

EFFECT OF MILK FAT SUBSTITUTION WITH VEGETABLE OILS ON THE QUALITY OF UF SOFT CHEESE

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Abstract

UF soft cheese was made from skim-milk buffaloe's retentate standardized to concentration factor = 4 and 15% of fat. Using fresh cream (60% fat) or substituted with 100%, 75%, 50% of olive oil, sesame oil, corn oil and coconut oil. Substitution of milk fat with vegetable oils did not affect the total solids, total nitrogen, fat content, soluble nitrogen, tyrosine, tryptophan, total volatile fatty acids, pH value and titratable acidity of the resultant cheese, while affected the flavour of all the treatments when fresh or during storage period. Olive oil gained the lowest flavour score and coconut oil was near to control.

INTRODUCTION

Dommati cheese is the most popular soft cheese in Egypt, which is consumed fresh or after pickling in salted whey for several months. It requires a ripening period of 3-4 months in order to develop the characteristic aroma and flavour. It is made from buffalo's or cow's milk or mixture of them. The rate of salt used in Dommati cheese manufacture depends on several factors such as milk type, season of the year and ripening time. The use of ultrafiltration technique in the manufacture of cheeses specially soft cheese was introduced by ultrafiltrating skim milk (Maubois and Mocquot, 1975 and Covacevich and Kosikowski, 1978) for continuous cheese making.

Excessive intake of milk fat in the diet has been linked to certain diseases such as heart disease, cancer, obesity and possibly gallbladder disease and it is associated with high blood cholesterol which increased the risk of coronary heart disease (Mistry, 2001). Replacement of milk fat with vegetable oils in making soft cheese had been studied by several investigators (Hofi et al., 1963 and El-Hefny, 1975). They reported that the use of cotton seed oil and maize oil in soft cheese making affected the coagulation and characteristics of the fresh cheese and caused changes in the composition during ripening.

The aim of the present study was to investigate the possibility of replacing milk fat with different kinds of vegetable oils in the manufacture of ripened soft cheese made from concentrated milk.

MATERIALS AND METHODS

Materials:-

Ultrafiltered buffalo's skim milk (concentration factor = 4) using DDS Lab 20 ultrafiltration unit at 45°C and inlet and outlet pressure of 3.6 and 0.6 bar respectively was obtained from the Unit of Dairy, Tech. Depart. Animal Production Research Institute. Imported olive, coconut, corn oil and locally produced sesame oil were obtained from the local market.

Soft Cheese Making:-

Skim milk (10% TS) was ultrafiltered (concentration factor = 4). Milk fat (using fresh cream 65% fat) or 100%, 75%, 50% of olive oil, sesame oil, corn oil and coconut oil. It was standardized to reach 15% fat in the final product then homogenized at 65°C under a pressure of 200 kg/cm² using a Rannie homogenizer (Rannie, Copenhagen, Denmark). The homogenized concentrated milk was cooled to 40°C, salt was added at the rate of 5%, and rennet (Rennilas, Denmark) at the rate of 3 g/100 kg, then distributed in 500 ml plastic cans and left to complete coagulation at 40°C, then stored at room temperature. Cheese was stored for four months, and it was analyzed monthly.

Methods of analysis:-

Total solids, fat, total nitrogen, soluble nitrogen and acidity were determined according to the methods described by AOAC (2000). pH value was measured using a digital pH-meter with combined glass-calomel electrode (Jenway 3305, England). Total volatile fatty acids (TVFA) were determined using the method of Kosikowski (1977). Soluble tyrosine and tryptophan were measured spectrophotometrically according to Vokaleris and Price (1959). The organoleptic properties of soft cheese samples were examined as described by ADSA (1987) with maximum score points of 50, 30 and 20 for flavour, body and texture and appearance respectively.

RESULTS AND DISCUSSION

I- Chemical composition of cheese:-

Chemical composition of soft cheese made from ultrafiltered milk with different treatments is shown in Table (1).

Data showed that, total solids, total nitrogen and total volatile fatty acids of all the treatments flocculated with the storage period. The flocculation was higher in the

first two months then followed with slight increase till the end of the storage period. A slight difference was observed in total solids, total nitrogen and total volatile fatty acids of the different treatments. It was obvious that, the replacement of milk fat with vegetable oil from different sources had no effect on the moisture content, total nitrogen or total volatile fatty acids of cheeses. Although, Javenpaa *et al.*, (2007), Schmid *et al.*, (2006), Wilezak *et al.*, (2006) and El-Hefny (1975) reported that, the use of vegetable oils in soft cheese making by traditional method weaken the formed curd and that cheese retained high moisture content. In the ultrafiltration technique used in the present investigation, the moisture content was adjusted in the pre-cheese retentate to eliminate formation of whey. Therefore, the adverse effect of vegetable oil used on the moisture content of cheese was not observed. El-Shibiny *et al.*, (1974) mentioned that TVFA of cheese were not affected with the replacement of milk fat with vegetable oil.

The fat content of cheese had the same trend as total solids, which increased in the first two months and then slight increase was observed till the end of storage (Table 1).

The acidity of the cheese rapidly increased and pH value decreased in the first two months of storage and almost unchanged at the rest of storage period therefore, replacing milk fat with vegetable oil did not affect the development of acidity. El-Koussy (1966) mentioned that, the acidity and pH value of cheese were comparable to that reported for conventional cheese.

II- Ripening indices of soft cheese:-

Ripening of soft cheese made from milk retentate by replacing milk fat with different kinds of vegetable oils was shown in Table (2).

The data showed that both, soluble nitrogen in total nitrogen, soluble tyrosine and soluble tryptophan of all the treatments increased with increasing the storage period. Also, data showed that replacing milk fat with different ration of vegetable oil had no effect on both soluble nitrogen in total nitrogen, soluble tyrosine and soluble tryptophan in all treatments which nearly to be the same at the same ripening period. These results are in agreement with those of Osman and Abbas (2001) who reported that, the increase in soluble nitrogen content through the ripening period may be due to the protein breakdown occurred through the growth of microflora and/or the proteolysis with proteolytic enzyme activities. Also, they reported that water soluble nitrogen in total nitrogen content gradually increased with the increase of the ripening period. Shehata *et al.*, (2004) mentioned that both tyrosine and tryptophan increase with the progress of ripening period.

III- Organoleptic properties:-

Organoleptic properties of the different treatments are shown in Table (3). It was noticed that, replacing milk fat with vegetable oils gave oily flavour to fresh cheese. The intensity of the oily flavour varies according to the oil used and its percentages, being more noticeable with olive oil, while coconut oil was less or nearly the same as the control cheese. The intensity of the oily flavour decreased with storage and was undetected in some treatments like coconut oil and corn oil.

The scoring of cheese for flavour, showed, comparable scores for cheese with vegetable oils to the control. This is largely may be attributed to the sharp oily flavour notice with olive oil treatment.

Also, it can be noticed from the same Table (3), that, body & texture of the treatments and the appearance had nearly the same scores.

Total scores of the different treatments (Table, 3) showed big differences in the obtained score with the kind of vegetable oils used or the replacement ration. Coconut oil treatments showed the highest total score obtained compared to the other vegetable oils used, while olive oil treatment had the lowest total score values.

From the foregoing data it can be concluded that, soft cheese made from ultrafiltered milk can be made with replacing milk fat with 100% coconut oil, 75% corn oil and 50% of olive oil or sesame oil.

Table 1. Effect of using vegetable oils on chemical composition of ultrafiltered soft cheese during storage period.

Storage Period (Month)	Control	Olive oil			Sesame oil			Corn oil			Coconut oil		
		100%	75%	50%	100%	75%	50%	100%	75%	50%	100%	75%	50%
Fresh													
TS%	38.13	38.00	38.21	38.16	38.31	38.25	38.31	38.10	38.09	38.17	38.33	38.33	38.26
Fat/DM	40.10	39.80	39.70	39.90	40.10	40.00	40.10	93.60	39.80	39.50	40.10	40.10	40.30
TN/DM	9.301	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30
Acidity %	0.14	0.15	0.15	0.14	0.15	0.14	0.13	0.17	0.16	0.16	0.15	0.15	0.15
pH value	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.7	6.7	6.7	6.8	6.8	6.8
T.V.F.A*	11.33	12.68	12.54	12.22	13.78	13.62	13.41	9.71	9.91	10.51	11.11	11.21	11.25
2 months													
TS%	40.07	39.98	40.16	40.18	39.78	39.57	39.74	40.19	40.01	40.21	39.93	38.85	38.91
Fat/DM	40.00	39.9	39.80	39.0	40.00	40.00	40.10	39.70	39.80	39.60	40.00	40.10	40.20
TN/DM	9.30	9.301	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30
Acidity %	2.22	2.35	2.37	2.31	2.29	2.28	2.29	2.31	2.33	2.29	2.21	2.22	2.26
pH value	4.5	4.3	4.3	4.4	4.4	4.4	4.4	4.4	4.3	4.4	4.5	4.5	4.5
T.V.F.A	36.80	39.70	40.5	41.30	37.40	39.30	39.10	38.50	38.90	38.70	39.900	39.80	39.70
3 months													
TS%	39.17	38.76	38.89	38.23	38.65	38.11	38.65	39.11	38.96	39.50	37.14	37.12	37.62
Fat/DM	40.09	40.01	39.90	40.0	40.08	40.07	40.10	39.90	40.00	39.90	40.07	40.20	40.20
TN/DM	9.30	9.303	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30
Acidity %	2.31	2.44	2.44	2.39	2.33	2.35	2.35	2.35	2.39	2.33	2.27	2.28	2.31
pH value	4.4	4.2	4.2	4.3	4.3	4.3	4.3	4.3	4.2	4.3	4.4	4.4	4.4
T.V.F.A	38.14	40.51	41.92	41.99	38.90	40.30	39.90	39.60	39.80	39.80	41.00	40.90	41.30
4 months													
TS%	39.06	38.52	38.65	38.07	38.41	38.00	38.17	38.91	38.65	39.42	37.00	37.00	37.00
Fat/DM	41.01	40.10	40.00	40.10	40.20	40.10	40.20	40.00	40.10	40.00	40.20	40.20	40.30
TN/DM	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30
Acidity %	2.53	2.68	2.69	2.61	2.59	2.62	2.63	2.63	2.68	2.61	2.54	2.51	2.61
pH value	4.2	4.0	4.0	4.1	4.1	4.1	4.1	4.1	4.0	4.1	4.2	4.1	4.1
T.V.F.A	39.50	41.20	42.50	43.60	40.00	41.70	41.30	41.50	41.70	41.60	42.10	42.00	42.50

* as mls 0.1 N NaOH / 100 gm cheese

Table 2. Effect of using vegetable oils on ripening indices of ultrafiltered soft cheese during storage period

Storage Period (Month)	Control	Olive oil			Sesame oil			Corn oil			Coconut oil		
		100%	75%	50%	100%	75%	50%	100%	75%	50%	100%	75%	50%
Fresh SN/TN	7.62	7.59	7.63	7.61	7.66	7.64	7.63	7.58	7.62	7.61	7.55	7.58	7.59
Tyrosine (mg/100g)	13.10	13.00	13.10	13.20	13.00	13.10	13.10	13.00	13.00	13.10	13.20	13.10	13.10
Tryptophan (mg/100g)	4.46	4.45	4.45	4.44	4.46	4.45	4.44	4.45	4.45	4.46	4.45	4.46	4.45
2 month SN/TN	12.65	12.49	12.56	12.61	12.63	12.66	12.63	12.61	12.60	12.60	12.63	12.62	12.65
Tyrosine (mg/100g)	131.50	132.00	131.70	131.50	132.10	131.70	133.00	132.60	131.90	133.10	132.70	132.20	132.40
Tryptophan (mg/100g)	43.20	42.9	43.10	43.60	42.80	43.70	43.10	43.20	43.30	42.80	42.70	42.90	42.50
3 month SN/TN	125.10	126.30	125.90	125.80	125.40	125.90	126.00	126.30	126.10	125.40	125.60	125.90	125.80
Tyrosine (mg/100g)	227.10	228.50	229.10	228.30	227.90	228.70	227.70	228.10	227.60	228.40	228.50	227.90	228.30
Tryptophan (mg/100g)	100.50	101.30	101.60	100.90	100.80	100.60	101.10	101.50	100.90	100.70	101.30	101.50	101.60
4 month SN/TN	261.70	262.10	262.30	261.90	261.50	261.70	261.30	262.10	262.20	262.00	261.90	261.60	261.80
Tyrosine (mg/100g)	252.80	250.10	253.20	252.10	252.70	253.10	254.20	254.60	254.30	257.70	256.90	257.30	257.90
Tryptophan (mg/100g)	115.30	114.70	114.60	112.50	113.30	117.20	116.90	117.80	119.50	119.10	114.20	113.90	113.80

Table 3. Effect of using vegetable oils on organoleptic properties of ultrafiltered soft cheese during storage period

Storage Period (Month)	Control	Olive oil			Sesame oil			Corn oil			Coconut oil		
		100%	75%	50%	100%	75%	50%	100%	75%	50%	100%	75%	50%
Fresh													
Flavour (50)	42	21	28	36	37	39	36	37	38	38	38	39	41
Body & texture (30)	22	20	21	22	20	21	21	19	20	21	21	22	22
Appearance (20)	18	13	15	17	15	16	17	17	17	17	18	18	18
Total (100)	82	53	64	75	62	74	77	72	74	76	77	79	81
2 month													
Flavour (50)	48	23	29	37	41	42	43	39	40	41	42	44	47
Body & texture (30)	29	25	26	27	25	27	26	24	25	27	27	28	28
Appearance (20)	19	13	15	18	16	17	18	18	18	18	19	19	19
Total (100)	96	61	70	82	82	86	87	81	83	86	88	91	94
3 month													
Flavour (50)	46	20	36	37	40	41	42	37	39	40	41	43	46
Body & texture (30)	28	24	26	26	24	26	26	23	25	26	26	27	27
Appearance (20)	19	13	15	18	16	16	17	17	18	18	18	19	19
Total (100)	93	57	67	81	80	83	85	77	82	84	85	89	92
4 month													
Flavour (50)	45	12	20	37	39	40	41	37	38	40	40	42	44
Body & texture (30)	28	23	25	26	24	25	25	23	24	25	25	26	26
Appearance (20)	18	12	15	17	15	15	16	17	18	18	18	18	18
Total (100)	91	47	60	80	78	80	82	77	80	83	83	86	88

REFERENCES

1. ADSA 1987. American Dairy Science Association. Score card for cheese, Champaign, T.L. P. 84.
2. AOAC 2000. Official Method of Analysis. Washington USA. P. 1553.
3. Covacevich, H.R. and F.V. Kosikowski. 1978. Mozzarella and Cheddar cheese manufacture by ultrafiltration principles. *J. Dairy Sci.*, 61: 701-711.
4. El-Hefny, A.A. 1975. The use of vegetable oils in soft cheese making. M.Sc., thesis, Ain-Shams Univ. Cairo.
5. El-Koussy, L.A. 1966. Studies on soft cheese manufacture from pasteurized milk. Ph.D. thesis, Ain-Shams Univ. Cairo.
6. El-Shibiny, S., A.A. Abdel-Baky, G.A. Mahran and A.A. Hofi 1974. Development of free fatty acids soft cheese during pickling *Milch Wissenschaft*, 29: 166-174.
7. Hofi, A.A., G.A. Tawab, M. Radi and N. Fawzi. 1963. Studies on Domiati cheese. I- Fat examination and development of total volatile acidity. *Annals of Agriculture Sci.*, Ain Shams Univ., 8: 157-163.
8. Jarvenpaa, S., R.L. Tahvonen, A.C. Ou-Wehand, M. Sandell, E. Javenpaa and S. Salminen. 2007. A probiotic, *Lactobacillus fermentum* ME-3, has antioxidative capacity in soft cheese spreads with different fats. *Journal of Dairy Science* 2007, 90(7): 3171-3177.
9. Kosikowski, F.V. 1977. *Cheese and Fermented Milk Foods*. 2nd ed Publ. By F.V. Kosikowski and Assoc. Brooktondale. New York, USA, 572-574.
10. Maubois, J.L. and G. Mocquot (1975): Application of membrane ultrafiltration for preparation of various types of cheese. *J. Dairy Sci.*, 58: 1001-1009.
11. Mistry, V.V. 2001. "Low fat cheese" *Technology Int. Dairy J.* 11: 413-422.
12. Osman, M.M. and F.M. Abbas. 2001. Fate of *Lactobacillus acidophilus* Lactobacillus *acidophilus* La-5 and *Bifidobacterium lactis* Bb-12 in "Probiotic" Ras cheese. Proc. 8th. Egyptian Conf. Dairy Sci. & Technology. 623-664.
13. Schmidty, E.B., J.G., Rasmussen, A.M. Joensen, M.B. Madsen and J.H. Christensen. 2006. Fish, marine n-3 polyunsaturated fatty acids and coronary disease: a minireview with focus on clinical trial data. *Prostaglandins, Leukotrienes and Essential Fatty Acids*. 2006, 75(3): 191-195 Journal article.
14. Shehata, A.E., M.A. El-Nawawy, Y.M. El-Kenany and I.E. Aumara. 2004. Use of *Bifidobacteria* in Ras cheese production. Chemical and organoleptic properties. Proc: The 9th. Egyptian Conf. For Dairy Sci. & Technol. Milk and Dairy products for a healthy future. 533-547.
15. Vokalerjes, D.C. and W.V. Price. 1959. A rapid spectrophotometric method for measuring cheese ripening. *J. Dairy Sci.*, 47:264.
16. Wilezak, J. 2006. Essential polyunsaturated fatty acids in pets nutrition. *Zycie – Weterynaryjne*. 2006, 81(4): 263-269.

تأثير استبدال دهن اللبن بالزيوت النباتية على جودة الجبن الطري المصنع من اللبن المركز

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تم صناعة الجبن الطري من لبن جاموسي فرز مركز بالترشيح الدقيق ومعدل إلى معامل تركيز = ٤، نسبة الدهن ١٥% باستخدام كريمة طازجة ٦٥% وتم استبدال دهن اللبن باستخدام ١٠٠% أو ٧٥% أو ٥٠% من زيت الزيتون أو زيت السمسم أو زيت الذرة أو زيت جوز الهند على التوالي. ووجد أن استبدال دهن اللبن لم يؤثر على الجوامد الكلية، نسبة الدهون، النيتروجين الكلي، النيتروجين الذائب، التيروزين، والتربتوفان، الأحماض الدهنية الطيارة الكلية، الحموضة، ال pH ولكن أثر على طعم الجبن الناتج في جميع المعاملات سواء طازج أو مسوى. ووجد أن استخدام زيت الزيتون يؤثر على الطعم بصورة واضحة وحصل على أقل درجات تحكيم، ودرجات طعم، بينما الجبن المستخدم فيه الهند كان تقريبا مشابه لجبن المقارنة.