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Quality Characteristics of White Cheese in Different Packaging Materials in Khartoum State, Sudan

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A B S T R A C T

The study was conducted to study the quality characteristics of white cheese in Khartoum State, 60 samples of white cheese (30 samples from each plastic and paper packs) were collected randomly from three different areas (Khartoum North, Omdurman and Khartoum) in Kharoum state. The manufacture date of cheese samples was defined to fixed date. Cheese samples were examined for chemical composition and microbial contents under different packing materials. The packaging materials significantly affected the chemical composition of the white cheese samples ($P< 0.01$) the higher (24.23 ± 1.10 %) fat content was in plastic pack. The fat (14.62 ± 0.98 %) was higher in plastic pack, also the results showed that protein, total solids, titratable acidity and the ash contents were higher in the cheese samples in plastic pack. However, volatile fatty acids were higher (7.06 ± 0 .21) in paper pack in comparison with plastic pack. The mineral contents (Calcium, Phosphorus and Potassium) were significantly higher in plastic pack. The high total bacterial count was found in cheese samples in paper pack (5.47 ± 0.76 cfu/ml). The results indicated that presence of yeast and molds, *Staphylococcus aureus*, *E. coli* and coliforms were found in white cheese samples in different packing materials (15%, 8%, 1% and 1%, respectively), with average counts (2.4 – 2.7 Lg cfu/ml), (2.5 – 2.8 Lg cfu/ml), (0.0 – 3.0 Lg cfu/ml) and (0.0 – 5.0Lgcfu/ml) respectively. *Salmonella* spp and Listeria monocytogenes were not detected in all cheese samples.

Introduction

Cheese as the product made from the curd obtained from milk by coagulation of casein with the help of rennet or similar enzymes in the presence of lactic acid produced by added or adventitious microorganisms, from which part of the moisture has been removed by cutting, cooking and / or pressing, which has been shaped in a mould, and then ripened by holding it for some time at a suitable temperature and humidity (Smith, 2005). White cheese is the only type of cheese available to the public at large quantities on the markets of Sudan, the method of its making was introduced from Egypt, from Mediterranean countries such as Syria or Greece (Dirar, 1993). Cheese packaging is an

integral part of processing operations and cheese preservation. Consumers more often directly purchase cheeses in the self-service section of the supermarket, along with other pre packaged fresh produces. It is thus necessary to package products in a way that makes it possible to preserve their quality (Floros *et al*, 2000). The study Intents effect of packing materials on the microbiological composition of white cheese.

Materials and Methods

The study will be conducted in Khartoum State. A total of 60 samples (30 samples from plastic package and 30 samples from paper package) from each of white cheese, will be collected from different area of Khartoum State with different packing materials. The manufacture date of the collected white cheese samples will be defined to fixed date for cheese samples were examined for microbiological composition under different packing material.

Chemical analysis of cheese

Fat, protein, total solid, titratable acidity, volatile fatty acids and Ash analysis according to the AOAC (2009). The Ca, P and K analysis according to the Perkin Elmer (1994) and AOAC (2009).

Microbiological analysis of cheese

Total bacteria count (TBC), *Staphylococcus aureus*, Coliforms, Salmonella and *Listeria monocytogens* were analysed according to Harrigan, (1998).Yeast and moulds, count according to Harrigan and McCance (1976).

Statistical analysis

Statistical analysis was done using SPSS programme (1998).

Results and Discussion

The table 1 showed the effect of packaging materials on the chemical composition of white cheese samples. Fat content of the white cheese significantly ($P< 0.01$) different, the highest (24.23 ± 1.10 %) fat was in the plastic pack and the lower (21.74 ± 1.46 %) one was for the paper one. The result in this study is higher than that by Mustafa *et al.,* (2013), who reported the fat (18.92 ± 0.012%). The findings in this study disagree with Hamid (2005) and Bilal (2000) who reported that fat contents of the cheese stored in antiacid cans were higher than those stored in polyethylene bags. Fat content decrease during storage period was probably due to lipolytic activity of microorganisms on fat (Khalid, 1991; Abdalla, 1992 and Nuser, 2001).

Protein content of cheese samples in plastic pack increased (14.62 ± 0.98 %), while that in paper pack decreased (13.89 ± 0.97 %). These values was higher than those reported by Mustafa *et al.,* (2013) who recorded protein content of cheese samples (15.73 ± 0.150%). Our results were in agreement with Bilal (2000) who found the protein contents of cheese packed in polyethylene bags were higher than those stored in antiacid cans. Lower protein contents due to the heavy proteolytic action during storage (Abdel-Salam, 1987).

Total solids of cheese samples packed in plastic increased (50.16 ± 2.37 %) while that packed in paper pack decreased (41.51 ± 2.70 %). Values in this study were lower than that by Elkhider (2017) who recorded total solids content of (64.45±6.1%). Our findings were disagree with the study of Hamid (2005) and Bilal (2000) who reported total solids content of white soft cheese stored in cans were slightly higher when compared with those packed in polyethylene bags, lower total solids content of the cheese samples kept in plastic

containers might be due to higher moisture content of the cheese or could be due to the increased action of proteolytic and lipolytic microflora on the cheese components.

Volatile fatty acids of cheese in paper pack was higher (7.06 ± 0.21) than that in plastic one (5.44 ± 0.74 %). These results were higher than those found by Elkhider (2017). However, these results were not similar to those obtained by Hamid (2005) who stated that cheese kept in plastic containers was higher in VFA in comparison with those in antiacid cans. High VFA of cheese kept in plastic containers might be explained by increased activity of lipolytic agents in plastic containers during storage. Decrease in VFA could be attributed to utilization of some of VFA by microorganisms.

Titratable acidity of cheese packed in paper was higher (0.85 ± 0.10 %) than that in plastic pack (0.69 ± 0.24 %). These results were lower than those by ElNasri *et al.,* (2012) who reported titratable acidity of (1.35 ± 0.60%). These results were not in agreement with those of Hamid (2005). Increase titratable acidity of cheese samples in plastic pack could be due to activity of lactic acid bacteria which forms considerable level of lactic acid, low acidity of cheese could be due to growth of yeasts, hence utilizing lactic acid for metabolic processes.

Ash content of cheese samples packed in plastic was higher (5.84 ± 1.15 %) than that in paper, (3.72 ± 0.55 %). These results were related to Mustafa *et al.,* (2013). This result disagree with that by Hamid (2005) and Bilal (2000) who reported that ash contents of cheese stored in cans were higher than those of cheese kept in polyethylene bags. High ash contents could be due to the lower moisture content and absorption of salt by the curd.

Calcium contents of cheese packed in plastic was higher than that packed in plastic pack. Unrelated results were obtained by Abdalla and Hassan, (2013) who listed the calcium content of cheese affected by the type of packing and storage period. Decrease calcium content might be attributed to the increase in acidity (Khalid, 1991; Abbala, 1992; Nofal *et al.,* 1981 and Nuser, 2001).

Phosphorus contents of chees packed in plastic were higher than those packed in plastic pack. This result disagree with that by Wong *et al.,* (1988) who defined no significant differences between samples kept in metal tin and plastic containers on one side and between plastic lined with polyethylene and metal gallon on the other one. Decrease Phosphorus content could be attributed to the increase in acidity (E1–Abd *et al.,* 1982).

Potassium contents of cheese packed in plastic were higher than those packed in paper pack. Khalid (1991), Abbala (1992) Nofal *et al.,* (1981) and Nuser (2001) who detailed the decrease of potassium contents could be due to the lipolytic activity of microorganisms on potassium.

The total bacterial count (TBC) (Log colony forming unit/ml) of the white cheese samples was not significantly (P>0.05) different due to the packaging materials (Table 3).

These results were not agreed with that by ElNasri *et al.,* (2012) and Ahmed, (1985). El Owni and Hamid (2009) attributed such decrease in TBC of cheese to the effect of high acidity of the cheese samples. *Yeas*t and *mould* were determined cheese samples were packing in plastic pack was higher than those in paper pack (Table 2).

Table.1 The effect of packing materials on the chemical composition of white cheese in KHARTOUM State

Packing	Chemical Composition								
	Fat %	protein %	Total solids %	FVA	Titra. acidity %	Ash %	Ca %	P %	K %
Plastic	24.23 ± 1.10 [b]	14.62 ± 0.98 [a]	50.16 ± 2.37 [a]	5.44 ± 0.74 [b]	0.69 ± 0.24 [b]	5.84 ± 1.15 [a]	0.60 ± 0.14 [a]	0.37 ± 0.07 [a]	0.22 ± 0.06 [a]
Paper	21.74 ± 1.46 [a]	13.89 ± 0.97 [b]	41.51 ± 2.70 [b]	7.06 ± 0.21 [a]	0.85 ± 0.10 [a]	3.72 ± 0.55 [b]	0.42 ± 0.09 [b]	0.23 ± 0.07 [b]	0.19 ± 0.09 [b]
Level of sig.	**	**	**	**	**	**	**	**	**

Mean values bearing different superscripts within columns are significantly different (P< 0.01).

Table.2 Effect of packing materials on the total bacterial count of white cheese in Khartoum State

Total bacterial count (log cfu/ml)	
Packing	TBC
Plastic	5.37 ± 0.71
Paper	5.47 ± 0.76
Level of sig.	NS

Table.3 Effect of packing materials on the microbiological composition of White cheese in Khartoum State

Microbiological composition (log cfu/ml)	Packing	Khartoum (%)	Khartoum North (%)	Omdurman (%)	count (log cfu/ml)
Yeast and mold	Plastic	23	16	20	2.5 – 2.7
	Paper	13	10	10	2.4 – 2.6
	Total		15		2.4 – 2.7
Staph. aureus	Plastic	13	13	6	2.5 – 2.8
	Paper	7	6	7	2.6 – 2.7
	Total		8		2.5 – 2.8
E. coli	Plastic	ND	ND	ND	ND
	Paper	3	ND	3	0.00 – 3.00
	Total		1		0.00 – 3.00
Coliforms	Plastic	6	ND	6	3.00 – 5.00
	Paper	3	ND	ND	0.00 - 3.00
	Total		1		0.00 – 5.00

Mean values bearing different superscripts within column are significantly different (P< 0.05).

The present study results were in agreement with those reported by Hamid,(2005). Who reported cheese samples kept in antiacid cans contain no yeasts and moulds throughout the storage period while those kept in plastic containers increased in numbers till the day 60 then decreased gradually at the end of the storage period. The growth of *yeasts* and*moulds* in the cheese samples kept in plastic containers could be due to presence of oxygen in the plastic containers (Ahmed 1985). *Staphylococcus aureus count* in cheese samples packed in plastic pack was highest than those packed in paper pack. This result was in line with that by ElNasri *et al.*, (2012). *Escherichia coli* were no detected in cheese samples packed in plastic. While *E. coli* was found in cheese samples packed in paper pack. This result disagrees with El Owni and Hamid (2009) who found that cheese samples kept in plastic containers had higher coliform and *E. coli* counts than those stored in anti-acid cans once. *Escherichia coli* found in cheese samples indicated that the level of hygiene and handling were not properly (Elkhider *et al*, 2011). *Coliforms* were found in white cheese samples packed in plastic pack was highest than those packed in paper pack. Idris and Alhassa (2010) observed similar results and stated that the *coliforms* bacteria in plastic packages were higher than in metal pack. Coliforms found in cheese samples kept in plastic containers could be due to interaction effect of low storage temperature and low acidity in the cheese samples (Hamid, 2005). *Salmonella spp* and *Listeria monocytogens* were not detected in white cheese samples. This result was not in line with that reported by Amran and Abbas (2011) who stated that pathogenic flora such as Salmonella and Listeria were detected in some cheese samples and disappeared at the end of storage period.

In conclusions, chemical composition of white cheese samples showed significant (P> 0.01) differences between packing materials. Fat, crude protein, Total solids, titrtibility acidity, Ash, ca, p and k were increased, while the (FVA) were decrease when packed in plastic packing. High presence of yeast, molds, *Staphylococcus aureus* and Coliforms were found in white cheese samples when packed in plastic pack. High presence of *E. coli* counts was found in paper pack. Salmonella and *Listeria monocytogens* count were not detected in the cheese samples in this study.

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