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Research Article
Utilization of *Moringa oleifera* Leaves Powder in Production of Soft White Cheese

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Abstract

Background: *Moringa oleifera* leaf (MOL) is a good source of protein, antioxidant and minerals, making it a suitable functional ingredient for improving nutritional and organoleptical properties of food products. *Moringa oleifera* dried leaves were used in manufacture of soft white chesses with different ratios (1, 2 and 3%), respectively. **Materials and Methods:** Resultant cheese with best ratio was analyzed chemically and organoliptically fresh and during cold storage at for 2, 4 and 6 weeks. **Results:** Results showed that 1% of *Moringa oleifera* dried leaves powder was a best ratio and a good appearance, body and texture and flavour. Chemically analysis showed that treatment (1% mol) had higher acidity and lower pH than control fresh or during cold storage until 6 weeks. Total solids, total protein/dry matter and fat/dry matter took the same trend of acidity. Also, it had a higher content of soluble nitrogen/total nitrogen percent, total volatile fatty acids, tyrosine, tryptophan than control either fresh or during cold storage. Control had a higher whiteness than treatment and gradually decreased during cold storage. Change of colour in treatment may be due to increased of dietary fiber of *Moringa oleifera*. **Conclusion:** Treatment had a highest content of glutamic acid, proline and leucine. *Moringa* leaves and resultants of white cheese had 17 amino acids.

Key words: *Moringa oleifera* leaves powder, soft whit cheese, sensory evaluation, amino acids

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

INTRODUCTION

Moringa leaves have been considered as a valuable source of β-carotene, potassium, iron, calcium, protein and vitamin C[1,2]. The calcium content in *Moringa oleifera* is more than that in milk and the micro-nutrient content is more concentrated in dried leaves. About 17 times the calcium of milk, 9 time the protein of yoghurt[3]. *Moringa* has been found to be a good source of polyphenols and antioxidants.

It's reported to be anticancer activities, prevention of cardiovuscular diseases and liver diseases[4]. *Moringa oleifera* leaves considered as a safe supplement because it is not toxic. In the recent days *Moringa* has gained much importance to its multipurpose and benefits to industry and agriculture and it plays a role in fighting malnutrition some parts of Africa.

Mukunzi *et al.*[5] reported that *Moringa oleifera* can be used to improve the nutritional and sensory evaluation of food by incorporating its extract into food products.

Furthermore, interest has grown in the utilization of *Moringa oleifera* in production of innovative foods by implementation of new product with cost reduction.

Several researches had been done to produce dairy products using dry leaves of *Moringa oleifera* suchas yoghurt[6], labneh[7], cottage cheese[8] and soft cheese[9].

The aim of this study is production of soft white cheese using *Moringa oleifera* dry leaves powder as a suitable functional ingredient for improving nutritional and sensory evaluation of soft white cheese.

MATERIALS AND METHODS

Fresh buffalo's milk was obtained from the herd of the faculty of Agriculture, Cairo University, Giza.

Moringa oleifera leaves obtained from *Moringa* laboratory at National Research Centre. It contains 27-1/100 g protein, 2-3/100 g fat, moisture 7.5%, carbohydrate 38.2%/100 g and fiber 19.2/100 g.

Preparation of *Moringa*: *Moringa* leaves dried and made in powder by rubbing them over a sieve and the leaves powder stored in plastic container.

Preparation of soft white cheese: Buffaloe's milk was divided into five portions.

First was applied as control and second, third, fourth and fifth were incorporating with 1, 1.5, 2 and 3%, respectively with *Moringa* leaves powder after coagulate; soft white cheese was manufactured according to Fahmi and Sharara[10].

The resultant cheese was analyzed for chemically and organoleptically properties fresh and during cold storage at (5±1°C) for (2, 4 and 6 weeks).

Preliminary study: Resultant soft white cheese with different ratios of *Moringa oleifra* leaves (1, 1.5, 2 and 3%) were evaluated by apanel of staff members at dairy laboratory N.R.C. for sensory evaluation to choose best ratio. The best ratio was analyzed fresh and during cold storage at (5±1°C) for (2, 4 and 6 weeks).

Analytical methods: Total solids, soluble nitrogen, total protein were determined according to AOAC[11]. The pH values were measured using a digital laboratory pH meter (H1 93/400, Hanna instruments) with glass electrode. Total Volatile Fatty Acids (TVFA) content was determined according to Kosikowski[12]. Soluble tyrosine and tryptophan were determined according to Vakaleris and Price[13], total amino acids according to Marino *et al.*[14].

Colour change was measured using a spectrocolorimeter (Tristimulus color Machine) with CJE lab color scale (Hunter, lab scan XE-Restos VA, USA) in the reflection mode. The color was expressed in terms of L, a and b where, L value represents darkness from black (0) to white (100), a value represent yellow (+) to blue (-).

Sensory evaluation: Cheese samples were sensory evaluated by the method described by Scott[15].

Statistical analysis: Statistical analysis was carried out using SAS[16] software and probability of ($p>0.05$) was used to establish statistical significance.

RESULTS AND DISCUSSION

Table 1 shows thatcontrol had gained ahighest score for appearance, body and texture and flavour than other treatments followed by treatment with 1% of *Moringa oliefera* leaves powder. Finally with 2 and 3%, respectively. Preliminary study show that soft white cheese manufactured by 1% *Moringa oliefera* leaves powder was a best ratio and had a good appearance, body and texture and flavour than other treatments furthermore the best treatments was storage and analyzed chemically and organoleptically fresh and during cold storage.

Table 2 indicated that controls had a higher score than treatment for sensory evaluation during cold storage at

Table 1: Sensory evaluation of resultant cheese

MOLP (%)	Appearance (10)	Body and texture (40)	Flavor (50)	Total (100)
Control	10	38	48	96
1	9	38	45	90
1.5	8	34	42	84
2	8	33	39	80
3	6	30	35	71

MOLP: *Moringa oleifera* leaves powder

Table 2: Sensory evaluation of soft white cheese manufacturing by using 1% *Moringa oliefera* leaves powder fresh and during cold storage at (5±1°C)

Properties	Storage period (weeks)	Control	Treatment	±SE
Appearance (10)	Fresh	10[a]	9[a]	0.307
	2	10[a]	8[a]	0.333
	4	9[a]	7[a]	0.577
	6	8[a]	6[a]	0.428
Body and texture (40)	Fresh	38[a]	36[a]	0.577
	2	37[a]	34[b]	0.763
	4	34[a]	32[a]	0.577
	6	30[a]	29[b]	0.491
Flavour (50)	Fresh	48[a]	45[b]	0.763
	2	46[a]	43[a]	0.764
	4	44[a]	40[b]	0.966
	6	41[a]	38[b]	0.763

Dissimilar superscripts at the same row (for treatments) and the same column (for storage periods) are significantly differed (p>0.05)

Table 3: Chemical composition changes of soft white cheese with *Moringa oleifera* dry leaves fresh and during cold storage (5±1°C)

Properties	Storage period (weeks)	Control	Treatment	±SE
TS (%)	Fresh	35.21[a]	35.46[a]	0.066
	2	35.42[a]	35.65[a]	0.344
	4	35.61[a]	36.10[a]	0.382
	6	36.00	38.45[a]	0.315
TP/DM (%)	Fresh	31.04 [a]	31.35[a]	0.200
	2	32.32[a]	32.38[a]	0.310
	4	32.56[a]	33.11[a]	0.377
	6	33.00[a]	33.98[a]	0.343
Fat/DM (%)	Fresh	37.09[a]	37.86[a]	0.199
	2	37.21[a]	37.88[a]	0.307
	4	37.42[a]	37.91[a]	0.229
	6	37.92[a]	38.01[a]	0.306

Each value is a mean of 3 replicates (Table 2), Ts: Total solid, TP: Total protein, DM: Dry matter

5±1°C. Scores for appearance gradually decreased during storage until 6 weeks. Also, body, texture and flavour took the same trend of appearance.

Statistical analysis shows that there is a significantly different between control and treatment fresh and during cold storage at p>0.05.

Figure 1 shows pH of soft white cheese with *Moringa olifera* dry leaves fresh and during cold storage. The pH is higher in control than treatment either fresh as during cold storage (5±1°C) .This may be due to the *Moringa oleifera* dry leaves. The pH gradually decreased during cold storage until 6 weeks either in control or treatment. Acidity took an

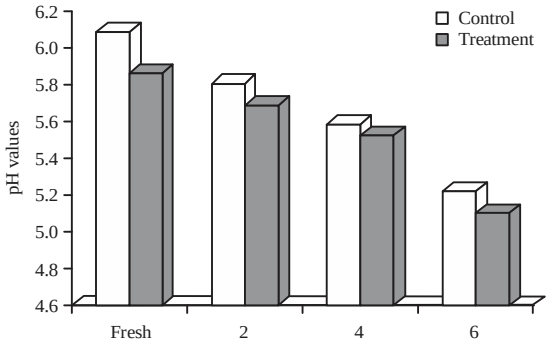

Fig. 1: pH of soft white cheese with *Moringa oleifera* dry leaves fresh and during cold storage at (5±1°C)

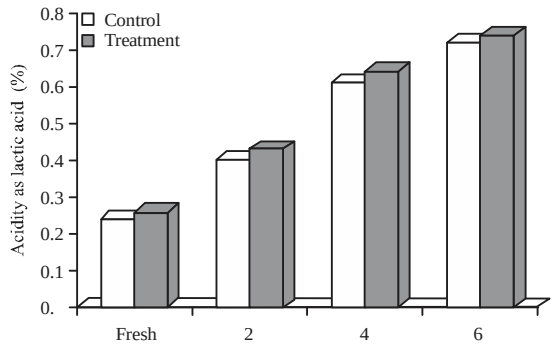

Fig. 2: Acidity of soft white cheese with *Moringa oleifera* dry leaves fresh and during cold storage at (5±1°C)

opposite trend of pH (Fig. 2). These results are in agreement to Hassan *et al*.[6] and Salem *et al*.[7].

Table 3 indicates total solids percentage of soft white cheese (control and treatment) fresh and during cold storage. Total solids are higher in treatment than control fresh and during cold storage. This may be due to the composition of *Moringa oliefera* dry leaves. Total solids increased gradually during storage until 6 weeks either control or treatment.

Total protein/dry matter and fat/dry matter are took the same trend of total solids either fresh as during cold storage until 6 weeks. These results are in agreement to Khalifa and Wahdan[17]. Statistical analysis shows that significantly differed between control and treatment and during cold storage at (5±1°C) at p>0.05 for total solids, total protein/dry matter and fat/dry matter.

Table 4 illustrate soluble nitrogen/total nitrogen (%), total volatile fatty acids as 0.1 mL of Na OH/100 g cheese, tyrosine and tryptophan mg/100 g cheese. It is clear that the best ratio (1%) had a higher soluble nitrogen/total nitrogen than control during cold storage.

The SN/TN percentage gradually increases during cold storage until 6 weeks in case of control and treatment. These

Table 4: Soluble nitrogen/total nitrogen percentage, total volatile fatty acids, tyrosine and tryptophan of soft white cheese with *Moringa oleifera* dry leaves fresh and during cold storage at 5±1°C

Properties	Storage period (weeks)	Control	Treatment	±SE
SN/TN%	Fresh	6.56[a]	7.95[a]	0.440
	2	6.81[a]	7.12[a]	0.385
	4	12.92[a]	14.23[a]	0.516
	6	15.82[a]	16.11[a]	0.364
TVFA 0.1 N Na OH/100 g cheese	Fresh	7.806[b]	7.46[a]	0.157
	2	9.44[b]	10.24[a]	0.181
	4	11.82[b]	12.43[a]	0.139
	6	12.44[a]	13.11[a]	0.482
Tyrosine mg/100 g cheese	Fresh	4.19[b]	6.34[a]	0.567
	2	7.21[a]	8.32[a]	0.301
	4	10.35[b]	12.40[a]	0.553
	6	12.22[b]	14.37[a]	0.545
Tryptophan mg/100 g cheese	Fresh	3.82[a]	4.93[a]	0.363
	2	8.53[a]	8.90[a]	0.291
	4	11.43[b]	13.60[a]	0.559
	6	13.53[a]	17.95[a]	0.344

Each value is a mean of 3 replicates (Table 2), SN: Soluble nitrogen and TN: Total nitrogen

Table 5: Colour changes of soft white cheese with *Moringa oliefera* leaves powder fresh and during storage period at 5±1°C

Samples	L*	a*	b*
Fresh			
*C	85.22[a]	-2.15[a]	20.00[a]
*T	81.03[b]	-1.92[a]	22.11[a]
±SE	1.009	0.265	0.545
2 Weeks			
C	84.87[a]	-2.17[a]	21.78[a]
T	80.34[b]	-1.98[a]	23.82[a]
±SE	1.067	0.843	0.578
4 Weeks			
C	82.16[a]	-2.49[a]	22.64[b]
T	79.05[b]	-2.01[a]	24.93[a]
±SE	0.764	0.369	0.633
6 Weeks			
C	80.23[a]	-2.54[b]	23.34[a]
T	77.95[a]	-2.02[a]	25.02[a]
±SE	1.821	0.082	0.473

C: Control, T: Treatment, L*: Darkness from black (0) to white (100), a: Colour ranged from red (+) to green (-), b: Value represent yellow (+) to blue (-). Dissimilar subscribes 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

results are in the same to Khalifa and Wahdan[17] and Ismail *et al.*[18] who reported that increasing soluble nitrogen throughout the ripening period may be due to the protein breakdown occurred by activities of microflora or proteolysis with proteolysis enzyme.

Table 4 shows total volatile content in control and treatment. Control had a lower content of TVFA than treatment in fresh and during cold storage. The TVFA increased gradually during cold storage until 6 weeks in both control and treatment. These results are in the same line with Abd El-Gawad[19].

Table 4 shows that control had lower content of tyrosine (mg/100 g cheese) and tryptophan (mg/100 g cheese) than treatment fresh and during cold storage. Tyrosine and tryptophan gradually increased during cold storage until 6 weeks as a result of proteolysis.

These results are in agreement to Abd El-Gawad and Hassan[20]. Statistically analysis show that a significantly differed between control and treatment at ($p>0.05$) and during cold storage at 5±1°C for soluble nitrogen total nitrogen, total volatile fatty acids, tyrosine and tryptophan.

Table 5 shows colour change of control and treatment of soft white cheese. Control had a higher whiteness (L) than treatment either fresh or during cold storage at 5±1°C values of whiteness (L) gradually decreased during cold storage until 6 weeks.

These results were agreement to Hassan *et al.*[6] who found that yoghurt manufactured by using 0.5% *Moringa olifera* leaves powder had a change of colour during cold storage. b represent yellow (+) to blue (-) had ahigher value in treatment than control. Values gradually increase during cold storage until 6 weeks. a represent colour ranged from red (+) to green (-) had ahigher value in control than treatment either fresh or during cold storage. Values of a gradually increased during cold storage at (5±1°C) until the end of storage. Saricoban and Yilmaz[21] reported that change of colour in treatment which fortified with *Moringa* due to increase of dietary fiber of *Moringa*. Statistical analysis show that differences in L values between control and treatment significantly fresh and during cold storage at ($p<0.05$). Table 6 illustrate the amino acids content in soft white cheese manufacture with (1%) *Moringa oleifera* leaves powder. It is clear that soft white cheese had a highest content of glutamic acid (8.67%) followed by proline (4.05%) and leucine (3.75%) whereas it had a lowest content of methionine (0.99%), glycine (0.81%) and histidine (1.17%). Resultant cheese had a higher content of amino acids than that in leaves of dried *Moringa*.

Table 6: Amino acids composition of dried *Moringa oleifera* leaves and resultant soft white cheese with 1% *Moringa oleifera* leaves powder

Amino acids	*Moringa oleifera* leaves	Soft white cheese
Aspartic acid	1.38	3.06
Thereonine	1.42	1.78
Serine	1.05	2.06
Glutamic acid	2.43	8.67
Glycine	0.53	0.81
Alanine	1.12	1.52
Valine	1.45	2.51
Isoleucine	1.17	2.04
Leucine	1.97	3.75
Tyrosine	1.30	2.02
Phenylalanine	1.60	1.98
Histidine	0.71	1.17
Lysine	1.61	3.18
Arginine	1.12	1.43
Proline	1.30	4.05
Cysteine	0.21	1.17
Methionine	0.43	0.99

Sanchez-Machado *et al.*[22] reported that the variations in the amino acids composition could be influenced by protein quality and the origin of the plant (Cultivated or Wild). Also, it is shown that leucine in leaves having highest value of (0.75%) which is lower than our findings (1.97%).

Moringa leaves and resultant soft white cheese had 17 amino acids which is the same findings of Hassan *et al.*[6] and differ from the findings of Foidl *et al.*[23] and Sanchez-Machado *et al.*[22] who reported 18 and 16 amino acids, respectively.

CONCLUSION

About 1% *Moringa oleifera* leaves powder was a suitable functional ingredient for improving nutritional and organoleptic properties of soft white cheese. Resultant soft white cheese was preferred and was more acceptable than control.

Moringa oleifera leaves powder led to increase the nutritional value of resultant cheese.

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. Thurber, M.D. and J.W. Fahey, 2009. Adoption of *Moringa oleifera* to combat under-nutrition viewed through the lens of the diffusion of innovations theory. Ecol. Food Nutr., 48: 212-225.
3. Mahmood, K.T., T. Mugal and I.U. Haq, 2010. *Moringa oleifera*: A natural gift-A review. J. Pharmaceut. Sci. Res., 2: 775-781.
4. Kumar, N.A. and L. Pari, 2003. Antioxidant action of *Moringa oleifera* Lam. (Drumstick) against antitubercular drugs induced lipid peroxidation in rats. J. Med. Food, 6: 255-259.
5. Mukunzi, D., J. Nsor-Atindana, Z. Xiaoming, A. Gahungu, E. Karangwa and G. Mukamurezi, 2011. Comparison of volatile profile of *Moringa oleifera* leaves from Rwanda and China using HS-SPME. Pak. J. Nutr., 10: 602-608.
6. 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.
7. 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.
8. Mahami, T., F.C.K. Ocloo, S.T. Odonkor, C. Owulah and S.A. Coffie, 2012. Preliminary study on the influence of *Moringa* seed extracts supplementation on the yield and quality of cottage cheese. Int. J. Recent Trends Sci. Technol., 2: 4-8.
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. Fahmi, A.H. and H.A. Sharara, 1950. Studies on Egyptian domiati cheese. J. Dairy Res., 17: 312-318.
11. AOAC., 2007. Association of Official Analytical Chemists Official Methods of Analysis. 18th Edn., AOAC Benjamin Frankin Station, Washington, DC., USA.
12. Kosikowski, E.V., 1987. Cheese and Fermented Milk Products. 2nd Edn., Cornell University, Ithca, NY., USA.
13. Vakaleris, D.G. and W.V. Price, 1959. A rapid spectrophotometric method for measuring cheese ripening. J. Dairy Sci., 42: 264-276.
14. Marino, R., M. Iammarino, A. Santillo, M. Muscarella, M. Caroprese and M. Albenzio, 2010. Technical note: Rapid method for determination of amino acids in milk. J. Dairy Sci., 93: 2367-2370.
15. Scott, R., 1981. Cheese Making Practice. Applied Sci. Publisher Ltd., London.
16. SAS., 2004. SAS User's Guide: Version 9.1. SAS Institute Inc., Cary, NC., USA.
17. Khalifa, S.A. and K.M. Wahdan, 2015. Improving the quality characteristics of white soft cheese using cranberry (*Vaccinium macrocarpon*) fruit extract. Int. Food Res. J., 22: 2203-2211.
18. Ismail, A.M., S.E. Harby and A.S. Salem, 2006. Production of flavoured labneh with extended shelf life. Egypt. J. Dairy Sci., 34: 59-68.

19. Abd El-Gawad, M.A.M., 2009. Enhancement of white soft cheese ripening made from buffaloes' milk retentate through addition of commercial preparation of yeast extract. Egypt. J. Dairy Sci., 37: 65-72.
20. Abd El-Gawad, M.A.M. and F.A.M. Hassan, 2000. Manufacture of low fat soft white cheese by using fat replacers. Arab Univ. J. Agric. Sci., 8: 253-261.
21. Saricoban, C. and M.T. Yilmaz, 2010. Modelling the effects of processing factors on the changes in colour parameters of cooked meatballs using response surface methodology. World Applied Sci. J., 9: 14-22.
22. Sanchez-Machado, D.I., J.A. Nunez-Gastelum, C. Reyes-Moreno, B. Ramirez-Wong and J. Lopez-Cervantes, 2010. Nutritional quality of edible parts of *Moringa oleifera*. Food Anal. Methods, 3: 175-180.
23. Foidl, N., H.P.S. Makkar and K. Becker, 2001. The potential of *Moringa oleifera* for agricultured and industrial uses. Proceedings of the International Workshop on Development Potential for Moringa Products, October 20-November 2, 2001, Dar es Salaam, Tanzania, pp: 45-76.