U. of K. J. Agric. Sci. 21(2), 253-268, 2013

Chemical and Microbiological Evaluation of Sudanese Braided Cheese (*Mudaffara*)

Mohamed Osman Mohamed Abdalla, Haifa Mukhtar Elsiddig, Nisreen Mohamed Elhaj and Tayseer Abdelrahim Suleiman

Department of Dairy Production, Faculty of Animal Production, University of Khartoum, Shambat P.O. Box 32, Postal Code 13314, Khartoum North, Sudan

Abstract: This study was conducted to determine the chemical and microbiological characteristics of traditional braided cheese (*mudaffara*) sold in Khartoum market, Sudan. Fifty four samples were collected from three different areas and subjected to chemical analysis (fat, protein, TS, ash, acidity) and microbiological examination (total viable bacteria, coliform bacteria, proteolytic bacteria, lipolytic bacteria, yeasts and moulds counts). Results showed that batch number significantly affected the chemical components of cheese, while area from which samples were collected did not. Fifty-five percent of samples had fat content of 26-37%, while 51% had low protein content (7-10%), 83% of samples had total solids content of 55-70%, 70% of samples had ash content of 3-5.99%, and 39% were highly acidic (1.0-1.5%). Microbiological populations examined were high in batch B except for yeasts and moulds which were high in batch A. The area from which sampling was done did not significantly affect the microbial quality of cheese. Microbiologically, samples were highly contaminated as shown in TVBC, where 89% of samples had Log 7.5-9.5 cfu/g, 89% had coliform count of Log 2.0-2.80 cfu/g, 72% had proteolytic bacteria count of Log 2.0-3.0 cfu/g, 65% had lipolytic bacteria count of Log 2.0-2.50 cfu/g and 91% had yeasts and moulds count of Log 2.0-3.80 cfu/g.

Keywords: Braided cheese; traditional; area; batch; chemical; microbiological

INTRODUCTION

Cheese making in Sudan is based on small-scale production and cheese is widely consumed by all Sudanese socioeconomic classes. There are no

available statistics on either size of manufacture or scale of consumption of cheese in Sudan which makes it difficult to estimate the amount of cheese produced. *Mudaffara* cheese is a pickled semi-hard cheese braided into a characteristic shape, and spices such as black cumin (*Nigella sativa*) are added. The method of manufacture is as follows: milk is renneted and left to form a curd (40–60 min), which is then left to ripen for 30–60 min. The curd is cut into small cubes and left in the whey to develop acidity. Ripening is assessed by dipping a small piece of curd into hot water, holding it in hands, kneading and pulling to form a curd of 2 m long. If the curd breaks before reaching this length, ripening is considered incomplete (Abdel Razig 2001; Elsheikh and Abdalla 2001). After ripening is tested, the curd is cooked in hot water for 5–10 min, and the hot curd is then put in a wooden plate and the spices are added. The curd is kneaded and pulled while hot to form a long curd which is braided and immersed in salted whey for two days after which cheese is packed and sold (Elsheikh and Abdalla 2001; Elsheikh 1997).

Abdel Razig (2001) studied the ripening behaviour of braided cheese (*mudaffara*) and found that during the ripening period the total solids increased while the weight of the braided cheese decreased due to decreasing moisture content. Elsheikh (1997) reported an increase in fat and protein content of braided cheese during ripening. From an investigation on marketed *mudaffara* cheese it was observed that fat ranged between 6.02% and 20.0%, protein 28.26 – 31.92%, total solids 53.63%–63.83%, ash 5.4%–7.29%, titratable acidity 0.29% – 0.69% and pH 3.2– 4.3 (Ahmed 1995). Ceylan *et al*. (2003) studied the microbiology of *Sikma* cheese in Turkey and found that there was a significant negative correlation between lactic acid bacteria and lipolytic bacteria and there was a significant positive correlation between the lipolytic and proteolytic bacteria. They also found that the lipolytic and proteolytic counts were lower than the lactic acid bacteria count. They found a significant negative correlation between the yeasts and moulds and coliform counts which was attributed to acid forming ability of lactic acid bacteria. *Mudaffara* cheese is produced in milk producing areas by traditional methods which may subject the product to deterioration in the quality and may be a source of pathogens. Therefore, it is necessary that cheese must be produced and marketed according to standards.

The objective of the study is to evaluate the chemical and microbiological characteristics of *mudaffara* cheese available in Khartoum market.

MATERIALS AND METHODS

Collection of samples

Fifty four samples of *mudaffara* cheese were collected from three different areas in Khartoum State, Sudan chosen according to the environment in which cheese was preserved as follows:

1. Area 1: cheese samples were collected from supermarkets having constant and regular electric supply.
2. Area 2: cheese was collected from medium-sized groceries having intermittent power cut off, and the refrigerators used to be turned off during the night.
3. Area 3: cheese was collected from small shops with no cooling facilities.

In areas 1 and 2, cheese was kept in the refrigerator in plastic bags, while cheese in area 3 was kept in whey in plastic containers. The whole retail bag (250 g) was collected as a sample in cheese from areas 1 and 2, while in cheese from area 3, a representative sample (200 g) was taken from the plastic container and transferred aseptically in sterile plastic bags. Samples were transported to the laboratory of the Department of Dairy Production, Faculty of Animal Production, University of Khartoum and kept at ≤5°C till analysis.

Chemical composition

Protein content was determined by Kjeldahal method (AOAC 2000) as total nitrogen (%) and then the protein content was obtained by multiplying the nitrogen content by a factor of 6.38. Fat content was determined by Gerber method according to Houghtby *et al*. (1992). Total solids content was determined by direct forced air oven drying method according to AOAC (2000). Ash content was determined by incinerating the sample in a muffle furnace at 550^{o}C (AOAC 2000). Titratable acidity was determined by titrating the sample against 0.1 N NaOH (AOAC 2000**).**

Microbiological examination

Eleven grams of cheese (11 g) were added to 99 mL of sterile distilled water in a flask and shaken well to make 10^{-1} dilution; then 1 mL was aseptically transferred to 9 mL sterile distilled water in test tubes. This procedure was repeated to make serial dilutions, and from each dilution, 1 mL was aseptically transferred to Petri-dishes (duplicates), followed by addition of sterile liquefied (45-46°C) culture medium, mixed gently, left to solidify, incubated (in a inverted position) for specified period and the typical colonies in each Petri dish were counted (Houghtby *et al*. 1992). Total viable bacterial count was determined according to Houghtby *et al*. (1992) using standard plate count agar medium and the plates were incubated at 37°C for 48 h. Coliform bacteria count was determined using MacConkey agar medium and the plates were incubated at 37°C for 24 h (Christen *et al*. 1992). Lipolytic bacteria count was determined according to the method described by Zaki (1988). Nutrient agar was used to determine the lipolytic bacteria count, the plates were incubated at 37°C for 4 days, and the colonies were identified using copper sulphate (20%). Proteolytic bacteria count was determined according to Frank *et al*. (1992) using plate count agar plus 10% sterile skim milk. The plates were incubated at 37°C for 4 days. Yeasts and moulds count was determined according to Frank *et al*. (1992) using yeast extract agar medium, and the plates were incubated at 25°C for 5 days.

Purification and identification of organisms

Purification was done by sub-culturing a well isolated typical colony on nutrient agar medium and incubating for 18-24 h at the appropriate temperature for each organism. The biochemical tests were carried out for confirmation of colonies (Barrow and Feltham 1993).

Statistical analyses

Statistical analysis was performed using Statistical Analysis Systems (SAS 2002). General Linear Models (GLM) were used to determine the effect of area and batch number on the chemical composition and microbiological quality of cheese. Means were separated using least significant difference test at $P \leq 0.05$.

RESULTS AND DISCUSSION

Chemical composition of *mudaffara* cheese

Table 1 shows that fat, protein, total solids and ash contents were high in batch C, while acidity was high in batch A. All chemical components did not differ between the three areas under study (Table 2). The mean chemical composition of cheese was as follows: fat 26.46±4.94, protein 14.72±8.14, total solids 58.19±4.21, ash 3.52±1.07 and acidity 0.978±0.294 (Table 5). Area 1 of batch C presented the highest protein, total solids and ash contents, while area 1 of batch A showed the lowest fat and protein contents, and the highest fat and acidity were in area 1 of batch B and area 2 of batch A respectively, and the lowest total solids and acidity were in area 3 of batch A and area 2 of batch B (Table 3). The highest frequency distribution (55%) was observed for fat content of 26-37%, meaning that most of the cheese had been manufactured from whole milk, while the low fat content of 15-25% (frequency distribution of 45%) might be due to the removal of some fat for the manufacture of butter oil (locally known as *samn*). The frequency distribution of 51% for protein content was observed for samples with protein content of 7.05-10.0%, while the second highest frequency distribution of 30% was observed for high protein content of 25.10 - 30% (Table 5). The frequency distribution of total solids values (51%) showed a range of 55.1- 60.0% and 32% of the samples had total solids content of 60.1-70.0%. This indicates that this cheese has a low moisture content compared to other cheeses (Mennane *et al.* 2007; Vasek *et al.* 2008*;* Uaboi-Egbenni *et al.* 2010), and this could be attributed to the method of manufacture and packaging. A significant number of samples (70%) had ash content of 3.0-5.99%. Cheese samples ranged from slightly acidic (33%) having acidity of 0.71-0.90% to highly acidic (39%) having acidity of 1.01-1.50% (Table 5).

The difference in the chemical composition as well as high standard deviation could be attributed to variation in the chemical composition of raw milk from which cheese was manufactured or difference in the manufacturing and marketing methods, since there is no standard procedure used in the manufacture of this cheese. Similar findings were reported by Kamber and Celik (2007) for fat, Elsheikh and Abdalla

(2001) for ash and Hernandez-Morales *et al*. (2010) for total solids, while the protein content was lower than that reported by Vasek *et al*. (2008), Elsheikh and Abdalla (2001) and Hernandez-Morales *et al*. (2010) and higher than that reported by Uaboi-Egbenni *et al*. (2010). The acidity reported in this study is higher than that reported by Kamber and Celik (2007), Elsheikh and Abdalla (2001) and Hernandez-Morales *et al*. (2010). From the results it is obvious that chemical composition of cheese satisfied the Sudanese standard for *mudaffara* cheese (SSMO 2007) in fat, protein, total solids and moisture, while the acidity did not satisfy the standard.

Table 1. Chemical composition (%) and microbiological quality (Log_{10} cfu/g) of three monthly batches of *Mudaffara* cheese (mean±S.D.)

Parameter	Batch			S.L.
	A	B	C	
Fat	22.22±3.56^{b}	28.56±3.87^{a}	28.61±4.45^{a}	***
Protein	28.26±3.48^{a}	27.00±0.79^{b}	28.23±1.16^{a}	***
Total solids	56.55±5.48^{b}	57.95±0.60^{ab}	60.08±2.39^{a}	*
Ash	3.13±1.59^{b}	3.42±0.14^{ab}	3.99±0.51^{a}	*
Acidity	1.17±0.37^{a}	0.771±0.55^{b}	0.996±0.17^{a}	***
Total viable bacteria	7.88±0.63^{b}	8.23±0.38^{a}	7.58±0.13^{c}	***
Coliform bacteria	2.41±0.17^{a}	2.43±0.38^{a}	2.08±0.23^{b}	***
Proteolytic bacteria	1.56±0.70^{c}	2.70±0.26^{a}	2.14±0.26^{b}	***
Lipolytic bacteria	2.18±0.23^{b}	2.30±0.15^{a}	1.79±0.17^{c}	***
Yeasts and moulds	2.63±0.14^{a}	2.29±0.36^{a}	2.31±0.18^{a}	N.S.

Means in the row bearing the same superscripts are not significantly different ($P>0.05$).

*** = $P<0.001$

* = $P<0.05$

N.S. = Not significant

S.D. = Standard deviation

S.L. = Significance level

Table 2. Chemical composition (%) and microbiological quality (Log_{10} cfu/g) of Mudaffara cheese from three different areas (mean±S.D.)

Parameter	Area[1]			S.L.
	1	2	3	
Fat	26.33±5.8[a]	26.61±4.57[a]	26.44±4.63[a]	N.S
Protein	27.54±7.87[a]	28.10±8.58[a]	27.84±8.43[a]	N.S
Total solids	58.64±3.73[a]	58.01±4.54[a]	57.93±4.52[a]	N.S
Ash	3.60±1.02[a]	3.26±1.13[a]	3.68±1.06[a]	N.S
Acidity	0.97±0.29[a]	0.96±0.31[a]	1.01±0.30[a]	N.S
Total viable bacteria	7.88±0.70[a]	7.89±0.45[a]	7.88±0.49[a]	N.S
Coliform bacteria	2.20±0.35[a]	2.33±0.34[a]	2.40±0.24[a]	N.S
Proteolytic bacteria	2.10±0.60[a]	2.02±0.81[a]	2.28±0.48[a]	N.S
Lipolytic bacteria	2.06±0.34[a]	2.13±0.30[a]	2.09±0.23[a]	N.S
Yeasts and Moulds	2.58±0.49[a]	2.37±0.93[a]	2.28±0.91[a]	N.S

Means in the same row bearing the same superscripts are not significantly different (P>0.05).
N.S = Not significant
S.D. = Standard deviation
S.L. = Significance level
[1] Areas 1, 2 and 3 refer to areas from which samples were collected as illustrated in the materials and methods

Microbiological quality of *mudaffara* cheese

Total viable bacteria, coliform bacteria, lipolytic bacteria and proteolytic bacteria counts were high in batch B, but there was no difference in yeasts and moulds count between the three batches (Table 1). The microbial populations under study did not differ between the areas from which samples were collected, although total viable bacteria and liplolytic bacteria were slightly high in area 2, while coliform bacteria and proteolytic bacteria were high in area 3 and yeasts and moulds were high in area 1 (Table 2). Cheese samples from area 1 (batch B) were highly contaminated with total viable bacteria compared to other areas, while area 3 (batch B) was highly contaminated with coliform and proteolytic bacteria, and areas 1 and 2 (batch B) were highly contaminated with yeasts and moulds and lipolytic bacteria, respectively (Table 4). The average bacterial count of cheese was as follows: TVBC Log 7.90±0.547

cfu/g, coliform bacteria Log 2.31±0.316, proteolytic bacteria Log 2.13±0.645, lipolytic bacteria Log 2.09±0.287 and yeasts and moulds Log 2.41±0.796 cfu/g (Table 6).

From the microbiological point of view, most cheese samples (89%) had a total viable bacteria count of Log 7.51-9.50 cfu/g (Table 6). The high number of total viable bacteria count of *mudaffara* cheese might be due to the use of raw milk for the manufacture of cheese since cheese is manufactured in rural areas with no chance for heat treatment of milk, in addition to poor conditions during the manufacture. Similar results were reported by Mennane *et al.* (2007) and Hernandez-Moralez *et al.* (2010). However, the results in this study are lower than those reported by Menendez *et al*. (2001) and Kamber and Celik (2007), and higher than those reported by Ugboi –Egbenni *et al.* (2010). More than half of the samples tested (55%) had a coliform bacterial count of Log 2.31-2.80 cfu/g (Table 6). Although this cheese is traditionally made under low hygienic conditions, coliform count in this study is lower than that reported by Vural *et al*. (2010) for *Orgu* braided cheese ($3.6x10^4$ cfu/g), Elowni and Hamed (2009) for *Gibna Beyda* (Log 4.04±1.05 cfu/g), Menendez *et al*. (2001) for *Tetilla* raw cows milk cheese (6.09±1.532 cfu/g) and Hernandez-Morales *et al*. (2010) for Mexican *Anefio* cheese (log 3.4 cfu/g). The majority of samples tested have proteolytic bacteria count of Log 2.0-3.0 cfu/g (72%), lipolytic bacteria count of Log 2.00-2.50 cfu/g (65%) and yeasts and moulds count of Log 2.30-3.80 cfu/g (91%) (Table 6). Dallol (1999) reported that the lipolytic and proteolytic bacteria counts in smoked cheese stored at the refrigerator were lower than that stored at room temperature, and in smoked cheese the proteolytic bacteria count increased during storage. Ceylan *et al.* (2003) reported that the lipolytic and proteolytic bacteria count decreased due to the presence of lactic acid bacteria. The yeasts and moulds count reported in this study is lower than that reported by Menendez *et al*. (2001), Mennane *et al*. (2007), Vasek *et al*. (2008) and Vural *et al.* (2010). Microbiologically, the cheese is of low quality compared to SSMO (2007) in total viable bacteria and coliform bacteria counts.

Table 3. Chemical composition (%) of *mudaffara* cheese from three areas collected in three monthly batches (Mean±S.D.)

Batch	Area	Chemical composition (%)				
		Fat	Protein	Total solids	Ash	Titratable acidity
	1	21.83±3.971[c]	24.26±6.013	57.72±5.595	2.96±1.493	1.167±0.378
A	2	22.67±3.445[c]	26.46±0.475	57.04±4.92	2.82±1.725	1.220±0.419
	3	22.17±3.868[c]	26.41±0.970	54.89±6.415	3.62±1.704	1.120±0.375
	1	31.33±5.125[a]	25.60±0.729	57.44±2.298	3.67±0.440	0.753±0.025
B	2	27.33±3.204[ab]	26.77±0.770	57.52±5.319	3.31±0.735	0.732±0.040
	3	27.00±0.632[ab]	28.21±0.941	58.90±2.928	3.29±0.609	0.827±0.238
	1	25.83±4.215[ab]	31.33±1.141	60.75±1.654	4.18±0.447	0.993±0.184
C	2	29.83±4.119[ab]	27.77±0.427	59.46±3.685	3.66±0.643	0.918±0.108
	3	30.17±4.308[a]	30.10±1.394	60.02±1.465	4.13±0.280	1.080±0.194
S.L.		*	N.S	N.S	N.S	N.S

Means in the same row bearing the same superscripts are not significantly different (P>0.05).
* = P<0.05
N.S = Not significant
S.L. = Significance level
S.D. = Standard deviation

Table 4. Microbiological quality (Log_{10} cfu/g) of *mudaffara* cheese collected from three areas collected in three monthly batches (Mean±S.D.)

Batch	Area	Microbiological quality (Log_{10} cfu/g)				
		TVBC	Coliform bacteria	Proteolytic bacteria	Lipolytic bacteria	Yeasts and moulds
A	1	7.38±0.467^{a}	2.30±0.174	1.45±0.432^{c}	2.15±0.260^{a}	2.71±0.101
	2	8.03±0.380^{b}	2.54±0.136	1.22±0.951^{c}	2.28±0.135^{a}	2.61±0.058
	3	8.22±0.723^{a}	2.40±0.129	2.02±0.383^{ab}	2.13±0.282^{a}	2.56±0.190
B	1	8.63±0.639^{a}	2.30±0.460	2.70±0.302^{a}	2.35±0.106^{a}	2.82±0.737
	2	8.11±0.511^{b}	2.41±0.416	2.60±0.299^{a}	2.36±0.106^{a}	2.10±1.652
	3	7.95±0.202^{b}	2.59±0.220	2.79±0.147^{a}	2.21±0.196^{a}	1.95±1.581
C	1	7.63±0.056^{b}	2.00±0.302	2.15±0.121^{ab}	1.67±0.123^{b}	2.23±0.169
	2	7.53±0.182^{b}	2.03±0.149	2.23±0.173^{a}	1.77±0.153^{b}	2.40±0.131
	3	7.59±0.118^{b}	2.21±0.193	2.03±0.388^{ab}	1.93±0.113^{b}	2.32±0.217
S.L.		**	N.S	*	*	N.S

Means in the same row bearing the same superscripts are not significantly different (P>0.05).
** = P<0.01
* = P<0.05
N.S = Not significant
S.L. = Significance level
S.D. = Standard deviation

Table 5. Frequency distribution of chemical composition of *mudaffara* cheese marketed in Khartoum State

Parameter	Mean±S.D[a]	Interval											
		1			2			3			4		
		Range	n	%	Range	n	%	Range	n	%	Range	n	**%**
Fat (%)	26.46±4.94	15-20	9	17	21.0-25.0	15	28	26.0-30.0	18	33	31.0-37.0	12	22
Protein (%)	14.72±8.14	7.05-10.0	28	51	10.05-20.0	10	19	20.10-25.0	0	0	25.10-30.0	16	30
Total solids (%)	58.19±4.21	45-50	2	4	50.1-55.0	7	13	55.1-60.0	28	51	60.1-70.0	17	32
Ash (%)	3.52±1.07	1.0-1.99	3	6	2.00-2.99	13	24	3.00-3.99	18	33	4.00-5.99	20	37
Acidity[b]	0.978±0.294	0.50-0.70	9	17	0.71-0.90	18	33	0.91-1.0	6	11	1.01-1.50	21	39

[a] Means of 54 samples
[b] Expressed as percentage of lactic acid
S.D = Standard deviation

Table 6. Frequency distribution of microbiological quality (Log_{10} cfu/gm) of *mudaffara* cheese marketed in Khartoum State

Parameter	Mean±S.D[a]	Interval											
		1			2			3			4		
		Range	n	%	Range	n	%	Range	n	%	Range	n	%
TVBC	7.90±0.547	6.5-7.5	6	11	7.51-8.00	36	67	8.10-9.00	8	15	9.10-9.50	4	7
Coliform bacteria	2.31±0.316	1.49-1.99	7	13	2.00-2.30	17	32	2.31-2.50	13	23	2.51-2.80	17	32
Proteolytic bacteria	2.13±0.645	0-1.99	15	28	2.00-2.30	16	30	2.31-2.50	8	14	2.51-3.00	15	28
Lipolriaytic bact	2.09±0.287	1.40-1.99	19	35	2.00-2.30	20	37	2.31-2.39	5	9	2.40-2.50	10	19
Yeasts and moulds	2.41±0.796	0-2.0	5	9	2.01-2.50	20	37	2.51-3.0	23	43	3.10-3.80	6	11

[a] Means of 54 samples
S.D = Standard deviation

CONCLUSION

This study concluded that *mudaffara* cheese satisfied SSMO standard in fat, protein and total solids and did not satisfy the standard in total viable bacteria and colifrom bacteria counts. Therefore, the method of manufacture and subsequent handling and storage should be improved to satisfy the standards from microbiological point of view. It was observed that most of the samples under study (more than 50%) had high content of chemical components, and high total viable bacteria, coliform bacteria, proteolytic bacteria, lipolytic bacteria and yeasts and moulds counts.

REFERENCES

Abdel Razig, A.K. (2001). *Quality Attributes of Braided Cheese "Mudaffara" as Affected by Level of Salt and Storage Temperature*. Ph.D. thesis. University of Khartoum, Sudan.

Ahmed, K.T. (1995). *Evaluation of Mudaffara Cheese from Different Milk Sources*. M.Sc. thesis. University of Khartoum, Sudan.

AOAC (2000). *Official Methods of Analysis*, 17th Edition. AOAC International, Gaitherburg, MD, U.S.A, Official Methods 920.124, 926.08, 935.42, 2001.1. Association of Official Analytical Chemists (AOAC), U.S.A.

Barrow, G.I. and Feltham, R.K.A. *(*1993*). Cowan and Steel's Manual for the Identification of Medical Bacteria*, 3rd edition. Cambridge University Press, Cambridge, UK.

Ceylan, Z.G.; Turkoglu, H. and Dayisoylu, K.S. (2003). The microbiological and chemical quality of *Skima* cheese produced in Turkey. *Pak. J. Nutr.* 2, 95-97.

Christen, L.G.; Davidson, P.M.; McAllister, J.S. and Roth, L.A. (1992). Coliform and other indicator bacteria. Pp. 247-269 in: Marshal, R.T. (edt.): *Standard Methods for the Examination of Dairy Products*, 16th edition. Washington, D.C.: American Public Health Association, U.S.A.

Dallol, M.S. (1999). *Studies on Smoked Cheese*. Ph.D. thesis. University of Khartoum. Sudan

Elowni, O.A.O. and Hamed, I.A.O. (2009). Effect of storage temperature on weight loss, chemical composition, microbiological properties and sensory characteristics of white cheese (*Gibna Bayda*). *Res. J. Agric. Biol. Sci.* 5, 498-505.

Elsheikh, A.N. (1997). *Production of Mudaffara Cheese from Cow's and Goat's Milk.* M.Sc. thesis. University of Khartoum, Sudan.

Elsheikh, A.N. and Abdalla, O.M. (2001). Effect of type of milk on the yield, physico-chemical and sensory characteristics of *mudaffara* cheese. *Sudan J. Anim. Prod.* 14, 1-9.

Frank, F. J.; Christen, L.G. and Bullerman, L.B. (1992). Tests for groups of microorganisms, Pp.271-286 in: *Standard Methods for the Examination of Dairy Products*, 16th edition. R.T. Marshal (edt.). Washington, D.C.: American Public Health Association, U.S.A.

Hernandez-Morales, C.; Hernandez-Montes, A.; Aguirre-Mandujano, E. and De Gante, V.A. (2010). Physicochemical, microbiological, textural and sensory characterisation of Mexican *Anejo* cheese. *Inter. J. Dairy Technol.* 63, 552-560.

Houghtby, A.G.; Maturin, L.J. and Koenig, K.E. (1992). Microbiological count methods. Pp. 213-246 in: *Standard Methods for the Examination of Dairy Products*, 16th edition. R.T. Marshal (edt.), 16th edition. Washington, D.C.: American Public Health Association, U.S.A.

Kamber, U. and Celik, T.H. (2007). Some microbiological and chemical characteristics of *Gorcola* cheese. *YY VET FAK DERG* 18, 87-92.

Menendez, S.; Godinez, R.; Centeno, J.A. and Rodriguez-Otero, J.L. (2001). Microbiological, chemical and biochemical characteristics of *Tetilla* raw cows-milk cheese. *Food Microbiol*. 18, 151-158.

Mennane, Z.; Khedid, K.; Zinedine, A.; Lagzouli, M.; Oussine, M. and Elyachioui, M. (2007). Microbial characteristics of *Klila* and *Jben* traditional Moroccan cheese from raw cow's milk. *World J. Dairy Food Sci.* 2, 23-27.

SAS (2002). Statistical Analysis Systems, ver. 9. SAS Institute Inc., Cary, N.C., U.S.A.

SSMO (2007). *Mudaffara* cheese. Sudanese Standard No. 1429. Sudanese Standards and Metrology Organization (SSMO), Khartoum, Sudan.

Uaboi-Egbenni, P.O.; Okolie, P.N.; Bisi-Johnson, O.; Enwe, L. and Bessong, P.O. (2010). Proximate analysis and microbiological quality of cheese produced from raw cow milk obtained from Fulani settlement in Ogun State Nigeria, using lactic acid bacteria and extract from Sodom apple leaf (*Calotropis procera*). *Pak. J. Nutr.* 9, 920-925.

Vasek, O.; Leblanc, G.J.; Fusco, A.; and De Giori, S.G. (2008). Chemical composition and microbial evaluation of Argentinean Corrientes cheese. *Inter. J. Dairy Technol*. 61, 222-228.

Vural, A.; Erkan, E.M. and Guran, S.H. (2010). The examination of the microbiological quality of *Orgu* cheese (braided cheese) samples. *Kafkas Univ. Vet. Fak. Derg* (Suppl-A) 16, S53-S58.

Zaki, S.A. (1988*). Application of Practical Microbiology*. Dar ElMaarif Printing Press, Cairo, Egypt (In Arabic).

التقييم الكيميائي والميكروبي للجبنة المضفرة السودانية

محمد عثمان محمد عبدالله و هيفاء مختار الصديق و نسرين محمد الحاج
وتيسير عبدالرحيم سليمان

قسم إنتاج الألبان – كلية الإنتاج الحيواني، جامعة الخرطوم
شمبات – الرمز البريدي 13314 – السودان

المستخلص: أجريت هذه الدراسة لتحديد الصفات الكيميائية والميكروبية للجبن المضفرة التقليدية المباعة في الخرطوم . جمعت 54 عينة من ثلاث مناطق بالخرطوم ، واخضعت للتحليل الكيميائي (الدهن ، البروتين ، الجوامد الكلية ، الرماد ، الحموضة) والاختبار الميكروبي (العدد الكلي للبكتيريا الحية ، بكتيريا القولون ، البكتيريا المحللة للبروتين ، البكتيريا المحللة للدهن ، الخمائر والعفن). أوضحت النتائج أن الدفعة أثرت معنويا على التركيب الكيميائي للجبن ، بينما لم تؤثر المنطقة التي جمعت منها العينات . خمس وخمسون بالمائة (55%) من العينات كانت لها نسبة دهن تراوحت بين 26% و 37% ، في حين أن 51% من العينات كانت لها نسبة بروتين منخفضة (7%–10%) ، و83% من العينات كانت لها نسبة جوامد كلية تراوحت بين 55% و 70% ، و70% من العينات كانت لها نسبة رماد تراوحت بين 3% و 5.99%، و 39% من العينات كانت عالية الحموضة (1.0% – 1.5%). من الناحية الميكروبية ، فان الاحياء الدقيقة كانت أعلي في الدفعة (ب) ، ماعدا الخمائر والعفن التي كانت أعلى في الدفعة (أ) ، بينما لم يكن للمنطقة التي جمعت منها العينات تأثير معنوي. كانت نسبة عالية من الجبنة التي اخضعت للدراسة(89%) ملوثة بالعدد الكلي للبكتيريا الحية (لو 7.5– 9.5 مستعمرة للجرام الواحد) ، و 89% من العينات كانت بها بكتيريا القولون تراوحت بين لو 2.0 و لو 2.8 مستعمرة ، و72% من العينات كانت بها بكتيريا محللة للبروتين تراوحت بين لو 2.0 ولو 3.0 مستعمرة ، و 65% من العينات كانت بها بكتيريا محللة للدهن تراوحت بين لو 2.0 و لو 2.50 مستعمرة ، و 91% من العينات كانت بها خمائر وأعفان تراوحت بين لو 2.0 ولو 3.80 مستعمرة للجرام الواحد .