PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 9 (4): 314-319, 2010
ISSN 1680-5194

Utilization of Groundnut Milk in Manufacturing Spread Cheese

Kamal Awad Abdel Razig[1] and Asma Mustafa Yousif[2]
[1]Department of Food Science and Technology, Faculty of Agriculture,
Al-Zaeim Al-Azhari University, P.O. Box 1432, Khartoum North, 13311, Sudan
[2]Industrial Research and Consultancy Centre, Sudan

Abstract: The utilization of groundnut milk in manufacturing the spread cheese in Sudan was investigated. Groundnut milk was prepared from grinded groundnut seeds. Four samples of spread cheese were prepared from groundnut milk with different levels of skim milk powder 0, 5, 10 and 15. The prepared spread cheese samples were stored for 6 months at 30±2°C. Analyses of chemical composition were carried on prepared spread cheese samples and the analyses were carried out at intervals 0, 1, 2, 3, 4, 5 and 6 months during storage period. The chemical analyses of spread cheese samples at zero time processing were for total solids 35.79, 37.91, 39.59 and 41.49%, the protein content 12.82, 14.35, 15.98 and 17.56%, the fat content 14.98, 14.99, 14.99 and 15.0%, the ash content 4.16, 4.18, 4.21 and 4.23% for samples A, B, C and D respectively. The pH was affected by the levels of skim milk powder and storage period. The levels of skim milk powder significantly ($p \leq 0.05$) affected the pH value of the spread cheese. Sample D (15% skim milk powder) recorded the lowest (5.14) and sample A (0% skim milk powder) the highest (5.60). Sample B (5% skim milk powder) and sample C (10% skim milk powder) were at an intermediate position (5.56 and 5.45), respectively. Storage period significantly ($p \leq 0.05$) affected the pH value of spread cheese the highest value (5.44) at the beginning of the storage period, while the lowest value (3.91) at the end of the storage period. The titratable acidity was affected by the levels of skim milk powder and storage period. The levels of skim milk powder significantly ($p \leq 0.05$) affected the titratable acidity of the spread cheese. Sample D (15% skim milk powder) was the highest, while sample A (0% skim milk powder) was the lowest. Sample B (5% skim milk powder) and sample C (10% skim milk powder) occupy an intermediate position. Storage period significantly ($p \leq 0.05$) affected the titratable acidity of spread cheese. The highest titratable acidity (2.09%) obtained at the end of storage period and the lowest (0.64%) at the beginning of the storage period. The best score of appearance, texture, flavour and overall acceptability obtained by sample B (5% skim milk powder), compared with others samples. Three months is found to be quite satisfactory to attain good quality spread cheese.

Key words: Groundnut milk, spread cheese, storage, skim milk powder

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a major source of edible oil and protein meal and therefore considered to be highly valuable in human and animal nutrition (Nwokalo, 1996). Since groundnut has a potential role to play in combating malnutrition, the present low level in its consumption, especially in the developing countries, should be increased. It is, therefore, necessary to adequately research into the possibility of groundnut processing into other useful and edible products. Fermentation of groundnut milk may serve as one such effort than can increase the protein availability and consumption (Roberts-Sunny *et al*., 2004).

Spread cheese means cheese which has been subjected to a process of melting and mixing with milk products other than the cheese, with or without the addition of emulsifying salts. Spread cheese has currently increased in the Sudan, although originally, it is a main meal supplement in countries where such a food has not been customarily used (particularly the Asian countries). Most spreadable cheese products are made from dairy products derived from cow milk patents (Tamime *et al*., 1999).

This group of cheese products differ from natural cheeses in that, they are made directly from milk, but rather from various ingredients such as natural cheese, skim milk, water, butter oil, casein caseinate other dairy ingredients, vegetable oil, and from vegetable proteins and minor ingredients. The two main categories are namely pasteurized processed cheese products and substitute or imitation products (Patrick *et al*., 2000).

Due to the high cost of milk in Sudan, which ultimately increases the cost of milk products, other alternatives are currently being sought in order to process nutritionally acceptable fermented dairy products, such as groundnut milk.

No attempt has been made in the Sudan to study the manufacture of spread cheese. The objectives of this

Corresponding Author: Kamal Awad Abdel Razig, Department of Food Science and Technology, Faculty of Agriculture, Al-Zaeim Al-Azhari University, P.O. Box 1432, Khartoum North, 13311, Sudan

work are to prepare the milk from groundnut and to study their effect on quality of spread cheese as affected by level of skim milk powder during storage period.

MATERIALS AND METHODS

Groundnut seeds, skim milk powder and salt were obtained from the local market. Bulk culture (*Lactobacillus bulgaricus* and *Streptococcus thermophilus*) were obtained from the Blue Nile Dairy Product Company (Capo). Rennet (chr. Hansen's, Denmark) were obtained from the local market.

Preparation of groundnut milk: Groundnut milk was prepared from kernels previously soaked in 1% sodium bicarbonate solution for 16-18 h, drained, washed with tap water, grinded and steeped for 4-5 h in tap water (100 g of groundnut mixed with 750 ml tap water). The mixture was then filtrated by cheese cloth, to obtain the groundnut milk.

Preparation of spread cheese samples: The prepared groundnut milk were heated to 70°C for 10 min and then cooled to 45°C. Skim milk powder(0, 5, 10 and 15%) and 10% of starter culture were added to the milk. 0.5 gm; rennet powder added to the mix and incubated at 45°C for 6 h, after that the mix was filtrated thoroughly cheese cloth. The curd mix was cooked to 70°C for 30 min with addition of 5% whey and mixed. The spread cheese was packed in glass container and stored at 30±2°C.

Chemical analysis: The content of moisture, protein, fat, ash, pH value and titratable acidity were carried out according to AOAC (1995).

Sensory evaluation: The sensory evaluation was performed by 10 untrained panelists using scoring procedure according to Drake *et al.* (2003).

Statistical analysis: The statistical analysis was carried out by computer using SAS pogramme 1997.

RESULTS AND DISCUSSION

Groundnut milk: The results of chemical properties of groundnut milk were of total solids (9.39%), pH-value (6.7), titratable acidity (0.10%), protein content (3.64%) fat content (2.95%) and ash content (0.85%). These results fairly agree with that of Hinds *et al.* (1997) who concluded that, the groundnut milk contained 11.8% total solids, 2.0% fat and 3.71% protein. Roberts-Sunny (2007) stated 2.8% fat content while, Graham (1970) found 3.48% protein content in groundnut milk. Vargas *et al.* (1998) reported that, the physic-chemical composition of Argentinean groundnut milk, to have pH-value, total solids, protein, lipids and ash contents to be 7.12, 9.10, 2.97, 4.24 and 0.2%, respectively. Variation in the results could be due to the origin of groundnut and to the processing condition (Lee and Beuchat, 1992).

Chemical properties of spread cheese: Physicochemical properties of spread cheese made by groundnut milk at zero time are presented in (Table 1). The total solid of spread cheese made from groundnut milk at zero time was affected by the levels of skim milk powder. The level of skim milk powder significantly ($p \leq 0.05$) affected the total solids of the spread cheese. Sample D (15% skim milk powder) recorded the highest content of total solids (41.49%) compared with sample A (0% skim milk powder), that gave the lowest content (35.79%). Samples B and C show an intermediate position. Salem *et al.* (1987) found that the total solids of processed spread cheese ranged from 56.02-61.12%. Gouda and El-Shibiny (1987) reported that, the total solids of processed spread cheese spread using ultrafiltered dried skim milk ranged from 35.40-41.31%. Abdel-Baky *et al.* (1987) stated that, the total solids of processed spread cheese manufacture from ras cheese ranged from 44.15-45.00%. Tamime *et al.* (1999) found the total solids of processed spread cheese ranged from 34.2-44.4%. Abd-Rabo *et al.* (2004) reported that, the total solids content of spread cheese ranged from 51.67-54.79%.

The protein content of spread cheese made from groundnut milk at zero time was affected by the levels of skim milk powder. The levels of skim milk powder significantly ($p \leq 0.05$) affected the protein content of the spread cheese (Table 1). Sample D (15% skim milk powder) was the highest (17.56%) and sample A (0% skim milk powder) was the lowest (12.82%). Sample B (5% skim milk powder) and sample C (10% skim milk powder) showed an in intermediate position (14.35%, 15.98%, respectively). Tamime *et al.* (1999) found that, the protein content of processed spread cheese ranged from 11.6-14.4%. Salem *et al.* (1987) reported that the protein content of processed spread cheese were increased with increasing the ratio of whey powder. Kebray *et al.* (1998); Abd-EL-Salam *et al.* (1996); Khader *et al.* (1997) and Mahfouz *et al.* (1986) reported that the protein content of processed spread cheese ranged from 16.2-20.09%. Gouda and El-Shibiny (1987) concluded that the protein content of processed spread cheese increased with increasing the ratio of skim milk powder. Salem *et al.* (1987) reported that the protein contents of processed spread cheese were increased with increasing the ratio of whey powder. Kebray *et al.* (2001) found positive correlation between the protein content of spread cheese and the rate of whey powder.

The fat of spread cheese retained from different samples was nearly the same (Table 1). Salem *et al.* (1987) found that the fat content of low fat processed cheese varied from 9.0-12.0%. Kebray *et al.* (1998) concluded that, the fat content of low fat processed spread cheese ranged from 11.2-19.6%. Tamime *et al.* (1999) reported that, the fat content of processed cheese varied from 12.0-22.8%. Kebray *et al.* (2001) found that the fat content of low fat processed spread cheese ranged from 14.3-15.0%.

Table 1: Chemical composition* of spread cheese made by groundnut milk at zero time

	Samples			
Parameter	A	B	C	D
Total solids (%)	35.79±0.18^{d}	37.91±0.13^{c}	39.59±0.16^{b}	41.49±0.14^{a}
Protein content (%)	12.82±0.09^{d}	14.35±0.05^{c}	15.98±0.07^{b}	17.56±0.06^{a}
Fat content (%)	14.98±0.07^{a}	14.99±0.03^{a}	14.99±0.02^{a}	15.00±0.01^{a}
Ash content (%)	4.16±0.02^{ab}	4.18±0.06^{ab}	4.21±0.01^{a}	4.23±0.04^{a}

*Mean±S.D having different superscript letter in rows differ significantly ($p \leq 0.05$)
A = Spread cheese prepared from groundnut milk and 0% skim milk powder
B = Spread cheese prepared from groundnut milk and of 5% skim milk powder
C = Spread cheese prepared from groundnut milk and 10% skim milk powder
D = Spread cheese prepared from groundnut milk and 15% skim milk powder

Table 2: Effect of level of skim milk powder on pH-value* and titratable acidity* (as % lactic acid) of spread cheese

	Level of skim milk powder			
Quality attribute	0%	5%	10%	15%
pH-value	4.76^{a}±0.11	4.72^{ab}±0.03	4.61^{b}±0.01	4.40^{bc}±0.07
Titratable acidity	1.34^{c}±0.02	1.35^{c}±0.05	1.40^{b}±0.03	1.60^{a}±0.01

*Mean±SD having different superscript letters in rows are significantly different ($p \leq 0.05$)

The level of skim milk powder significantly ($p \leq 0.05$) affected the ash content of the spread cheese (Table 1). Sample D (15% skim milk powder) was the highest (4.32%). Sample A (0% skim milk powder) was the lowest (4.16%) with sample B (5% skim milk powder) and sample C (10% skim milk powder) occupy an intermediate position (4.18,4.21%, respectively). Tamime *et al.* (1999) found that ash content of processed spread cheese ranged from 3.0-4.0%.

The levels of skim milk powder significantly ($p \leq 0.05$) affected the pH-value of the spread cheese (Table 1). Sample D (15% skim milk powder) was the lowest (5.14) and sample A (0% skim milk powder) was the highest (5.60). Sample B (5% skim milk powder) and sample C (10% skim milk powder) occurred at an intermediate position (5.56 and 5.45), respectively.

Storage period significantly ($p \leq 0.05$) affected the pH-value of spread cheese (Table 3 and Fig. 1); the highest value (5.44) was obtained at the beginning of the storage period, while the lowest value (3.91) was obtained at the end of the storage period. Abdel-Baky *et al.* (1987) found that, the pH-value of processed spread cheese during storage at 4-5°C and at 20-25°C were 5.60 and 5.50, respectively. Salem *et al.* (1987) reported that, the pH-value of local-low fat processed cheese ranged from 5.95-5.70. Kebray *et al.* (1998) stated that, the pH-value of spread cheese decreased slightly as storage period progressed. Tamime *et al.* (1999) stated that, the pH-value of processed cheese analogues during storage at 5°C ranged from 5.91-5.85. Bisht and Jha (1999) found that the pH-value of spread cheese from acidified milk curd stored at 5°C was 5.32. Abd Rabo *et al.* (2004) concluded that, the pH-value of full-fat processed spread cheese ranged from 5.63-5.75.

Table 2 show the titratable acidity (as % lactic acid) as affected by the level of skim milk powder of spread cheese samples made from groundnut milk. The levels of skim milk powder significantly ($p \leq 0.05$) affected the

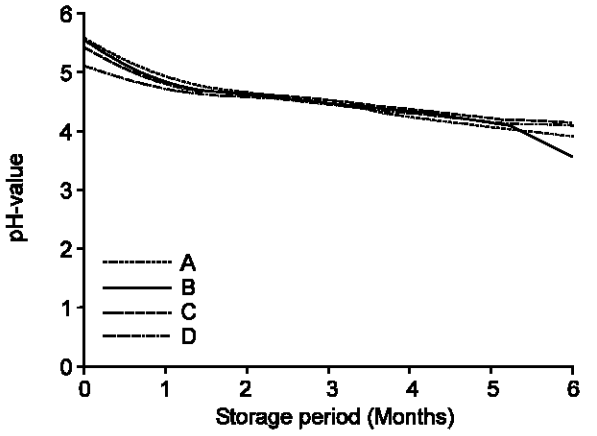

Fig. 1: Effect of storage period on pH-value of spread cheese

titratable acidity of the spread cheese. Sample D (15% skim milk powder) was the highest, while sample A (0% skim milk powder) was the lowest, with sample B (5% skim milk powder) and sample C (10% skim milk powder) being in an intermediate position.

Storage period significantly ($p \leq 0.05$) affected the titratable acidity of spread cheese (Table 3 and Fig. 2), the highest acidity (2.09%) was obtained at the end of storage period; the lowest acidity (0.64%) at the beginning of the storage period. Salem *et al.* (1987) reported that, the titratable acidity of low fat locally processed cheese increased with increasing the amount of denatured whey protein. Bisht and Jha (1999) found (0.38%) titratable acidity of spread cheese.

Organoleptic quality of spread cheese: The organoleptic quality of spread cheese made by groundnut milk was found to be affected by the levels of skim milk and storage period.

Table 3: Effect of storage period on pH-value* and titratable acidity (as % lactic acid)* of spread cheese

	Storage period (months)						
Quality attribute	0	1	2	3	4	5	6
pH-value	5.44^{a}±0.04	5.18^{b}±0.02	4.95^{c}±0.01	4.69^{d}±0.03	4.43^{e}±0.05	4.17^{f}±0.07	3.91^{g}±0.06
Titratable acidity	0.64^{g}±0.02	0.89^{f}±0.03	1.13^{e}±0.08	1.38^{d}±0.09	1.62^{c}±0.01	1.84^{b}±0.04	2.08^{a}±0.07

*Mean±SD having different superscript letters in rows are significantly different ($p \leq 0.05$)

Table 4: Effect of level of skim milk powder on organoleptic quality* of spread cheese

	Level of skim milk powder			
Quality attribute	0%	5%	10%	15%
Appearance	4.37^{c}±0.02	4.57^{a}±0.04	4.52^{b}±0.07	4.50^{b}±0.09
Texture	4.22^{c}±0.01	4.53^{a}±0.08	4.45^{b}±0.06	4.41^{b}±0.02
Flavour	4.30^{b}±0.07	4.47^{a}±0.02	4.46^{a}±0.05	4.45^{a}±0.03
Overall acceptability	4.29^{d}±0.06	4.53^{a}±0.01	4.47^{b}±0.04	4.36^{c}±0.03

*Mean±SD having different superscript letters in rows are significantly different ($p \leq 0.05$)

Results in Table 4 showed the effect of level of skim milk powder on organoleptic quality of spread cheese. B sample containing 5% skim milk powder significantly ($p \leq 0.05$) secured the best appearance (4.57) while other samples of spread cheese made with 10% and 15% skim milk powder scored 4.52 and 4.50 respectively. The worst appearance was recorded by spread cheese made with 0% skim milk powder (4.37).

Storage period significantly ($p \leq 0.05$) affected the appearance of the spread cheese (Table 5 and Fig. 3), the best score (4.63) was obtained at the 3rd month and the worst (4.30) at beginning of the storage period. Abdel -Baky *et al.* (1987) stated that, the processed spread cheese made from ras cheese revealed better flavour and appearance during storage at both refrigerator and at room temperatures. Kebray *et al.* (1998) reported that, the scores of organoleptic properties of spread cheese made from different blends decreased as storage period progressed except the scores of colour.

Results in Table 4 show the texture score of the spread cheese. Sample B (5% skim milk powder) significantly ($p \leq 0.05$) secured the best texture (4.53) followed by sample C made with 10% skim milk powder (4.45) and sample made with 15% skim milk powder (4.40). The worst texture (4.22) was recorded by sample A made with 0% skim milk powder.

Storage period significantly ($p \leq 0.05$) affected the texture of the spread cheese (Table 5 and Fig. 4), the best score (4.56) was obtained at the 3rd month, the worst texture (4.24) was obtained at the end of the storage period.

Results in Table 4 show the flavour score of the spread cheese. Samples B, C and D (5, 10 and 15% skim milk powder) significantly ($p \leq 0.05$) secured the best flavour (4.47, 4.47 and 4.36, respectively), the worst flavour (4.3) was recorded by sample A made with 0% skim milk powder. Storage period significantly ($p \leq 0.05$) affected the flavour of the spread cheese (Table 5 and Fig. 5), the best score (4.58) was obtained at the 3rd month and the worst score (4.26) was obtained at the end of the storage period. Abdel-Baky *et al.* (1987) stated that, the processed spread cheese made from ras cheese revealed better flavour and appearance during storage at both refrigerator and at room temperatures.

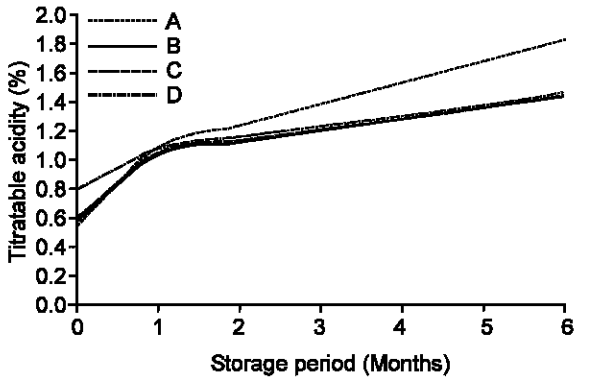

Fig. 2: Effect of storage period on titratable acidity of spread cheese

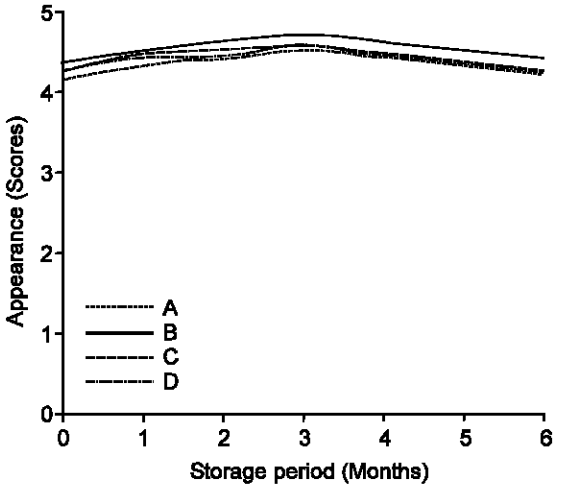

Fig. 3: Effect of storage period on appearance of spread cheese

Table 5: Effect of storage period on organoleptic quality* of spread cheese

	Storage period (months)						
Quality attribute	0	1	2	3	4	5	6
Appearance	4.30^{a}±0.02	4.46^{c}±0.08	4.53^{b}±0.03	4.63^{a}±0.05	4.51^{b}±0.04	4.41^{d}±0.01	4.44^{cd}±0.06
Texture	4.30^{d}±0.07	4.40^{c}±0.08	4.50^{b}±0.09	4.56^{a}±0.06	4.56^{a}±0.07	4.34^{cd}±0.02	4.24^{e}±0.01
Flavour	4.30^{e}±0.11	4.40^{c}±0.02	4.46^{b}±0.01	4.58^{a}±0.05	4.46^{b}±0.06	4.36^{d}±0.12	4.26^{e}±0.09
Overall acceptability	4.31^{cd}±0.06	4.40^{c}±0.09	4.51^{a}±0.08	4.59^{ab}±0.03	4.56^{b}±0.04	4.38^{d}±0.03	4.28^{e}±0.01

*Mean±SD having different superscript letters in rows are significantly different ($p \leq 0.05$)

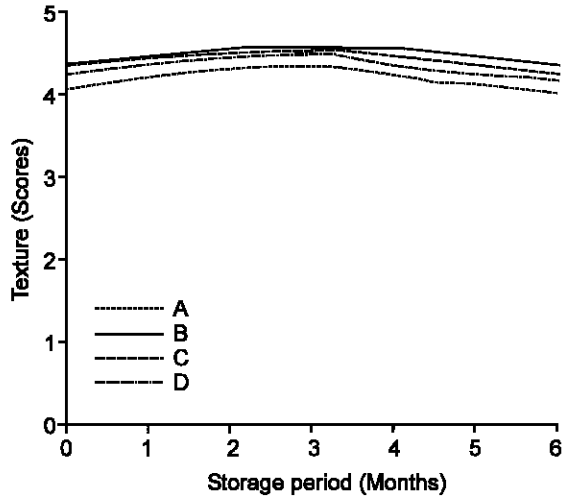

Fig. 4: Effect of storage period on texture of spread cheese

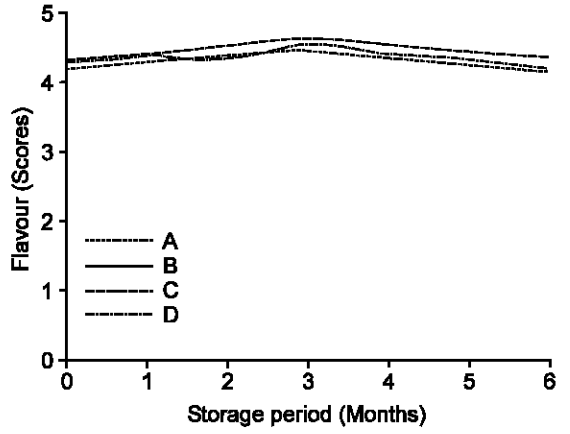

Fig. 5: Effect of storage period on flavour of spread cheese

Results in Table 4 show the overall acceptability of the spread cheese. Sample B (5% skim milk powder) significantly ($p \leq 0.05$) secured the best (4.53) acceptability and the worst (4.29) was recorded by sample A made with 0% skim milk powder.

Storage period significantly ($p \leq 0.05$) affected the acceptability of the spread cheese (Table 5 and Fig. 6), the best score (4.59) was obtained at the 3rd month and the worst value (4.28) was obtained at the end of the storage period. Salem *et al.* (1987) found that, the

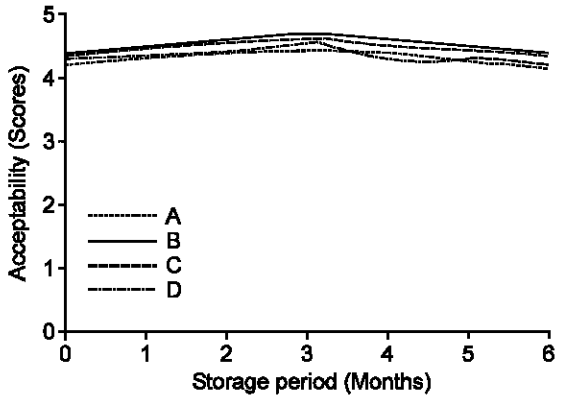

Fig. 6: Effect of storage period on acceptability of spread cheese

processed cheese prepared from milk fortified with whey protein gave a good and higher score than that of the control. Abdel-Baky *et al.* (1987) stated that, the processed spread cheese made from ras cheese revealed better flavour and appearance during storage at both refrigerator and room temperatures.

REFERENCES

Abdel-Baky, A.A., A.A. El-Neshawy and S.M. Farahat, 1987. The use of ras cheese made by direct acidification in the manufacture of processed cheese spread. Egyptian J. Dairy Sci., 15: 273-285.

Abd-El-Salam, M.H., A.F. Al-Khamy, G.A. El-Garawany, A. Hamed and A. Khader, 1996. Composition and rheological properties of processed cheese spread as affected by the level of added whey protein concentrates and emulsifying salt. Egyptian J. Dairy Sci., 24: 309-322.

Abd-Rabo, M.A., H.R. Fawzia, M.A. El-Asser and M. Mahassen, 2004. Characterization of low-fat proceeds cheddar cheese spreads prepared from mixture of buffaloes and cow's milk. The 9th Egyptian Conf. for Dairy Sci., Tech. "Milk and Dairy products for a Healthy Future", Dokki, Cairo, Egypt.

AOAC, 1995. Method of the Analysis of Official Analyst Chemists 15th Edn. Washington.

Bisht, R.S. and Y.K. Jha, 1999. Storage stability of cheese spread from acidified milk curd. J. Food Sci. Technol., 36: 15-18.

Drake, M.A., Y.K.R. Karagul-Yuccer, C.V. Civille and P.S. Tong, 2003. Determination ingredients. J. Sensory Stud., 18: 199-216.

Gouda, E. and S. El-Shibiny, 1987. The use of ultra-filtered skim milk in the manufacture of processed cheese spread. Egyptian J. Dairy Sci., 15: 255-262.

Graham, D.M., 1970. Industrial view of imitation milk products. J. Dairy Sci., 53: 103-105.

Hinds, M.J., L.R. Beuchart and M.S. Chinnan, 1997. Effects of homogenization pressure and stabilizers on some physical characteristics of a beverage prepared from partially defatted, roasted peanuts. J. Plant Hum. Nutr. (Formerly Qualitas Plantarum), 50: 269-277.

Kebray, K.M.K., A.M. Ahmed and R.M. Badawi, 1998. Impact of fat replacers on properties of low fat processed cheese spread. Proc. 8th Egyptian Conf. Dairy Sci. Tech., 383-401.

Kebray, K.M.K., S.A. Hussein and R.M. Badawi, 2001. The use of whey protein in flavored low-fat processed cheese spread. Proc. 8th Egyptian Conf. Dairy Sci. and Technol., 369-381.

Khader, A., A. Hamed, A.F. Al-Khamy, G.A. El-Garawany and M.M. Abd El-Salam, 1997. Chemical composition and some properties of market processed cheese. Egyptian J. Dairy Sci., 25: 269-279.

Lee, C. and L.R. Beuchat, 1992. Chemical, physical and sensory characteristics of peanut milk as affected by processing conditions. J. Food Sci., 57: 401-405.

Mahfouz, M.B., H.F. El-Dien, S. El-Shibiny, H.F. Maggag and M.N. Mahgoub, 1986. Chemical and microbiological quality of market processed cheese. Egyptian J. Dairy Sci., 14: 33-41.

Nwokalo, E., 1996. Peanut (*Arachis lypogaea* L.) In: Nwokolo E, Mart, J.S. (Eds.). Legumes and oil seeds in nutrition. Chapman and Hall, London, P49.

Patrick, F., P.G. Timothy, T.M. Cogan and L.H. Paul, 2000. Fundamental of Cheese Science. Aspen Publishers, Inc. Gaithersburg, Maryland.

Roberts-Sunny, E.O., 2007. An evaluation of the nutritional and physicochemical properties of candies from imitation milks. University of Kassel-Witzenhausen and University of Göffingen. Conf. on Int. Agric. Research for Devel.

Roberts-Sunny, E.O., E.T. Ofunda and B.T. Iwakun, 2004. An evaluation of some quality parameters of laboratory-prepared fermented groundnut milk. J. Eur. Food Res. Technol., 218: 452-455.

Salem, S.A., A.E. Salem and E. Gouda, 1987. Improvement of chemical, rheological and organoleptic properties for local-low fat processed cheese. Egyptian J. Dairy Sci., 15: 263-271.

SAS, 1997. SAS/STAT User's Guide, Version 6.03 edition, Cary, NC: SAS Institute Inc., pp: 1028.

Tamime, A.Y., D.D. Muir, M.E. Dhenana and A.M. Dawood, 1999. Processed cheese analogues incorporating fat-substitutes. I. Composition, microbiological and falvour changes during storage at 5°C. Lebensm-Wiss.u.-Technol., 32: 41-49.

Vargas, G., N.R. Grasso, A.G. Lópen and A.C. Guzmán, 1998. Chemical and physical characteristics of Argentinean groundnut milk. International a rachis Newsletter.