International Journal of
Dairy Science

ISSN 1811-9743

Academic
Journals Inc.

www.academicjournals.com

International Journal of Dairy Science 7 (2): 43-50, 2012
ISSN 1811-9743 / DOI: 10.3923/ijds.2012.43.50

Effect of Adding Cardamom, Cinnamon and Fenugreek to Goat's Milk Curd on the Quality of White Cheese During Storage

[1]Omer Ibrahim Ahmed Hamid and [2]Nafessa Ahmed Musa Abdelrahman
[1]Department of Dairy Science and Technology, College of Animal Production Science and Technology, Sudan
[2]University of Science and Technology, Khartoum, Sudan, Khartoum North, Kafouri, Sudan

Corresponding Author: Omer Ibrahim Ahmed Hamid, Department of Dairy Science and Technology, College of Animal Production Science and Technology, Sudan

ABSTRACT

Many people do not prefer goat's milk cheese due to the characterized flavour of the goat's milk. This Study was designed to show the effect of adding different levels of Cardamom, Cinnamon and Fenugreek powder to the goat's milk curd on the quality of white cheese. Forty liters of goat's milk were obtained from the local farm at Khartoum State. In this study four treatments were carried out as follows: First treatment is the control in which goat's milk cheese had no additive. In the second, third and fourth treatments 0.02% of fenugreek, cinnamon and cardamom powder were added to the curd after coagulation, respectively. The results indicated that the fat, total solids, ash contents and titratable acidity were significantly ($p<0.05$) affected by the storage period. Statistical analysis showed that the spices type significantly ($p<0.05$) the chemical composition of the cheese. The results showed that there were no significant difference ($p<0.05$) in the fat and total solids contents between all treatments. The results revealed that there was significant difference ($p = 0.05$) in the protein content between the control and the goat's milk cheese with cinnamon. The ash content was highest in the cheese with fenugreek (3.357±0.835%). The result indicated that the best value for all characters was at 20 day. The results indicated that the odour of the cheese significantly ($p<0.05$) affected by the storage period. The color of the cheese affected significantly ($p = 0.05$) by spices type, the best value of the colour was for control and the lowest one was for the cheese with cinnamon and there were no change in fenugreek and cardamom cheeses colours. Spices types had no significant ($p = 0.05$) effect on the flavor and odour of the cheese in all treatments.

Key words: Cheese, chemical, goat's milk, spices, storage

INTRODUCTION

White cheese is the only type of cheese available to public at large on the market in the Sudan. Gibna (white cheese) making is the major preservation method for surplus milk in rural areas. The highest production is during the rainy season and is manufactured from raw or heated milk (Ibrahim, 2003, 1971). Some factors affected cheese manufacturing process such as chemical composition the milk, processing conditions and ways of packaging (El-Diam and El-Zubeir, 2006). Goat's milk is much more easily digested than cow's milk, also goat's milk has 13% less lactose than cow's milk and most people who are allergic to cow's milk tend not to be allergic to goat's milk (Einsiedel, 2005; Riekeman, 2005). Production and processing of

goat's milk is of vital nutritional and social importance in Sudan. In the rural areas of the country, goat's breeding, along with that of ewe's, has been the main occupation of people since ancient times. Most of the goat's milk production is utilized in cheese making or to be mixed with ewe's or cow's milk. It has been reported that the goat's milk has more easily digestible fat and protein content than cow's milk, as well as an increased content of vitamin A, thiamine and niacin (Heilein, 2001). Spices are plants products added to the food to contribute towards aroma, taste, flavour, colour and pungency. These attribute are believe to be due to the presence of phenolic compounds in spices (Muchuweti *et al*., 2007). Presence of spices in cheese causes retardation of bacterial growth and decreases great changes occurred during fermentation process (Abdalla and El-Zubeir, 2006). At the end of last century, anti microbial activities of herbs and spices had already been examined and were known to retard microbial spoilage in dairy products (Abd El-Kader *et al*., 2001). In recent years, there are growing interests in using natural anti microbial compounds, especially those extracted from plants for the preservation of foods and dairy products which leads to increase the shelf life of these products. Many investigators used natural flavouring additives in dairy products such flavours are used as preservatives, antiviral, anti bacterial and anti fungal compound such as black cumin, cardamom, fenugreek (Abdalla *et al*., 2000). Previous researches indicated that addition of spices to cheeses decrease the acidity of the cheese and consequently suppresses the bacterial growth (El-Tantawy *et al*., 2006). In Sudan goat's milk products are not highly accepted because fresh goat's milk has a mild "goaty flavour" this flavour is mainly due to the presence of short chain fatty acids to make the goat's milk cheese acceptable addition of spices and herbs can cut short the problem of the goaty flavour of the goat milk. It's found that the addition of spices to the goat's milk improved the quality of the white cheese. White cheese made of goats milk with spices showed improved organoleptic characteristics. Therefore, white soft cheese could be successfully made from goats' milk with tested spices powder could be used as natural preservatives and improved the flavour of goat's cheese, especially clove and cardamom powder (El-Tantawy *et al*., 2006). The main objective of the study was to study the effect of adding cardamom, cinnamon and fenugreek on the chemical composition and sensory characteristics of goat's milk white cheese during storage.

MATERIALS AND METHODS

Experimental design: The experiment was conducted during 2010 at the Laboratory of Dairy Sciences and Technology Department, College of Animal production Sciences and Technology. In this study four treatments were carried out as follows: First treatment is the control in which goat's milk cheese had no additive. In the second, third and fourth treatments 0.02% of fenugreek, cinnamon and cardamom powder were added to the curd after coagulation, respectively.

Materials: Forty liters of goat's milk were obtained from the local farm at Khartoum State. Seeds of cardamom, cinnamon and fenugreek were obtained from local spices market (Attar) at Khartoum. They were grinded to fine powder before use. Commercial edible grade table Salt (Sodium Chloride) was obtained from the local market. Rennet tablet from (Ch. Hansen's Lab., Copenhagen, Denmark) were added at the rate of one tablet per 100 pounds of milk.

Cheese manufacture: The cheese was made according to the traditional method (Hamid, 2005). Raw goat's milk was thermized at 40°C then salt was added at the rate of 3% and rennet tablet was added at the rate of one tablet per 45 kg milk with stirring then, the milk left until complete

coagulation. The first treatment was control cheese (C) without any spices and the other three treatment were supplemented with different spices as follows: in the second, third and fourth portions 0.02% of Fenugreek (FN), Cinnamon (CN) and Cardamom (CR) powder were added, respectively to the curd of each ones. Then the curd of each treatment was left for drainage, after whey drainage in each treatment the cheese was packed into plastic containers (three replicates) then the cheese stored at 5°C for 30 days. The chemical analysis and sensory evaluation were carried out in duplicates at zero, 10, 20 and 30 days of storage for each treatment.

Chemical analysis: Titratable acidity was determined according to AOAC (2000), total solids was determined as described by AOAC (2000), protein was determined by Kjeldahl method as determined by AOAC (2000), fat and the ash contents of milk and cheese were determined according to AOAC (1990).

Sensory evaluation: The quality of the cheese samples stored under different conditions were judged by 10 untrained panelists for color, flavor, texture, odour and taste using sensory evaluation sheet according to Larmond (1987).

Statistical analysis: Statistical analysis was done using SPSS (1998) program (version 17). General linear models were used to estimate the effect of storage periods, flavoring materials and interaction between them on the chemical and sensory characteristics of goat's white cheese. Least Significance Difference (LSD) was used for mean separation between the treatments. The level of significance (0.05) was used in this study.

RESULTS

Chemical composition of milk: The average chemical composition of the milk used for cheese making in this study were as follows: 0.11, 9.8, 3.2, 3.5 and 0.5% for titratable acidity, total solid, protein, fat and ash content, respectively.

Effect of the storage on the chemical composition of the goat's cheese: Results in Table 1 show the main effect of the storage period on chemical composition of the goat's cheese. The results indicated that fat contents of the cheese was affected significantly ($p<0.05$) by the storage period. It was decreased from 14.88±3.47% at day zero to 12.03±1.51 at day 10, then increased to 18.25±4.93% at day 20 and finally decreased to 13.68±1.62 at day 30.

Total solid contents of the goat's cheese significantly ($p<0.05$) affected by storage period (Table 1). Total solids decreased from 41.813±3.66% at day zero to 27.43±4.25% at day 10. Then the value increased to 44.94±6.8% at day 20 and decreased to 33.81±3.02% at day 30.

Table 1: Effect of storage period on the chemical composition (%) of goat's cheese

	Chemical composition				
Storage period (days)	Fat	Total solid	Ash	Protein	Acidity
0	14.88±3.47^{b}	41.81±3.66^{c}	2.88±0.92^{b}	13.03±1.47^{b}	0.16±1.89^{a}
10	12.03±1.51^{a}	27.43±4.25^{a}	3.06±0.49^{b}	9.68±1.77^{a}	0.21±3.07^{b}
20	18.25±4.93^{c}	44.94±6.80^{d}	2.19±0.65^{a}	15.26±2.06^{c}	0.33±5.12^{c}
30	13.68±1.62^{ab}	33.81±3.02^{b}	2.31±1.34^{a}	13.02±2.41^{b}	0.31±9.08^{c}

The ash contents of the cheese increased significantly ($p<0.05$) with storage time from 2.88±0.92% at zero days to 3.063±0.496% at day 10, then slightly decreased to 2.19±0.65 at day 20 followed by a slightly increase to 2.31±1.34 at day 30. The protein contents of the goats cheese significantly ($p<0.05$) affected by storage period it decreased from 13.03±1.47% at day zero to 9.68±1.767 at day 10. Then it Increased to 15.260±2.06% at day 20 and decreased to 13.026±2.413% at day 30. The storage period affected the acidity of the cheese significantly ($p<0.05$), with an increase in storage time till 20 day thereafter no changes were observed at day 30.

Effect of spice types on the chemical composition of goat's cheese: Results in Table 2 illustrated the effect of the additive types on the chemical composition of the goat's cheese. The results indicated that there were no significant difference ($p<0.05$) in the fat content between all treatments. The results showed that the highest protein content (14.07±2.42%) was in the goat's milk cheese with cinnamon while the lowest protein content was in the goat's milk cheese without additive (Table 2). The results revealed that there was significant difference ($p = 0.05$) in the protein content between the control and the goat's milk cheese with cinnamon. The ash content was highest in the cheese with fenugreek (3.38±0.84%). However, the lowest ash content was in the cheese with cardamom (2.38±1.25%). The statistical analysis showed that there was no significance difference ($p = 0.05$) in the total solids contents of the goat cheese in all treatments (Table 2). The results indicated that the acidity did not significantly ($p = 0.05$) affected by spices addition (Table 2).

Sensory evaluation: Results in Table 3 showed the main effect of the storage period on sensory characters of the goat's cheese. The result indicated that the best value for all characters was at 20 day. The colour of the cheese was affected significantly ($p<0.05$) by the storage period.

Table 2: Effect of spices types on chemical composition of goat's cheese

	Chemical composition (%)				
Treatments	Fat	Total solid	Ash	Protein	Acidity
C	13.38±2.42	35.36±7.34	2.38±1.25^{a}	11.61±3.06^{a}	0.261±0.12
FN	13.38±3.67	37.75±6.67	3.38±0.84^{b}	13.02±3.11^{ab}	0.72±8.48
CN	16.28±5.48	38.75±11.31	2.56 ±0.49^{ab}	14.07±2.42^{b}	0.25±9.27
CR	15.44±3.30	36.13±7.33	2.13±0.64^{a}	12.28±2.21^{ab}	0.23±5.81
LS	NS	NS	S	S	NS

Means within columns bearing different superscripts are significantly different ($p\leq0.05$), S: Significantly different, NS: Not significantly different, C: Control, FN: Cheese with fenugreek, CN: Cheese with cinnamon, CR: Cheese with cardamom, LS: Level of significance

Table 3: Effect of storage period on sensory evaluation of goat's cheese

	Parameters				
Storage period (days)	Colour	Taste	Texture	Flavour	Odour
0	6.42±2.59^{a}	5.41±2.18^{a}	5.48±1.95^{a}	5.68±2.26^{a}	5.08±2.29^{a}
10	6.83±2.16^{ab}	0.6±2.06^{b}	5.9±2.18a	6.1±2.32^{ab}	5.35±2.46^{a}
20	7.2±1.93^{b}	6.45±1.95^{b}	7.2±1.89^{b}	6.3±2.02^{ab}	6.93±1.81^{b}
30	7.22±2.31^{b}	6.20±2.48^{b}	6.94±1.93^{b}	6.52±2.17^{b}	6.61±2.29^{b}

Means within columns bearing different superscripts are significantly different ($p\leq0.05$)

Table 4: Effect of spices type on the sensory evaluation of goat's cheese

Treatment	Colour	Taste	Texture	Flavour	Odour
C	7.40±2.259[a]	6.500±1.89	6.68±2.09[b]	6.05±2.198	5.67±2.48
FN	6.87±2.143[ab]	5.75±2.14[a]	6.50±2.349[ab]	6.10±2.179	5.80±2.39
CN	6.57±2.5[a]	6.175±2.05[ab]	6.35±2.08[ab]	6.25±2.347	6.225±2.32
CR	6.85±2.29[b]	5.70±2.547[a]	5.77±1.82[a]	6.36±2.09	6.28±2.16
LS	S	S	S	NS	NS

Means within columns bearing different superscripts are significantly different ($p \leq 0.05$), S: Significantly different, NS: Not significantly different, C: Control, FN: Cheese with fenugreek, CN: Cheese with cinnamon, CR: Cheese with cardamom, LS: Level of significance

No changes were observed between day 0 and day 10 after that colour scores increased at day 20 and no change at day 30. The lowest value of the Colour scores recorded at day zero and the highest value at days 20 and 30.

Table 3 showed that the taste of the cheese samples improved from day 10 till the end of storage period. The results indicated that the odour of the cheese significantly ($p<0.05$) affected by the storage period (Table 3). There were no changes at day 0 and day 10, thereafter it increased at day 20 and no changes at day 30. The flavour of the cheese affected significantly ($p = 0.05$) by storage period (Table 3) the highest value (6.52) was at day 30 while the lowest one was at day 0 (5.68). The texture of the cheese during the storage period showed the same trend as the odour of the cheese done.

Effect of spices types on sensory characteristics of goat's milk cheese: Table 4 showed the main effect of spices types on sensory characteristics of goat's milk cheese. The color of the cheese affected significantly ($p \leq 0.05$) by spices type, the best value of the colour was for control and the lowest one was for the cheese with cinnamon and there were no change in fenugreek and cardamom cheeses colours. Spices types had no significant ($p \geq 0.05$) effect on the flavor and odour of the cheese in all treatments. The values of the texture decreased significantly ($p<0.05$), the best texture scores was for the control cheese while the lowest one was for the cheese with the cinnamon. The results indicated that the taste of the control cheese was significantly different ($p<0.05$) from the other treatments.

DISCUSSION

Effect of storage period and spices type on the chemical composition of the goat's milk cheese: The chemical composition of the goat's milk cheese was significantly ($p \leq 0.05$) affected during storage period (Table 1). The fat contents of the cheese samples significantly decreased during storage period. The decrease in fat content during storage from day 20 to 30 was probably due to the lipolytic activity of microorganisms on fats resulting in leakage of some fat from curd into the pickling whey. The findings in this study agreed with those of Khalid (1991), Abbasi (1992) and Nuser (2001), who reported that there was decrease in fat contents during storage period. Although, the decreased in fat content from day 0-10 was attributed to decrease in the total solid (Khalid, 1991). Total solids contents of the goat cheese increased from day 10 to day 20 then decreased throughout the storage period (Table 1). The findings were in accordance with the work of Babiker (1987), Abdel-Razig (1996), Hamid (2005) and Bilal (2000) who found that the total solid content of the white soft cheese increased during storage. The increase could be due to continuous loss of moisture from the curd as a result of lactic acid development which causes curd contraction. However, the decrease of total solids content from days 20-30 possibly due to proteolytic

effect of microorganisms on the proteins and dissolution of fat and salt into the pickling solution (Nuser, 2001). The results of ash content confirmed the finding of Abdel-Razig (1996); Hamid (2005) and Nuser (2001) who reported that the increased in the ash content during storage might be due to decrease in moisture content and absorption of salt by curd. The decrease in ash content was possibly due to diffusion of salt from the curd into the pickling solution (Abbasi, 1992).

The results in protein contents in this study were in accordance with the findings of Kur (1992), Abdel-Razig (1996) and Hamid (2005) that showed the protein contents of cheese increased during ripening due to decrease in moisture contents. Other results demonstrated that the protein contents decreased during storage due to protein degradation leading to formation of water soluble compounds Nuser (2001). Titratable acidity of the cheese affected significantly ($p = 0.05$) by storage period (Table 1). These results were in agreement with those reported by Kur (1992), Nuser (2001) and Bilal (2000). The development of titratable acidity during storage till day 20 could be attributed to growth of lactic acid bacteria which increased the level of lactic acid in the cheese (Walstra *et al.*, 1999). On the other hand the decrease in titratable acidity at day 30 might be due to utilization of lactic acid by other micro flora during storage. Increase of fat (Table 2) in cheese with cinnamon could be due to the contents of essential oils in its components (Valero and Salmeron, 2003; El-Tantawy *et al.*, 2006). The highest total solids content of the cheese with cinnamon might be due to high retention of moisture from the curd and high level of fat while the low total solids content of the control cheese could be attributed to the high moisture contents in curd (Table 2). The highest value of ash content of cheese with fenugreek could be due to high level of minerals it content while the lowest ash content of the cheese with cardamom probably due to high moisture content in the curd. The decrease of protein in control cheese may be due to the degradation of protein by micro organisms (Table 2). The highest titratable acidity in cheese with fenugreek could be due to high level of lactic acid produced by lactic acid bacteria. On the contrary the low titratable acidity in cheese with cardamom was due to inactivation of lactic acid bacteria by cardamom. Present results were consistent with those of El-Tantawy *et al.* (2006), Bilal (2000) and Hamid (2005).

Effect of storage period and spices types on sensory characteristics of white goat cheese: The sensory evaluation (Table 3) affected significantly ($p \leq 0.05$) by storage period. The colour, taste, texture and flavour of the cheese improved during storage period this could be due to proteolytic and lipolytic processes occurred during storage.

Results showed that the best colour of the control cheese (Table 4) could be due to consumer acceptability of the white colour in cheese. Statistical analysis showed that the spices types had no significant effect on the flavour and odour of the cheese in all treatments, probably due to low percent of all additives. These results were in accordance with the results of El-Tantawy *et al.* (2006).

CONCLUSION

Chemical composition and sensory characteristics of goat's milk white soft cheese were significantly ($p<0.5$) affected by storage period. Sensory evaluation results showed that addition of spices improve flavour and odour of the goat's milk cheese. Fat, protein and ash contents of the cheese were significantly ($p<0.5$) affected by storage period and spices types. While, total solids and acidity were not affected by spices types. The use of some spices powders improved the quality of goat's milk cheese.

REFERENCES

AOAC, 1990. Official Methods of Analysis. 15th Edn., Association of Official Analytical Chemists, Washington, DC., USA.

AOAC, 2000. Association of Official Analytical Chemists. 17th Edn., AOAC, Washington, DC., pp: 21-447.

Abbasi, K.U., 1992. Effect of processing conditions on the microbiological quality of white picked cheese. Ph.D. Thesis, University of Tennessee, Knoxuille, USA.

Abd El-Kader, Y.I., M.Y. Mehana and M.A.E. Ammar, 2001. Study on the effect of adding some spices to Ras cheese curd on the chemical, microbiological and orangoleptical properties of the resultant cheese. Proceedings of the 8th Egyptian Conference Dairy Science and Technology, November 3-5, 2001, Cairo, Egypt, pp: 595-607.

Abdalla, M.S., K.M. Atalla, I.M. Ghazi and E.A. Galal, 2000. Effect of some a aqueous plant extracts on microbiological, chemical and organoleptics properties of ultra filtered cheese. Annals Agric. Sci. Ain. Shams Univ., Cairo, 45: 409-420.

Abdalla, W.M. and I.E.M. El-Zubeir, 2006. Microbial hazards associated with fermented milk (Roub and Mish) processing in Sudan. Int. J. Dairy. Sci., 1: 21-26.

Abdel-Razig, A.K., 1996. The production of white soft cheese from different milk sources. M.Sc. Thesis, University of Khartoum, Sudan.

Babiker, M.A., 1987. Technological studies on Sudanese white soft cheese (Gibna Beyda). M.Sc Thesis, University of Khartoum, Sudan.

Bilal, A.M., 2000. Effect of partial substitution of soy milk on the chemical composition and sensory characteristics of white soft cheese. M.Sc Thesis, University of Khartoum, Sudan.

Einsiedel, M., 2005. Raw goat milk vs. pasteurized cow milk. Dairy Goat J., 4: 3-5.

El-Diam, M.S.A.N. and I.E.M. El-Zubeir, 2006. Comparison of microbiological quality of processed and Non processed Sudanese white cheese. Res. J. Microbiol., 1: 273-279.

El-Tantawy, R.B.A., W.A.M. El-Demerdash and O.A. El-Aziz, 2006. Effect of cardamom, thyme and clove powder on the composition and quality of white soft cheese from goats milk. Assuit J. Agric. Sci., 37: 139-157.

Hamid, O.I.A., 2005. Effect of storage period on weight loss, chemical composition, microbiological properties and sensory characteristics of white soft cheese. Ph.D Thesis, University of Khartoum, Sudan.

Heilein, G.F., 2001. Past, present and future perspective of small ruminant's dairy. Res. J. Dairy Sci., 84: 2097-2115.

Ibrahim, A.A., 2003. Effect of processing and storage condition on the chemical composition and microbial quality of white soft cheese. M.Sc Thesis, University of Khartoum, Sudan.

Ibrahim, A.E., 1971. Studies on some characteristics of Sudanese white cheese. Sudan J. Vet. Sci. Anim. Husb., 12: 31-39.

Khalid, E.A., 1991. The effect of salt concentration on the yield and chemical composition of Sudanese white cheese. M.Sc Thesis, University of Khartoum, Sudan.

Kur, L.L.A., 1992. Effect of storage on the quality and chemical composition of Sudanese white cheese. M.Sc. Thesis, University of Khartoum, Sudan.

Larmond, E., 1987. Laboratory Methods of Sensory Evaluation of Food. Canadian Government Publishing Center, Ottawa, ON, Canada.

Muchuweti, M., E. Kativu, C.H. Mupure, C. Chidewe, A.R. Ndhlala and M.A.N. Benhura, 2007. Phenolic composition and antioxidant properties of some spices. Am. J. Food Technol., 2: 414-420.

Nuser, S.N.M., 2001. The effect of cooking and vacuum packaging on the quality of white soft cheese. M.Sc Thesis, University of Khartoum, Sudan.

Riekeman, J., 2005. Dairy goats have a rightful place in the food chain. Dairy Goat J., 4: 1-5.

SPSS, 1998. SPSS for windows version 10.SPSS, data files could contain multiple record types. SPSS versions 16.0 and later run under Windows, Mac and Linux.

Valero, M. and M.C. Salmeron, 2003. Antibacterial activity of 11 essential oils against Bacillus cereus in tyndallized carrot broth. Int. J. Food Microbial., 85: 73-81.

Walstra, P., T.J. Geurts, A. Noomen, A. Jellema and M.A.S. Van Bookel, 1999. Dairy Technology Principles of Milk Properties and Processes. Marcel Dekker, New York.