly decreased the actual yield whereas slightly increased the adjusted yield. On the other hand, Domiati cheese made from cooled stored cow's milk either raw or pasteurized had lower actual and adjusted yields.

Chemical properties of Domiati cheese

During cheese ripening, the titratable acidity increased significantly ($p < 0.001$) while pH values decreased significantly ($p < 0.001$) in all types of cheese (Table 2). This may be attributed to lactic acid bacteria growth which produce lactic acid. Nearly similar finding were obtained by Omer and Elshibiny (1985), Abd-El-Salam et al. (1992); Marth and Steele (2001). Also, TS, fat, Fat/DM (dry matter), salt, salt in moisture (Table 2) TN, TN/DM, WSN, WSN/TN, NPN, and NPN/TN values (Table 3) of Domiati cheese had the same trend as acidity during the storage period. The increase obtained in these contents may likely be due to the moisture evaporation. Kebary et al. (2006) stated that moisture content of Domiati cheese decreases significantly while TS values increases significantly as pickling period proceeds. This might be due to the contraction of curd as a result of developed acidity during pickling period, which helps to expel the whey from the curd.

Similar results of TS and fat increasing in Domiati cheese during storage period were reported by Kebary et al. (1996); El-Sonbaty (2000); El-Sheikh et al. (2001); Abd-El-Kader (2003). More so, Kebary et al. (2006) found that TN content of Domiati cheese decreases as pickling period proceeds. This was explained through their data which occurred as a result of the degradation of proteins into WSN compounds and subsequently the loss of some WSN from the degraded proteins in pickling solution. The cheese obtained from pasteurized milk obtained the lowest acidity, TS, fat, TN, TN/DM, WSN, WSN/TN, NPN, and NPN/TN contents and the highest pH, salt and salt in moisture values (Table 2). The effect of pasteurization on cheese acidity may be attributed to the high microbial content of raw milk cheese and the greater utilization of lactic acid leading to low pH value, even though pasteurized milk cheese contained the lowest bacterial content due to the effect of pasteurization (Ghosh et al., 1999). Nearly, similar finding were reported by Abd-El-Salam et al. (1992); Elein et al. (1999).

Table 3. Effect of cold storage of cow's milk on TN and some ripening indices of Domiati cheese.

Treatments	Storage period (days)	TN %	TN/DM %	WSN %	WSN/TN %	NPN %	NPN/TN %	TVFA*
A	0	2.23	6.62	0.342	15.33	0.112	5.02	7.2
	15	2.71	7.18	0.458	16.90	0.145	5.35	12.4
	30	3.05	7.30	0.574	18.81	0.189	6.19	15.4
	60	3.28	7.52	0.687	20.94	0.207	6.31	18.6
	90	3.47	7.74	0.811	23.37	0.230	6.62	20.8
B	0	2.30	6.54	0.330	14.34	0.105	4.56	6.0
	15	2.80	6.85	0.439	15.67	0.139	4.96	11.2
	30	3.11	6.92	0.560	18.00	0.175	5.62	13.6
	60	3.35	6.97	0.673	20.08	0.200	5.97	17.0
	90	3.56	7.32	0.801	22.50	0.217	6.09	18.6
C	0	2.38	6.63	0.321	13.48	0.098	4.11	5.8
	15	2.84	6.83	0.426	15	0.131	4.61	11.0
	30	3.19	6.92	0.555	17.39	0.170	5.32	13.2
	60	3.37	6.95	0.661	19.61	0.191	5.66	16.2
	90	3.61	7.37	0.789	21.85	0.209	5.78	18.4
D	0	2.15	6.68	0.354	16.46	0.121	5.62	7.2
	15	2.66	7.19	0.471	17.70	0.156	5.86	12.6
	30	2.98	7.42	0.587	19.69	0.197	6.61	15.6
	60	3.24	7.63	0.692	21.35	0.213	6.57	19.2
	90	3.39	7.75	0.823	24.27	0.245	7.22	21.2
E	0	2.11	6.64	0.368	17.44	0.135	6.39	7.8
	15	2.56	7.19	0.485	18.94	0.165	6.44	13.4
	30	2.91	7.33	0.594	20.41	0.205	7.04	16.2
	60	3.19	7.60	0.705	22.10	0.225	7.05	19.8
	90	3.33	7.84	0.836	25.10	0.259	7.77	22.2
F	0	2.19	6.24	0.329	15.02	0.092	4.20	6.0
	15	2.65	6.83	0.436	16.45	0.132	4.98	10.6
	30	2.97	6.89	0.559	18.82	0.174	5.85	13.4
	60	3.15	7.31	0.672	21.33	0.195	6.19	16.6
	90	3.28	7.20	0.794	24.20	0.219	6.67	18.2
G	0	2.27	6.25	0.316	13.92	0.085	3.74	5.8
	15	2.76	6.96	0.422	15.28	0.123	4.60	9.8
	30	3.04	6.80	0.543	17.86	0.160	5.26	12.6
	60	3.21	7.00	0.659	20.52	0.183	5.70	15.4
	90	3.35	7.17	0.784	23.40	0.208	6.20	17.4
H	0	2.33	6.26	0.307	13.17	0.079	3.39	5.4
	15	2.80	6.97	0.412	14.71	0.118	4.21	9.6
	30	3.10	6.77	0.535	17.25	0.154	4.96	11.8
	60	3.26	7.06	0.646	19.82	0.174	5.33	14.6
	90	3.42	7.10	0.773	22.60	0.201	5.87	16.8
I	0	2.11	6.03	0.338	16.01	0.103	4.88	6.8
	15	2.54	6.59	0.450	17.71	0.146	5.74	11.2
	30	2.87	6.64	0.571	19.89	0.185	6.44	14.0

Table 2. Contd.

	60	3.03	6.82	0.680	22.44	0.210	6.93	17.2
	90	3.16	6.99	0.804	25.44	0.231	7.31	19.2
J	0	2.04	6.01	0.349	17.10	0.113	5.53	7.2
	15	2.46	6.49	0.463	18.82	0.158	6.42	12.2
	30	2.84	6.72	0.584	20.56	0.193	6.79	14.6
	60	3.01	6.86	0.688	22.85	0.219	7.27	17.8
	90	3.09	6.95	0.824	26.66	0.245	7.92	20.2

*expressed as ml 0.1 NaOH 100 g ¯1 cheese.

Table 4. Amino acid concentrations (µg/g) of Domiati cheese at the end of storage period.

Amino acids	Treatments									
	A	B	C	D	E	F	G	H	I	J
Aspartic	9.53	36.43	3.44	8.92	5.77	21.27	14.67	4.17	6.48	11.77
Threonine	16.11	41.19	1.73	3.88	11.85	43.01	45.22	11.80	29.45	23.59
Serine	39.80	45.09	4.43	7.89	22.00	18.79	8.72	20.24	13.03	17.80
Glutamic acid	97.47	83.48	18.34	21.75	44.23	34.84	19.91	31.50	21.20	31.85
Glycine	6.78	4.98	1.02	8.61	6.28	1.15	11.05	4.27	6.30	4.63
Alanine	18.18	17.73	2.71	2.59	13.25	13.95	12.75	11.40	13.43	13.58
Valine	35.13	18.65	7.37	9.02	12.58	12.22	20.01	20.53	26.68	22.70
Methionine	282.10	136.48	37.91	46.08	85.64	166.34	157.29	110.27	161.42	24.76
Isoleucine	31.13	17.21	6.60	29.09	16.72	14.93	35.14	18.71	24.59	10.47
Leucine	77.41	56.52	21.13	67.20	48.24	41.59	78.51	52.90	38.96	33.00
Tyrosine	45.93	82.56	56.30	50.03	107.62	95.43	204.69	143.22	165.37	135.06
Phenylalanine	22.86	51.83	18.66	40.07	46.06	58.55	125.82	64.68	104.90	64.43
Histidine	91.79	60.45	25.10	45.66	49.46	26.72	96.15	32.74	24.03	19.68
Lysine	221.47	156.32	57.25	185.21	122.74	95.77	203.74	108.38	91.31	87.91
NH4+	148.99	105.88	50.08	70.53	93.87	70.21	81.66	74.77	75.97	70.06
Arginine	66.46	50.27	21.25	76.32	40.92	24.95	37.79	29.51	42.13	22.70
Proline	1386.56	1017.21	553.56	484.83	918.33	1241.47	1344.60	832.66	866.41	801.89

Awad et al. (2001) showed that pasteurization of buffalo and cow milks decreases the percent of dry matter of resultant fresh Domiati cheese by 2.19 and 2.16%, respectively. On the other hand, blending raw or pasteurized evening and morning milks with refrigerated stored milk slightly raised TS, fat, Fat/DM, salt and salt in moisture, TN and TN/DM values but decreased WSN, WSN/TN, NPN, and NPN/TN contents of cheese. Preservation of both raw and pasteurized cow's milk in cooling tank for 24 or 48 h lowered TS, fat and TN content of the produced Domiati cheese. Similar trend was found by Youssef et al. (1975); El-Wahsh (1998). On contrast, Domiati cheese made from cooled milk had higher salt and salt in moisture, WSN, WSN/TN, NPN, and NPN/TN contents. These results are in agreement with those obtained by Ammar (1999); Abdel- Kader (1999).

TVFA values of Domiati cheese at zero time and during storage period (Table 3) showed that as storage time increased, TVFA contents increased significantly ($p < 0.001$) in all cheese treatments A – J. As it is expected, the TVFA contents of Domiati cheese was found to decrease as a result of pasteurization of the cow's milk. However, adding evening and morning milk to cold stored milk increased lipolytic bacteria counts in Domiati cheese (Table 5) although; it lowered its TVFA contents. The highest concentrations of TVFA were found in cheese made from cold stored milk (without mixing with various lactations milk). This may be due to the increasing of lipolytic bacteria numbers during cold storage of cheese milk.

Free amino acids (FAA)

Results of free amino acids determinations after 90 days of ripening period of Domiati cheese are shown in Table 4. The proline amino acid was the corresponding one of

Table 5. Effect of cold storage of cow's milk on some microorganisms of Domiati cheese.

Treatments	Storage period (days)	Microbial groups cfu g-1							
		TVBC ($x10^6$)	Lactic acid bacteria ($x10^4$)	Psychrophilic Bacteria ($x10^4$)	Proteolytic bacteria ($x10^3$)	Lipolytic bacteria ($x10^3$)	Coliform bacteria ($x10^2$)	Spore-forms bacteria ($x10^3$)	Moulds and yeast ($x10^3$)
A	0	341	321	2	27	10	59	114	30
	15	98	140	0	10	8	30	36	21
	30	39	52	0	2	5	18	13	14
	60	8	10	0	1	2	6	6	8
	90	1	2	0	0	0	0	0	3
B	0	367	331	6	33	12	71	122	34
	15	114	149	0	13	9	37	43	24
	30	52	63	0	3	7	24	18	15
	60	14	14	0	1	3	9	9	10
	90	3	4	0	0	0	1	1	4
C	0	410	360	11	40	16	80	135	39
	15	131	164	1	19	14	44	51	28
	30	72	81	0	8	11	31	24	17
	60	22	22	0	2	7	15	12	12
	90	6	7	0	0	3	4	2	5
D	0	370	345	7	37	13	76	127	35
	15	130	160	1	17	10	41	48	26
	30	75	72	0	5	8	29	20	17
	60	16	18	0	1	5	14	9	11
	90	5	6	0	0	1	3	2	4
E	0	397	383	14	51	19	88	146	44
	15	147	175	3	26	15	52	60	31
	30	91	90	1	10	12	37	33	19
	60	28	27	0	3	8	19	18	12
	90	8	8	0	1	4	6	4	5
F	0	55	94	1	6	3	2	22	11
	15	25	30	0	1	0	0	10	6
	30	13	19	0	0	0	0	4	0
	60	3	5	0	0	0	0	0	0
	90	0.4	-	0	0	0	0	0	0
G	0	64	105	1	7	5	2	28	13
	15	30	58	0	2	1	0	14	7
	30	17	25	0	0	0	0	6	1
	60	5	9	0	0	0	0	1	0
	90	1	1	0	0	0	0	0	0

Table 5. Contd.

H	0	75	120	3	9	6	3	36	17
	15	36	65	0	3	2	0	17	9
	30	24	34	0	1	1	0	8	2
	60	9	15	0	0	0	0	2	0
	90	2	3	0	0	0	0	0	0
I	0	70	114	5	8	5	2	31	15
	15	37	63	1	2	2	0	15	7
	30	22	27	0	0	0	0	8	1
	60	7	13	0	0	0	0	2	0
	90	2	2	0	0	0	0	0	0
J	0	90	132	8	10	7	3	41	20
	15	43	78	1	3	3	0	19	12
	30	25	44	0	1	1	0	10	6
	60	11	21	0	0	0	0	3	1
	90	3	4	0	0	0	0	0	0

FAA in different cheese treatments at 90 days of storage period, whereas the glycine amino acid was the lowest. Levels of the majority of FAA were higher in raw milk cheese than in cheese made from pasteurized milk, except aspartic, threonine and phenylalanine amino whose concentrations were higher in the later cheese than in the former one. Levels of alanine amino acid in samples A and F were 18.18 and 13.95 µg/g, respectively. Mixing raw or pasteurized evening and morning milk with cold stored milk showed no clear effect on FAA contents of the resultant cheese. Cooling of cow's milk for 24 or 48 h decreased the concentrations of aspartic acid, threonine, serine, glutamic, alanine, methionine, leucine, phenylalanine histidine, lysine and arginine while increased levels of glycine and tyrosine of Domiati cheese stored for 90 days.

Microbial profile of cheeses

Data presented in Table 5 show changes that occurred in some microbial group's numbers of Domiati cheese at zero time and during ripening period. The numbers of different microbial groups for all samples decreased significantly ($p < 0.001$) within ripening period. This trend was similar to that reported by El-Shafei (1994). Pasteurization of cow's milk to 63°C/30 min lowered the total viable bacterial count (TVBC), lactic acid bacteria (LAB), psychrophilic bacteria, proteolytic, lipolytic, coli-fom, sporeformers, moulds and yeast numbers of Domiati cheese. Similar results were found by Rehman et al. (2000). Adding evening and morning milks to cold stored milk raised the numbers of mentioned microbial groups. Cooling of raw or pasteurized cow milk for 24 or 48 h at 4 - 5°C increased the counts of total viable bacterial count (TVBC), lactic acid bacteria (LAB), psychrophilic bacteria, proteolytic, lipolytic, colifom, sporeformers, moulds and yeast of Domiati cheese. This may be related to the increasing of bacterial groups numbers during cold storage of milk.

Organoleptic properties

The scores gained from the resultant cheese of all treatments are shown in Table 6 and 7. Generally, the organoleptic properties of Domiati cheese of all samples improved significantly ($p < 0.001$) during the ripening period. Clearly, no significant differences were obtained from the appearance and colour results of various treatments of Domiati cheese at zero time or during period of ripening. The scores obtained for body and texture of cheese made from raw milk were slightly higher than those made from pasteurized milk. This may be due to the effect of heat treatment on casein micelles which increase its water holding capacity and produce cheese with more moisture. Also, flavour of cheese showed the same trend as body and texture. However, the raw milk cheese gained the highest scores of flavour. Similar results were obtained by Aly and Galal (2002). Adding evening and morning milk to cold stored milk slightly increased scores of body, texture and flavour of Domiati cheese. Refrigerated storage of cow's milk had no pronounced effect on body and texture of Domiati cheese, but slightly improved its flavour. This may be attributed to the increasing of microbial group's numbers within cold storage of milk and consequently increasing of proteolytic and lipolytic rates in produced cheese.

Table 6. Effect of cold storage of cow milk on organoleptic properties of Domiati cheese.

Treatments	Storage period (days)	Colour and appearance (15)	Body and texture (35)	Flavor (50)	Total (100)
A	0	12	28	41	81
	15	12	30	42	84
	30	12	32	44	88
	60	12	33	46	91
	90	12	33	47	92
B	0	12	29	42	83
	15	12	31	43	86
	30	12	32	44	88
	60	12	33	46	91
	90	13	33	47	93
C	0	11	30	42	83
	15	12	31	44	87
	30	12	32	46	90
	60	12	32	47	91
	90	12	33	48	93
D	0	11	30	42	83
	15	12	31	44	87
	30	12	32	46	90
	60	12	33	47	92
	90	12	33	47	92
E	0	11	31	41	83
	15	12	32	44	88
	30	12	32	45	89
	60	13	33	47	93
	90	13	33	47	93
F	0	11	26	38	75
	15	11	29	41	81
	30	12	30	43	85
	60	12	31	43	86
	90	12	32	46	90
G	0	11	28	39	78
	15	12	30	42	84
	30	12	31	43	86
	60	12	32	44	88
	90	12	33	46	91
H	0	11	28	39	78
	15	11	30	42	83
	30	12	31	42	85
	60	12	33	44	89
	90	12	33	46	91
I	0	11	29	40	80
	15	11	30	42	83
	30	11	32	42	85
	60	12	32	43	87
	90	12	33	47	92

Table 6. Contd.

J	0	11	29	40	80
	15	12	30	42	84
	30	12	31	42	85
	60	12	32	45	89
	90	12	33	47	92

Table 7. Statistical analysis of Domiati cheese treatments.

Analysis	Effect of cheese treatments										
	A	B	C	D	E	F	G	H	I	J	LSD
Actual yield %	18.85^{f}	18.21^{g}	18.24^{g}	17.71^{h}	17.57^{i}	20.55^{a}	20.5^{b}	20.43^{c}	19.78^{d}	19.62	0.032***
Adjusted yield %	17.20^{f}	17.25^{e}	17.72^{d}	16.33^{i}	15.81^{j}	18.29^{c}	18.98^{b}	19.32^{a}	17.06^{g}	16.77^{h}	0.032***
Acidity %	1.55^{c}	1.46^{d}	1.38^{e}	1.63^{b}	1.72^{a}	0.684^{h}	0.647^{i}	0.598^{j}	0.708^{g}	0.768^{f}	0.022***
pH	4.94^{h}	5.04^{g}	5.09^{f}	4.87^{i}	4.79^{j}	6.00^{c}	6.06^{b}	6.12^{a}	5.97^{d}	5.89^{e}	0.028***
TS %	41.5^{abcd}	42.6^{abc}	39.3^{cd}	41.2^{abcd}	40.5^{abcd}	40.3^{bcd}	43.5^{ab}	44.2^{a}	39.0^{cd}	38.3^{d}	3.77***
Fat %	21.6^{cd}	22.6^{ab}	23.0^{a}	21.4^{cd}	21.14^{d}	20.9^{d}	21.7^{bcd}	22.2^{abc}	21.2^{cd}	21.0^{d}	0.970***
Salt %	5.7^{e}	5.8^{de}	5.9^{cd}	5.9^{cd}	6.0^{bc}	5.9^{cd}	6.0^{bcd}	6.1^{abc}	6.1^{ab}	6.2^{a}	0.181***
Salt in moisture %	9.04^{g}	9.3^{e}	9.6^{c}	9.3^{e}	9.3^{d}	9.1^{f}	9.7^{b}	9.9^{a}	9.2^{e}	9.3^{e}	0.045***
TN %	2.8^{f}	2.9^{d}	2.9^{c}	2.7^{g}	2.7^{h}	2.9^{d}	3.0^{b}	3.0^{a}	2.9^{e}	2.8^{f}	0.028***
WSN %	0.558^{g}	0.545^{i}	0.535^{j}	0.569^{e}	0.582^{c}	0.570^{d}	0.560^{f}	0.55^{h}	0.585^{b}	0.582^{c}	0.001***
NPN %	0.162^{cde}	0.151^{de}	0.145^{e}	0.175^{bc}	0.186^{ab}	0.177^{bc}	0.167^{cd}	0.159^{cde}	0.186^{ab}	0.198^{b}	0.018***
TVFA	14.9^{b}	13.3^{de}	12.9^{e}	15.2^{b}	15.9^{a}	12.9^{e}	12.2^{f}	11.6^{g}	13.7^{d}	14.4^{c}	0.419***
TVBC	97.4^{e}	110.0^{d}	128.2^{b}	119.2^{c}	134.2^{a}	19.3^{j}	23.4^{i}	29.2^{g}	27.6^{h}	34.4^{f}	1.26***
Lactic acid bacteria	105.0^{e}	112.2^{d}	126.8^{b}	120.2^{c}	136.6^{a}	29.6^{j}	39.5^{i}	47.4^{g}	43.8^{h}	55.8^{f}	1.25***
Psychrophilic bacteria	0.400^{e}	1.20^{cd}	2.40^{b}	1.60^{c}	3.60^{a}	0.200^{e}	0.200^{e}	0.600^{de}	1.20^{cd}	1.80^{bc}	0.719***
Proteolytic bacteria	8.0^{e}	10.0^{d}	13.8^{b}	12.0^{c}	18.2^{a}	1.4^{g}	1.8^{fg}	2.6^{f}	2.0^{fg}	2.8^{f}	1.03***
Lipolytic bacteria	5.0^{e}	6.2^{d}	10.2^{b}	7.4^{c}	11.6^{a}	0.600^{g}	1.2^{fg}	1.8^{f}	1.4^{fg}	2.2^{f}	1.05***
Coliform bacteria	22.6^{e}	28.4^{d}	34.8^{b}	32.6^{c}	40.4^{a}	0.400^{f}	0.400^{f}	0.600^{f}	0.400^{f}	0.600^{f}	0.968***
Spore forms bacteria	33.8^{d}	38.6^{c}	44.8^{b}	44.2^{b}	52.2^{a}	7.2^{g}	9.8^{fg}	12.6^{ef}	11.2^{f}	14.6^{e}	3.10***
Moulds andyeasts	15.2e	17.4d	20.2b	18.6c	22.2a	3.4i	4.2hi	5.6g	4.6gh	7.8f	1.14***
Appearance andcolor	11.6^{a}	11.8^{a}	11.6^{a}	11.4^{a}	11.8^{a}	12.0^{a}	12.4^{a}	11.8^{a}	11.8^{a}	11.8^{a}	1.3
Body and Texture	29.6^{c}	30.8^{bc}	31.0^{ab}	31.2^{ab}	30.8^{bc}	31.2^{ab}	31.6^{ab}	31.6^{ab}	31.8^{ab}	32.1^{a}	1.3***
Flavour	42.2^{e}	42.8^{de}	42.6^{e}	42.8^{de}	43.2^{cde}	44.0^{bcd}	44.2^{abc}	45.4^{a}	45.2^{ab}	44.8^{ab}	1.3***

	Effect of storage time (days)					
	0	15	30	60	90	LSD
Acidity %	0.226^{e}	0.844^{d}	1.30^{c}	1.50^{b}	1.69^{a}	0.015***
pH	6.64^{a}	5.80^{b}	5.16^{c}	4.99^{d}	4.80^{e}	0.02***
TS %	34.6^{d}	38.8^{c}	43.2^{b}	42.9^{b}	45.8^{a}	2.7***
Fat %	17.0^{e}	20.3^{d}	22.8^{c}	23.7^{b}	24.7^{a}	0.687***
Salt %	5.11^{e}	5.62^{d}	6.04^{c}	6.43^{b}	6.83^{a}	0.128***
Salt in moisture %	7.26^{e}	8.4^{d}	9.60^{c}	10.46^{b}	11.28^{a}	0.032***
TN %	2.21^{e}	2.68^{d}	3.00^{c}	3.20^{b}	3.36^{a}	0.02***
WSN %	0.334^{e}	0.446^{d}	0.566^{c}	0.676^{b}	0.804^{a}	0.0009***
NPN %	0.104^{e}	0.141^{d}	0.180^{c}	0.202^{b}	0.226^{a}	0.013***
TVFA	6.52^{e}	11.40^{d}	14.04^{c}	17.24^{b}	19.30^{a}	0.296***
Lactic acid bacteria	223.9^{a}	79.1^{b}	43.0^{c}	12.3^{d}	3.14^{e}	0.889***
Psychrophilic bacteria	230.5^{a}	108.2^{b}	50.7^{c}	15.4^{d}	3.7^{e}	0.882***
Proteolytic bacteria	5.8^{a}	0.700^{b}	0.100^{c}	0.000^{c}	0.000^{c}	0.508***

Table 7. Contd.

Lipolytic bacteria	22.8^{a}	9.6^{b}	3.0^{c}	0.800^{d}	0.100^{d}	0.729***
Coliform bacteria	9.6^{a}	6.4^{b}	4.5^{c}	2.5^{d}	0.800^{e}	0.740***
Spore forms bacteria	38.6^{a}	20.4^{b}	13.9^{c}	6.3^{d}	1.4^{e}	0.684***
Moulds and yeasts	80.2^{a}	32.8^{b}	14.4^{c}	6.2^{d}	0.900^{e}	2.19***
Lactic acid bacteria	25.8^{a}	17.1^{b}	9.2^{c}	5.4^{d}	2.1^{e}	0.803***
Appearance and color	11.2^{b}	11.7^{ab}	11.9^{ab}	12.2^{a}	12.2^{a}	0.898***
Body and Texture	28.75^{d}	30.4^{c}	31.5^{b}	32.4^{ab}	32.8^{a}	0.909***
Flavour	40.4^{e}	42.6^{d}	43.7^{c}	45.1^{b}	46.8^{a}	0.898***

Significant different at $p <$ (*0.05, **0.01, ***0.001). For each effect the different letters in the means the multiple comparisons are different from each. Letters a is the highest means followed by b, c etc.

Conclusion

From the presented results, it could be concluded that mixing of different lactations milk and cold storage of cow's milk for 24 or 48 h had no significant effect on the quality of Domiati cheese. Also, to obtain higher quality of cow milk, it is recommended to pasteurize it before storage.

REFERENCES

Abd El–kader YI (2003). Changes in the nitrogen fractions of Domiati cheese made with microbial and recombinant rennets during ripening . Egyptian J. Dairy Sci. 31: 111.

Abd El-Kader YI (1999). Effect of cooling or freezing process on some properties of cow's milk and Domiati cheese. Egypt J. Appl. Sci. 14(2) 56.

Abd El-Salam M, Askar A, Hamzawi L, El-Dien H, Farag A (1992). Compositional quality of Domiati cheese as affected by lactose content in milk. Egyptian J. Dairy Sci. 20: 41-51.

Aly SA, Galal EA (2002). Effect of milk pretreatment on the keeping quality of Domiati cheese. Pak. J. Nutr. 1(3): 132-136.

American Public Health Association (1992). Standard Methods for the Examination of Dairy Products. Am. Publ. Health Assoc. Inc.12th edtion New York, USA.

Ammar EMA (1999). Composition and properties of Domiati cheese from cold and frozen stored buffalo's milk. Egyptian J. Dairy Sci. 27: 109-125.

Awad SA, Abdel-Kader YI, Nawar MA (2001). The quality of white pickled cheese as affected with the types of calcium salt. J. Agric. Sci. Mansoura University, 26(4): 2183-2203.

Bastian E, Hansen K, Brown R (1993). Inhibition of plasmin by β lactoglobulin using casein and a synthetic substrate. J. Dairy Sci. 76: 3354-3361.

Duncan DB (1955). Multiple Range and Multiple F-test. Biometrics 11: 1-42.

Elein GI, Abd El-Ghany A, Youssef L, Mohamed L (1999). Effect of milk pretreatment and storage condition on the properties and keeping quality of Ras cheese. Egyptian J. Dairy Sci. 27: 153-166.

El-Shafei NM (1994). An attempt for production of Domiati cheese with higher yield and acceptable quality. Egyptian J. Food Sci. 22: 261-270.

El-Sheikh MM, Farage AF, Shahein NM, Safinaz El-Shibiny (2001). Low fat Domiati cheese with particulate whey protein concentrate (PWPC). Egyptian J. Dairy Sci. 29: 331-342.

El–Sonbaty AH (2000). Studies on some Biochemical changes in Domiati cheese during pickling. Minufiya J. Agric. Res. 25: 135.

El-Walsh NAA (1998). Physico – Chemical studies on milk stored at low temperatures . M.Sc. Thesis, Faculty of Agriculture, Tanta University, Egypt.

Fahmi AH, Sharara HA (1950). Studies on Egyptian Domiati cheese. J. Dairy Res. 17: 312-328.

Ghosh B, Steel A, Kessler H (1999). Effect of heat treatment and homogenization of milk on camembert cheese. Egyptian J. Dairy Sci. 27: 331-343.

Kebary KMK, Hamed AI, Zedan AN, El-Beheary AAF (2006). Manufacture of Low fat Domiati cheese using Novagel . Egyptian J. Dairy Sci., 34: 175-184.

Kebary KMK, Kamaly KM, Zedan AN, Zaghlol A (1996). Accelerated ripening of Domiati cheese by accelase and lipozyme enzymes. Egyptian J. Dairy Sci., 24: 75.

Kosikowski FV (1978). Cheese and Fermented Milk Food. 3rd ed., Published by the author, Cornell Univ., Ithaca, New York, USA.

Kroll S (1995). Thermal stability. In: Enzymes of psychrotrophs in raw milk (McKeller S (Ed.) Academic Press Canada, pp. 121-148.

Ling ER (1963). A text - book of Dairy Chemistry. Vol. 2, Practical, 3rd ed., Champan and Hall, London, England.

Marth E, Steele J (2001). Starter cultures and their use. In: Applied Dairy Microbiology. 3rdEd. USA, pp. 131-173.

Metzger LE, Barbano DM, Rudan MA, Kindstedt PS (2000). Effect of milk preacidification on low fat Mozzarella cheese. I. Composition and yield. J. Dairy Sci. 83: 648–658.

Omer M, Elshibiny S (1985). Composition and microstructure of Domiati cheese as affected by lactose. Egyptian J. Dairy Sci. 13: 33-39.

Rehman S, Bank J, Mcsweeney P, Fox P (2000). Effect of ripening temperature on the growth and significance of non starter lactic acid bacteria in Cheddar cheese made from raw and pasteurized milk. Int. Dairy J. 10:45-53.

Richardson GH (1985). Standard Methods of the Examination of Dairy Products. 15th ed. American Public Health Association. Washington DC.

SAS (1991). SAS User's guide: statistics. SAS Inst, Inc, Cary NC.

Youssef A, Salama F A and El-Deeb S A (1975). Effect of storage on the physico chemical properties of cow and buffalo milk used for cheese manufacture Egyptian J. Dairy Sci., 3: 113.