Int.J.Curr.Microbiol.App.Sci (2018) *7*(11): 2807-2813

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 7 Number 11 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.711.323

Effect of Packaging Materials on the Chemical and Microbiological Quality of Romi Cheese

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Keywords

Romi cheese, Microbial contents, Chemical composition, Package

Article Info

Accepted:
22 October 2018
Available Online:
10 November 2018

A B S T R A C T

The study was conducted to evaluate the chemical composition and microbial contents of Romi cheese in Khartoum state. Sixty samples of Romi cheese (30 samples from each of plastic and paper packs) were collected randomly from three different areas (Khartoum North, Omdurman and Khartoum). The manufacture date of cheese samples was defined to fixed date. Samples were examined for chemical composition and microbial contents under different packing materials. The packaging materials significantly affected the chemical composition of the Romi cheese samples ($P< 0.01$) the higher chemical parameters were in Romi cheese samples in paper pack (29.40±1.41; 25.76±2.04%; 64.40±4.12%; 0.99±0.25%; and 11.42±1.43ml NaOH/100g cheese for fat, protein total solids, titratable acidity and volatile fatty acids respectively, while the ash content was higher (4.45±0.80%), in plastic pack. The highest in plastic package and the lowest in paper pack. The minerals content (Phosphorus and Potassium) were higher in Romi cheese samples in plastic pack while the Calcium was higher in Romi cheese samples in paper pack. The results indicated that 9 % of the collected Romi cheese samples showed presence of yeast and molds, 3.3 % of the samples demonstrated the presence of *Staphylococcus aureus*, 1.6 % of samples indicated the presence of coliforms and *E. coli*, Salmonella and *Listeria monocytogenes* were not detected in the cheese samples in Khartoum state. Romi cheese samples in plastic packed revealed high microbial load in comparison with paper pack.

Introduction

Cheese is a product that made from the curd obtained from milk by coagulating the casein with the help of rennet or similar enzymes in the presence of lactic acid microorganism (Ramakant, 2006). The diversity of cheese-manufacturing protocols, ripening regimens, and composition makes cheese a complex subject microbiologically. Romi cheese is fermented hard cheese manufactured from raw cows and buffalo's milk. As a result of moulds growth mycotoxins may be produced in cheese, rendering it unfit for human consumption (Pitt and Hocking, 2009). Romi cheese has been introduced to Sudanese

markets very recently, and research concerning them in Sudan is very limited. 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 prepackaged 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 Objective was to determine the effect of packing materials on the chemical composition and microbial contents of Romi cheese.

Materials and Methods

A total of 60 samples of Romi cheese (30 samples from each of plastic and paper pack) were collected randomly from different area of Khartoum State with different packing materials. The manufacture date of the collected white cheese samples was defined to fixed date for cheese samples. Collected samples were examined for chemical and microbioloical composition under different packing materials.

Chemical analysis

Chemical composition (fat, protein. total solid, titratable acidity, volatile fatty acids and ash contents) were analysed according to the AOAC (2009). The Ca, P and K were determined according to the Perkin Elmer (1994).

Microbiological analysis of cheese

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

Statistical analysis

Statistical analysis was done using SPSS programme (1998). Complete Randamized Design was used to estimate the effect of area and packing materials on the chemical and microbiological quality of Romicheese. Least significant difference tests were used for mean separation between the treatments. The levels of significance $\alpha<0.05$ was used in this study.

Results and Discussion

Chemical composition of Romi cheese was significantly affected by the packing materials (Table 1). Fat contents of Romi cheese samples in paper pack were higher in comparison with those in plastic pack. The highest value of fat content (29.40±1.41%) was obtained by the sample of Romi cheese on paper pack, the lowest value (23.31±1.88%) found in samples of the Romi cheese in plastic pack. Protein content of Romi cheese was affected significantly ($P< 0.01$) by the packing materials. The highest value (25.76±2.04%) was found in Romi cheese sample in paper pack, the lowest value (16.77±1.26%) was obtained by Romi cheese samples in plastic pack. Total solids of Romi cheese was affected significantly ($P< 0.001$) by the packing materials. The highest value (64.40±4.12%) was found in Romi cheese samples in paper pack, the lowest value (48.86±2.37%) of Romi cheeses samples in plastic pack.

Volatile fatty acids of Romi cheese was affected significantly ($P< 0.01$) by the packing materials. The Romi cheese samples in paper pack had higher VFA content than those in plastic pack. Titratable acidity of Romi cheese was affected significantly ($P< 0.001$) by the packing materials. The highest value (0.99±0.25%) noted in Romi cheese samples in plastic pack, the lowest value (0.83±0.19%) was found in Romi cheese samples in paper

pack. Ash content of Romi cheese was affected significantly (P< 0.01) by the packing materials. The highest value (4.45±0.80%) obtained by Romi cheese sample in paper pack, the lowest value (4.02±0.47%) recorded by Romi cheese sample in plastic pack.

Calcium contents of the Romi cheese were affected significantly (P< 0.01) by the packing material. The highest value found in samples of Romi cheese was packed on paper pack than those plastic packs. Romi cheese Phosphorus was affected significantly (P< 0.01) by the packing material. Phosphorus content of Romi cheese samples on plastic pack higher than those on paper pack. Potassium content of Romi cheese was affected significantly (P< 0.01) by the packing materials. The highest potassium value was found in samples packed in plastic pack, and the lowest one was in samples packed in paper pack.

Table 2 showed that total bacterial counts of Romi cheese were not significantly (P>0.05) affected by the packing materials. The highest total bacterial count was (5.43 ± 0.67 cfu/ml) obtained by samples of Romi cheese in paper pack and the lowest count (5.37 ± 0.62 cfu/ml) was noted by samples of the Romi cheese in plastic pack.

Yeast and moulds count was higher in Romi cheese samples in plastic pack compared to that in paper pack (Table 3). *Staphylococcus aureus* in Romi cheese samples in paper pack was highest than those in plastic pack. *Escherichia coli* were not detected in Romi cheese samples in plastic pack, while found in paper pack. *E. coli* was not detected in cheese samples in Khartoum north while found in Khartoum and Omdurman samples. Coliforms were not detected in Romi cheese samples in plastic pack while appeared in cheese samples in paper pack. *Salmonella spp* and *Listeria monocytogens* were not detected in Romi cheese samples which might be due to proper hygienic and handling process of cheese. The high fat content of Romi cheese samples in paper pack could be due to the loss of water and the increasing of dry matter. This value was high in compared with (Habib, 2014 and El-Fadal, *et al.,* 2015) who found that fat content of fresh Ras cheese was (24.05%) and (25.89%).

The higher protein in Romi cheese samples in paper pack may be due to the partial denaturation of soluble proteins by the heat. This value was lower than that by Awad *et al.,* (2014) who studied the chemical composition of Ras cheese and found the Protein content was (26.78%) which increased while packing in plastic pack. The low total solids content of Romi cheese samples in plastic pack could be due to the increased action of proteolytic and lipolytic microflora on the cheese components. These values were higher than El-Zahar, (2014) who stated the total solids content of Ras cheese (47.2±2.9 %; 58.3±3.8 %). The low VFA of Romi cheese samples in plastic pack could be attributed to utilization of some of VFA by microorganisms. This result disagrees with that by Abdalla *et al.,* (2013) who found the VFA of cheese samples kept in plastic container higher than those in tin container.

Table.2 Total bacterial count of Romi cheese in Khartoum state

Packing	Total bacterial count(log cfu/ml)
Plastic	5.37 ± 0.62
Paper	5.43 ± 0.67
Level of sig.	NS

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

Table.1 The effect of packing materials on the chemical composition of Romi cheese in Khartoum State

Chemical Composition									
Packing	**Fat %**	**Crude protein %**	**Total solids %**	**FVA ml NaoH/100g cheese**	**Titra. acidity %**	**Ash %**	**Ca %**	**P %**	**K %**
Plastic	23.31±1.88^{b}	16.77±1.26^{b}	48.86±2.37^{b}	6.14±0.58^{b}	0.99±0.25^{a}	4.02±0.47^{b}	0.29±0.04^{b}	0.90±.05^{a}	0.25±0.06^{a}
Paper	29.40±1.41^{a}	25.76±2.04^{a}	64.40±4.12^{a}	11.42±1.43^{a}	0.83±0.19^{b}	4.45±0.80^{a}	0.85±0.12^{a}	0.71±.14^{b}	0.15±0.05^{b}
Level of sig.	***								

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

Table.3 Microbial contents of Romi cheese samples in Khartoum state

Microbial contents (log cfu/ml)	Packing	Khartoum (%)	Khartoum North (%)	Omdurman (%)	count (log cfu/ml)
Yeast and mold	**Plastic**	15	10	10	2.4 – 2.6
	Paper	10	5	5	2.5 – 2.7
	Total (%)	9			2.4 – 2.7
Staph. aureus	**Plastic**	10	ND	ND	2.5 - 2.8
	Paper	5	5	ND	2.5 – 2.6
	Total (%)	3.3			2.5 – 2.8
E. coli	**Plastic**	ND	ND	ND	ND
	Paper	ND	ND	ND	ND
	Total (%)	0			00.00
Coliforms	**Plastic**	ND	ND	ND	ND
	Paper	ND	10	ND	3.00 – 5.00
	Total (%)	1.6			3.00 – 5.00

The low acidity of Romi cheese samples in paper pack could be due to the growth of yeasts in cheese. Those values were lower than those by El-Zahar (2014) who found the titratable acidity contents of Ras (2.2±0.43%; 1.85±0.23%). The high ash contents of Romi cheese samples in paper pack could be due to the lower moisture content. These values related to those by Mangia *et al.,* (2011). This result disagree with Abdalla *et al.,* (2013) who stated that, the calcium content affected by type of packing and found the higher value for calcium obtained in cheese samples in plastic. The low Calcium contents of Romi cheese samples on plastic pack could be due to the degradation of calcium by cheese microflora. Phosphorus content of Romi cheese samples on plastic pack higher than those on paper pack. Khalid (1991). Abdlla (1992), Nofal *et al.,* (1981) who studied the lower Phosphorous content of Romi cheese samples might be due to the degradation of Phosphorus by microorganisms. The highest potassium value was found in samples packed in plastic pack, and the lowest onewas in samples packed in paper pack. Khalid (1991), Abdalla (1992) Nofal *et al.,* (1981) and Nuser, (2001) who stated the decrease of Potassium contents could be due to the lipolytic activity of microorganisms on Potassium.

The low TBC of Romi cheese sample in paper pack probably due to salting processing. This value lower than that reported by El-Fadaly *et al.,* (2015) who found the total count of bacteria of Ras cheese wheels were (6.13±0.18 log10cfu/g) and (6.12±0.21 log10cfu/g). The high yeast and mold count of Romi cheese samples on plastic pack could be due to presence of oxygen in the plastic pack. That results were not agree with those reported by Hamid, (2005). *Yeast* and *mould* were detected in all cheese samples in Khartoum, Khartoum north and Omdurman. The high *Staphylococcus aureus* count in Romi cheese samples in paper pack might probably comparable to those by ElNasri *et al.,* (2012) who found that the counts of *S. aureus* showed in the cheese samples packed in plastic containers. The presence of *S. aureus* in Romi cheese samples indicated the poor hygienic conditions and handling (IFST, 1998). *Staphylococcus aureus* were detected in all cheese samples in Khartoum, Khartoum north and Omdurman. The presence of coliforms in Romi cheese samples, these result were not similar to those of Osman and Abbas (2001) who found that coliforms bacteria were not detected in Ras cheese samples. *Coliforms* were detected in cheese samples in Khartoum, Khartoum north and Omdurman. Cyelan *et al.,* (1989) expressed that coliforms found in cheese samples might be due to poor environmental and unhygienic conditions of handling. Salmonella and Listeria monocytogens were not detected in all the Romi cheese samples, this result was not agreed with Amran and Abbas (2011) who stated the pathogenic flora such as *Salmonella* and *Listeria* were detected in some samples of cheese.

It would be concluded that Romi cheese samples in plastic pack showed higher fat, crude protein, Total solids, FVA, ash, Ca in comparison with that in paper pack while, lower titratable acidity, K and P were recorded for those packed in paper pack. The microbial contents of Romi cheese samples were noted to be higher in plastic container when compared to those in paper pack. *E.coli, Salmonella and Listeria monocytogenes* were not detected in all Romi cheese samples.

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How to cite this article:

Esraa Ahmed Mohammed Abdelmagid and Omer Ibrahim Ahmed Hamid. 2018. Effect of Packaging Materials on the Chemical and Microbiological Quality of Romi Cheese. *Int.J.Curr.Microbiol.App.Sci.* 7(11): 2807-2813. doi: https://doi.org/10.20546/ijcmas.2018.711.323