http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

OPEN ACCESS Pakistan Journal of Biological Sciences

ISSN 1028-8880
DOI: 10.3923/pjbs.2018.394.400

Research Article
Production of Healthy Functional Soft White Cheese Using *Moringa oleifera* Oil

Fatma A.M. Hassan, A.K. Enab, Mona A.M. Abd, El-Gawad, N.S. Abd Rabou, Hoda S. El-Sayed and Aboelfetoh M. Abdalla

Department of Dairy Science, Division Food Industrial and Nutrition, National Research Centre, 33 El Bohouth St. Dokki, P.O. Box 12622, Giza, Egypt

Abstract

Background and Objective: *Moringa oleifera* oil is composed of highly unsaturated fatty acids containing 80.4% polyunsaturated, mainly oleic acids 67.9% and had a low acid value and low free fatty acids composition, so it is acceptable for edible application. The objective of study was the feasibility of using *Moringa oleifera* oil in manufacture of cheese compared with other oils (olive, sun flower) and the effect of using *Moringa oleifera* oil in chemically; organoleptically and microbial content in cheese. **Materials and Methods:** Fat was mechanically separated from buffalo's milk to reach 3% fat. Then the resultant milk divided into four portions. First let as control, then, the rest milk divided into three portions and fat substituted with 1, 1.5 and 3% of olive, moringa and sunflower oils. The resultant milk manufactured to soft white cheese and the resultant cheese was analyzed chemically, microbiologically and organoleptically. **Results:** Findings showed that 1.5% of different oils are best ratio and had gained highest scores for appearance, body and texture and flavor. The soft white cheese manufactured by *Moringa oleifera* oil was a best treatment than control and other treatments and has antimicrobial properties. Acidity, fat, total nitrogen, soluble nitrogen, total volatile fatty acids (TVFA) and thiobarbituric acid (TBA) increased during cold storage at 5°C+1 for 3 weeks cheese with *Moringa oleifera* oil had lower (PV) peroxide value than other treatments and pH took an opposite trend. **Conclusion:** It was concluded that *Moringa oleifera* oil in soft cheese improved body and texture, flavor, than olive and sunflower oils and also increased the shelf life of cheese.

Key words: *Moringa oleifera* oil, soft white cheese, sunflower oil, olive oil, microbial count, yeast and mould, sensory evaluation

Citation: Fatma A.M. Hassan, K.E. Ali, Mona A.M. Abd, El-Gawad, N.S. Abd Rabou, Hoda S. El-Sayed and Aboelfetoh M. Abdalla , 2018. Production of healthy functional soft white cheese using *Moringa oleifera* oil. Pak. J. Biol. Sci., 21: 394-400.

Corresponding Author: Fatma A. M. Hassan, Department of Dairy Science, Division Food Industrial and Nutrition, National Research Centre, 33 El Bohouth St. Dokki, P.O. Box 12622, Giza, Egypt Tel: 002/01220289165

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Moringa oleifera has been found to be a potential new source of oil. *Moringa oleifera* leaves and seeds are good source of antioxidants and oil which is highly resistant to oxidation[1]. Oybunugafor[2] showed that Moringa oil is composed of highly unsaturated fatty acids containing 80.4% polyunsaturate, mainly oleic acids 67.9%. Moringa oil has a low acid value and low free fatty acids composition which suggest lesser susceptible to rancidity. Oil of low acidity has been considered to acceptable for edible application[3], *Moringa oleifera* seed oil is a green able taste, highly safe to eat and resembles olive oil in its fatty acids composition[4], Moringa seed oil contains all the major fatty acids found in olive oil and can be used as a possible replace with the costly olive oil after some modification.

The importance of olive oil is related to its high levels of mono-unsaturated fatty acids (mainly oleic acid) and to the presence of minor components including aliphatic and tri-terpenic alcohols, sterols, hydrocarbons, volatile compounds and several antioxidants[5,6]. It concluded that 1% olive oil is the best concentration for preparation yoghurt cheese and gave good appearance and flavor. On the other hand, increase in olive oil concentration led to decrease in lactic acid bacterial count. Addition of some aromatic and essential oils to yoghurt and Labneh had stimulatory effect on lactic acid bacteria by enhancing their growth and acid production[7,8].

Belewu *et al.*[9] concluded that the use of *Moringa oleifera* oil in preparation of soft cheese lead to improve the overall acceptability and improve flavor and texture which could be accounted for the nice aroma of *Moringa oleifera* oil as well as improve the nutritional, therapeutic and shelf life of cheese.

Moringa oleifera is rich dietary source of omega 3 polyunsaturated fatty acid[10]. Several studies showed that omega 3 fatty acids aid to decline inflammation and pain related to rheumatoid arthritis[11].

This study is important because *Moringa oleifera* oil had anti-microbial effect as shown at previous studies so *Moringa oleifera* oil should be increase the shelf life of cheese. Therefore, the aim of this study was manufacture of healthy and functional soft white cheese using *Moringa oleifera* oil to improve the nutritional, therapeutic and shelf life of soft white cheese.

MATERIALS AND METHODS

Fresh buffaloes' milk was obtained from the herd of faculty of Agriculture; Cairo University, Egypt *Moringa oleifera* oil was obtained from, Laboratory at National Research Centre. Olive oil and sunflower were obtained from the market.

Analytical methods: Total solids, fat, ash, total nitrogen, soluble nitrogen, total protein were determined according to AOAC[12] lactose, pH values were measured using a digital laboratory pH meter (H1 93/400, Hanna instruments) with glass electrode. Total Volatile fatty Acids (TVFA) values were determined according to Kosikowski[13] and expressed as milliliter of 0.1N NaOH/100 g. Peroxide value was determined according to method described by AOAC[14]. Free fatty acids (as oleic acid) was determined as described in IDF[15].

Thiobarbituric acid (TBA) was carried out by using the method of Pearson *et al.*[16]

Preparation of soft white cheese: Fat was mechanically separated from buffalo's milk (6.0 fats, 11.5 SNF). The resultant milk incorporating with 3% fat and fat substituted with 1, 1.5 and 3% of olive, moringa and sunflower oils. Soft white cheese was manufactured according to Fahmi and Sharara[17]. Resultant cheese was analyzed chemically, sensory evaluation and microbiologically fresh and during storage until 3 weeks at 5°C+1.

Preliminary study: Resultant soft white cheese manufactured with different ratios (1, 1.5, 2, 3%) of different oils (olive, Moringa, sunflower) were evaluated by a panel of 10 Judges to choose best ratio. The best ratio was analyzed fresh and during cold storage at 5°C+1 for 3 weeks.

Microbiological examination: Total bacterial counts were enumerated using plate count agar medium (oxide). The plates were incubated[18] at 37°C for 48 h.

Coliform bacteria counts were enumerated using violet red bile agar medium. The plates were incubated at 37°C for 18 h. Mossel[19] yeasts and molds counts were enumerated using potato dextrose agar acidified to pH 3.5 with sterile lactic acid solution (10%). The plates were aerobically incubated at 25°C for 4 days[20].

Sensory evaluation: Samples of resultant soft white cheese were Judged by a panel of 10 Judges and evaluated by the method described by Scott[21].

Statistical analysis: Statistical analysis was carried out using software[22] and probability of $p>0.05$ was used to establish statistical significance.

RESULTS AND DISCUSSION

It can be seen from Table 1 sensory evaluation of soft white cheese manufactured using different ratios of different oils. It is clear that 1.5% of olive, Moringa and sunflower oils had gained highest total scores than other treatments 1.5 of Moringa oil gained highest, total scores followed by olive oil and finally sunflower oil. Soft white cheese manufactured by 1.5% of Moringa oil had gained a highest scores for appearance, body and texture and flavor than other treatments followed by olive oil and finally sunflower oil preliminary study show that soft white cheese manufactured by 1.5% of Moringa oil was a best ratio and had a good appearance, body and texture and flavor than other treatments. So best treatment was storage and analyzed chemically, sensory evaluation, fresh and during cold storage at 5°C+1.

The values in Table 2 indicated sensory evaluation of soft white cheese manufactured using 1.5% of different oils fresh and during cold storage at 5°C+1. Control had gained highest scores for appearance, body and texture and flavor followed by treatment by Moringa oil followed by treatment with olive oil and finally treatment with sunflower oil.

Degrees of appearance, body and texture and flavor gradually decrease in case of control and three treatments until 3 weeks. These results were in agreement to Hassan *et al.*[23], who reported that scores for appearance, body and texture and flavor of soft white cheese manufactured by *Moringa oleifera* leaves powder decreased during storage at 5°C+1. Also, labneh manufactured by using different ratios of Moringa oil slightly decreased during storage period at 5°C+1 as recommended by El Sayed *et al.*[24].

Acidity and pH: The data in Table 3 showed that control had highest acidity than all treatments followed by treatment with Moringa oil, olive oil respectively and finally sunflower. Acidity gradually increases during cold storage until 3 weeks either control or treatments. On the other hand pH took an opposite trend. These results were in agreement to Hassan *et al.*[25]; Salem *et al.*[26] and El-Sayed *et al.*[24].

Fat: Control had lowest content of fat (Table 3). Fat was nearly similar at three treatments. Fat slightly increased during storage at 5°C+1 either control or treatments until 3 weeks. These results were in agreement with El-Sayed *et al.*[24], who reported that TS and fat content increased by increasing the ratio of *Moringa oleifera* oil.

Total solid took the same trend of fat. Total nitrogen increased during storage until 3 weeks either control or treatments. Also soluble nitrogen and soluble nitrogen/total nitrogen took the same trend.

Table 1: Sensory evaluation of soft white cheese manufactured using different ratios of different oils

Moringa oleifera oil (%)	Appearance (10)	Body and texture (40)	Flavour (50)	Total (100)
***Moringa oleifera* oil**				
Control	10	38	48	96
1	7	35	43	85
1.5	9	39	49	97
2	6	34	45	85
3	5	30	44	79
Olive oil				
1	8	34	45	87
1.5	9	38	49	96
2	7	31	46	84
3	6	33	43	82
Sunflower oil				
1	6	30	42	78
1.5	7	36	46	89
2	5	32	43	80
3	4	30	40	74

Each value is a mean of 3 replicates

Table 2: Sensory evaluation of soft white cheese manufacture using 1.5% of different oils fresh and during cold storage at 5°C+1

Storage period (weeks)	Properties	C	T_1	T_2	T_3	±SEM
Fresh	Appearance (10)	10^a	8^b	9^b	7^c	0.492
1		9^a	7^a	8^a	5^b	0.527
2		8^a	6^b	7^a	4^b	0.570
3		7^a	5^b	6^a	3^b	0.462
Fresh	Body and texture (40)	38^a	36^a	37^a	36^a	0.590
1		37^a	$35^{b,a}$	36^a	32^b	0.763
2		36^a	$34^{b,a}$	35^a	30^b	0.861
3		34^a	33^a	$32^{a,b}$	28^b	0.937
Fresh	Flavour (50)	49^a	47^a	48^a	45^a	0.705
1		46^a	46^a	46^a	43^a	0.608
2		45^a	45^a	43^a	43^a	0.710
3		43^a	42^a	41^a	39^a	0.514

Dissimilar superscripts at the same row (for treatments) and the same column (for storage periods) are significantly differed ($p>0.05$). Each value is a mean of 3 replicates. C: Control without oil, T_1: Treatment with olive oil (1.5%), T_2: Treatment with *Moringa oleifera* oil (1.5%), T_3: Treatment with sunflower oil (1.5%)

Table 3: Chemical composition of soft white cheese manufacture by different oils fresh and during storage at 5°C+1

Components	Storage period (week)	Treatments				±SEM
		Control	Olive oil	*Moringa oleifera* oil	Sunflower oil	
Acidity (%)	F	0.21^{c}	0.18^{b}	0.20^{a}	0.17^{b}	0.005
	1	0.22^{a}	0.19^{a}	0.19^{a}	0.17^{b}	0.005
	2	0.24^{a}	0.21^{b}	0.22^{a,b}	0.19^{c}	0.005
	3	0.27^{a}	0.24^{b}	0.26^{a}	0.27^{b}	0.006
pH	F	6.41^{a}	6.30^{c}	6.35^{b}	6.15^{d}	0.028
	1	6.30^{a}	6.30^{a}	6.30^{a}	6.05^{b}	0.033
	2	6.10^{a}	6.20^{a}	6.20^{a}	5.90^{b}	0.032
	3	5.90^{a}	5.90^{c}	5.90^{b}	5.80^{d}	0.028
Fat (%)	F	13.00^{b}	15.20^{a}	15.10^{a}	15.00^{a}	0.423
	1	13.10^{b}	15.25^{a}	15.15^{a,b}	15.10^{b}	0.270
	2	13.20^{b}	15.30^{a}	15.20^{a}	15.20^{a}	0.262
	3	13.30^{b}	15.35^{a}	15.30^{a}	15.25^{a}	0.423
TS (%)	F	39.10^{b}	38.40^{c}	37.20^{d}	39.40^{a}	0.264
	1	39.60^{a}	38.60^{b}	37.50^{c}	39.50^{a}	0.301
	2	40.20^{a}	38.90^{b}	37.90^{c}	40.20^{a}	0.267
	3	40.70^{b}	39.40^{c}	38.60^{d}	41.80^{a}	0.264
TN (%)	F	2.08^{b}	2.12^{a}	1.98^{c}	1.94^{d}	0.022
	1	2.06^{b}	2.15^{a}	2.02^{c}	2.02^{c}	0.016
	2	2.07^{b}	2.15^{a}	2.15^{a}	2.02^{b}	0.016
	3	2.10^{b}	2.18^{a}	2.18^{c}	2.15^{d}	0.022
SN (%)	F	0.152^{a}	0.144^{b}	0.138^{b}	0.161^{a}	0.002
	1	0.163^{a}	0.146^{a}	0.110^{a}	0.180^{a}	0.105
	2	0.165^{b}	0.161^{b}	0.165^{b}	0.195^{a}	0.004
	3	0.391^{a}	0.210^{b}	0.225^{b}	0.240^{a}	0.002
SN/TN (%)	F	7.305^{b}	6.792^{d}	6.970^{c}	8.300^{a}	0.175
	1	7.913^{b}	6.79^{c}	5.44^{d}	8.911^{a}	0.352
	2	7.976^{b}	7.488^{d}	7.674^{c}	8.653^{a}	0.258
	3	18.619^{b}	9.633^{d}	10.32^{c}	11.163^{a}	0.175

Each value is a mean of 3 replicates. Ts: Total solid, TP: Total protein, SN: Soluble nitrogen. Dissimilar superscripts at the same row (for treatments) and the same column (for storage periods) are significantly differed (p>0.05). Each value is a mean of 3 replicates

Table 4: Peroxide value (P.V) (m.equiv. O_2/kg oil) of soft white cheese manufactured by using different oils fresh and during storage

Storage period (week)	Treatments				±SEM
	C	T_1	T_2	T_3	
Fresh	0.00^{c}	0.28^{b}	0.00^{c}	1.50^{a}	0.186
1	0.21^{c}	1.20^{b}	0.20^{c}	1.58^{a}	0.177
2	0.35^{c}	1.25^{b}	0.25^{d}	1.62^{a}	0.176
3	0.52^{c}	1.30^{b}	0.36^{d}	1.68^{a}	0.164

Dissimilar superscripts at the same row (for treatments) and the same column (for storage periods) are significantly differed (p>0.05). Each value is a mean of 3 replicates

The data in Table 4 illustrated peroxide value (PV) m.equiv.O_2/kg oil of soft white cheese manufactured by using different oils fresh and during cold storage at 5°C+1. Control and treatment (II) with Moringa oil recorded lowest PV than other treatments followed by treatment I by olive oil and treatment III with sunflower in fresh state. The PV is important parameter for storage stability of fat dairy products. Peroxide value (PV) increased throughout the storage period in control and treatments until 3 weeks. Treatment II with Moringa oil recorded lowest PV than control and other treatments during storage. These results are in agreement to Manzoor *et al.*[27] and Oybunugafor *et al.*[2], who reported that lower PV of *Moringa oleifera* oil due to the stable of oil to oxidative degradation.

It can be seen in Table 5 the free fatty acids FFA (%) (as oleic) of soft white cheese manufactured by different oils fresh and during storage.

The FFA increased gradually during storage until three weeks either control or treatments. Treatment (II) by *Moringa oleifera* oil and treatment (I) with olive oil recorded highest FFA than control and treatment either fresh or during storage[27,2]. High oleic acid content of Moringa oil coupled with its highly unsaturated nature and low peroxide value may qualify the Moringa oil for use in industry.

The data in Table 6 indicated the thiobarbituric acid (TBA) of soft white cheese manufactured by using different oils fresh and during storage. It was clear that TBA gradually increased during cold storage at 5°C+1 until 3 weeks either control

Table 5: Free fatty acid (FFA %) (asoleic) of soft white cheese manufactured by using different oils fresh and during storage

Storage period (week)	Treatments C	T_1	T_2	T_3	±SEM
Fresh	0.18^{c}	0.20^{a}	$0.19^{b,c}$	0.15^{c}	0.005
1	0.20^{c}	0.24^{b}	0.20^{c}	0.18^{a}	0.010
2	0.24^{b}	0.25^{b}	0.22^{c}	0.32^{a}	0.011
3	0.26^{c}	0.28^{b}	0.24^{c}	0.35^{a}	0.012

Dissimilar superscripts at the same row (for treatments) and the same column (for storage periods) are significantly differed (p>0.05). Each value is a mean of 3 replicates

Table 6: Thiobarbituric acid (TBA) of soft white cheese manufactured by using different oils fresh and during storage

Storage period (week)	Treatments C	T_1	T_2	T_3	±SEM
Fresh	0.00^{b}	0.022^{a}	0.00^{b}	0.025^{a}	0.003
1	0.016^{b}	0.024^{b}	0.018^{b}	0.028^{a}	0.001
2	$0.018^{b,c}$	$0.025^{a,b}$	0.021^{c}	0.032^{a}	0.001
3	0.020^{c}	0.027^{b}	0.022^{c}	0.036^{a}	0.002

Dissimilar superscripts at the same row (for treatments) and the same column (for storage periods) are significantly differed (p>0.05). Each value is a mean of 3 replicates

Table 7: Total volatile fatty acid (0.1 N NaOH/100 g cheese) of soft white cheese manufactured by using different oils fresh and during storage

Storage period (week)	Treatments C	T_1	T_2	T_3	±SEM
Fresh	16^{c}	23^{a}	24^{a}	20^{a}	0.844
1	18^{c}	28^{a}	30^{a}	24^{b}	1.134
2	22^{c}	34^{a}	36^{a}	26^{b}	1.636
3	28^{c}	38^{a}	40^{a}	30^{b}	1.647

Dissimilar superscripts at the same row (for treatments) and the same column (for storage periods) are significantly differed (p>0.05). Each value is a mean of 3 replicates

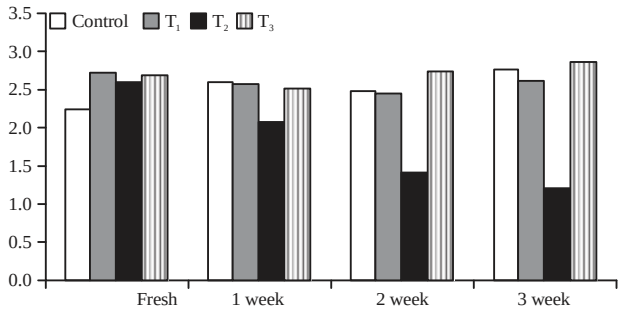

Fig. 1: Coliform bacteria counts in soft white cheese manufactured by using different oils fresh and during cold storage (5°C+1)
C: Control without oil, T_1: Soft white cheese with olive oil, T_2: Soft white cheese with Moringa oil and T_3: Soft white cheese with sunflower oil

or treatments. Treatment III by sunflower oil recorded highest TAB than control and other treatments. This may be due to the composition of oil.

Whereas control had lowest value of TBA than other treatments. These results were in agreement with Abd El-Aziz *et al.*[28] who found that TBA of Egyptian white Brined cheese increased during storage until two months.

The contents in Table 7 showed the total volatile fatty acids (0.1 N NaOH/100 g cheese) of soft white cheese manufactured by using different oils fresh and during storage. Control recorded lowest (TVFA) than other treatments followed by treatment III by sunflower and finally treatment (I) by olive oil whereas treatment (II) by Moringa oil had highest total volatile fatty acids (TVFA) increased gradually during cold storage until the end of storage (3 weeks) in case of control and all treatments. These results were in agreement to El-Sayed *et al.*[24], who concluded that manufacture of labneh fortified with Moringa oil recorded highest value of TVFA than control.

Microbiological analysis: It was found from Fig. 1 that the coliform bacterial counts in soft white cheese manufactured by using different oils fresh and during cold storage (5°C+1). Some coliform bacterial was found in control and treatments fresh and during storage period, in treatment T2 with *Moringa oleifera* oil coliform count gradually decreased during cold storage to reach 1.22 log CFU g^{-1} after 3 weeks when compared with control and other treatments. This may be due to the effect of *Moring oleifera* oil. It had antimicrobial activity which established by El-Sayed *et al.*[24] and Jahn *et al.*[29]. In control and treatment T1 with olive oil and treatment T3 with sunflower oil; coliform count increased gradually during storage period until 3 weeks. Moreover, *Moringa oleifera* oil is a best treatment than other treatments.

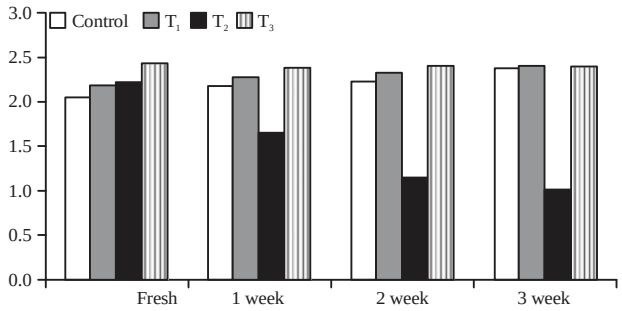

Fig. 2: Mould and yeast counts in soft white cheese manufactured by using different oils fresh and during cold storage (5°C+1)

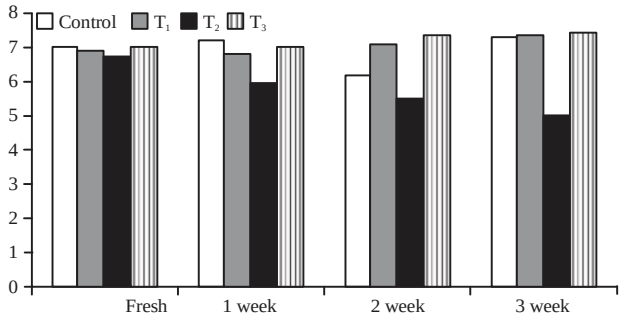

Fig. 3: Total bacteria counts in soft white cheese manufactured by using different oils fresh and during cold storage (5°C+1)

The data in Fig. 2 indicated that mould and yeast counts in soft white cheese manufactured by using different oils fresh and during storage at 5°C+1. Data observed that treatment with *Moringa oleifera* oil had less mould and yeast count during storage which reached to 1.00 log CFU g^{-1} at three weeks[2]. Whereas control and other treatments. The counts of mould and yeast gradually slight increased with storage period. This may be due to the effect of oil. El-Sayed *et al.*[24] established that *Moringa oleifera* had good antimicrobial properties against pathogenic and spoilage organisms that cause problem in dairy products and have ability to extend the shelf life of labneh.

Figure 3 showed total bacterial counts in soft white cheese manufactured by using different oils fresh and during cold storage (5°C+1). The results indicated that total counts gradually increased throughout the storage period in control and T1, T3 on the other hand T2 took an opposite trend. Total bacterial count gradually decreased during storage period until 3 weeks. This may be due to the effect of *Moringa oliefera* oil which has antimicrobial properties.

CONCLUSION

The use of *Moringa oleifera* oil in preparation of soft cheese with (1.5%) led to improve body and texture, flavour, than other oils (olive, sunflower) and increased the shelf life of cheese.

SIGNIFICANCE STATEMENTS

This study confirmed that *Moringa oleifera* oil is the best oil for manufacturing soft white cheese which has antimicrobial properties.

REFERENCES

1. Anwar, F., S. Latif, M. Ashraf and A.H. Gilani, 2007. *Moringa oleifera*: A food plant with multiple medicinal uses. Phytother. Res., 21: 17-25.
2. Ogbunugafor, H.A., F.U. Eneh, A.N. Ozumba, M.N. Igwo-Ezikpe and J. Okpuzor *et al.*, 2011. Physico-chemical and antioxidant properties of *Moringa oleifera* seed oil. Pak. J. Nutr., 10: 409-414.
3. Fuglie, L.J., 1999. The Miracle Tree: *Moringa Oleifera*, Natural Nutrition for the Tropics. Charch World Service, Dakkar, Senegal, Pages: 63.
4. Ramachandran, C., K.V. Peter and P.K. Gopalakrishnan, 1980. Drumstick (*Moringa oleifera*): A multipurpose Indian vegetable. Econ. Bot., 34: 276-283.
5. Ocakoglu, D., F. Tokatli, B. Ozen and F. Korel, 2009. Distribution of simple phenols, phenolic acids and flavonoids in Turkish monovarietal extra virgin olive oils for two harvest years. Food Chem., 113: 401-410.
6. Abbas, H.M., F.A.M. Hassan, J.M. Kassem, N.M. Rasmy, M.H. El-Kaluobi and M.F. El-Okaby, 2015. Preparation of cheese yoghurt using extracted high virgin olive oil. Int. J. Dairy Sci., 10: 288-296.
7. Abou Ayana, I.A.A. and A.A. Gamal El Deen, 2011. Improvement of the properties of goat's milk labneh using some aromatic and vegetable oils. Int. J. Dairy Sci., 6: 112-123.
8. Khaleel, E.M., 2000. Studies on milk and milk products. M.Sc. Thesis, Zagazig Universty, Egypt.
9. Belewu, M.A., M.F. Zubair, F.O. Ogunleke, I.O. Busari and A.A. El-Imam, 2012. Comparative evaluation of soft cheese treated with *Moringa oleifera* oil and pure natural honey. Int. J. Acad. Res., 4: 130-134.
10. Lalas, S. and J. Tsaknis, 2002. Extraction and identification of natural antioxidant from the seeds of the *Moringa oleifera* tree variety of Malawi. J. Am. Oil Chem. Soc., 79: 677-683.
11. Delaveau, P., 1980. Oils of *Moringa oleifera* and *Moringad rouhardii*. Planets Med. Phytotherapie, 14: 29-33.

12. AOAC., 2007. Association of Official Analytical Chemists Official Methods of Analysis. 18th End., AOAC, Washington, DC., USA.
13. Kosikowski, F.V., 1986. Cheese and Fermented Milk Products. 2nd Edn., Cornell University, Ithca, NY., USA.
14. AOAC., 2005. Official Methods of Analysis of Association of Official Analytical Chemists. 18th Edn., Association of Official Analytical Chemists, Gaithersburg, MD., USA.
15. IDF., 1969. Determination of the acid value of fat from butter. International Dairy Federation (IDF), Brussels.
16. Pearson, D., H. Egan, R.S. Kirk and R. Sawyer, 1981. Pearsons Chemical Analysis of Foods. 8th End., Longman Scientific and Technical, New York, USA., pp: 536-538.
17. Fahmi, A.H. and H.A. Sharara, 1950. Studies on Egyptian domiati cheese. J. Dairy Res., 17: 312-328.
18. APHA., 1992. Standard Methods for Examination of Dairy Products. 16th Edn., American Public Health Assiciation, Washington, DC., USA.
19. Mossel, D.A.A., 1985. Media for Enterobacteriaceae. Int. J. Food Microbial., 2: 27-32.
20. APHA., 1994. Standard Methods for Examination of Dairy Products. 16th Edn., American Public Health Association, Washington, DC., USA.
21. Scott, R., 1981. Cheese Making Practice. Applied Science Publisher Ltd., London.
22. SAS., 2004. Statistical Analysis System. SAS Institute Inc., Cary NC., USA.
23. Hassan, F.A.M., A.K. Enab, M.A.M. Abdel-Gawad, H.M. Bayoumi and Y.B. Youssef, 2017. Utilization of *Moringa oleifera* leaves powder in production of soft white cheese. Int. J. Dairy Sci., 12: 137-142.
24. El-Sayed, S.M., H.S. El-Sayed, H.H. Salama and S.A.H. Abo El-Nor, 2017. Improving the nutritional value and extending shelf life of labneh by adding *Moringa oleifera* oil. Int. J. Dairy Sci., 12: 81-92.
25. Hassan, F.A.M., H.M. Bayoumi, M.A.M. Abd El-Gawad, A.K. Enab and Y.B. Youssef, 2016. Utilization of *Moringa oleifera* leaves powder in production of yoghurt. Int. J. Dairy Sci., 11: 69-74.
26. Salem, A.S., W.M. Salama, A.M. Hassanein and H.M. El Ghandour, 2013. Enhancement of nutritional and biological values of Labneh by adding dry leaves of *Moringa oleifera* as innovative dairy products. World Applied Sci. J., 22: 1594-1602.
27. Abd El-Aziz, M., S.H.S. Mohamed, F.L. Seleet and M.A.M. Abd El-Gawad, 2007. Physicochemical characterization of Moringa conciseness seeds and seed oil. J. Am. Oil Chem. Soc., 84: 413-419.
28. El-Aziz, M.A., S.H. Mohamed, F.L. Seleet and M. Al, 2015. Effect of brine solution containing ginger extracts on the properties of Egyptian white brined chese. Am. J. Food Technol., 10: 37-47.
29. Jahn, S.A.A., H.A. Musnad and H. Burgstaller, 1986. The tree that purifies water: Cultivating multipurpose Moringaceae in the Sudan. Unasylva, 38: 23-28.