Research Journal of Animal and Veterinary Sciences, 2: 47-52, 2007

Yield and Sensory Evaluation of the Processed Cheese from Sudanese White Cheese

Nour El Diam, M.S.A. and El Zubeir Ibtisam, E.M.

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

Abstract: Trails for manufacturing the processed cheese from the Sudanese white cheese is done during this study. The processed cheese was made from Sudanese white cheese with different ripening time (15 days and 30 days) from milk with different fat present (2.2% and 4.4%). At time of processing the processed cheese was packed into two types of packaging (glass and plastic) and stored at 4º C for 3 months. The yield of the processed cheese and the Sudanese white cheese made out of it from 4.4 fat % of milk after 15 and 30 days ripening were 2.850 Kg and 1.75 Kg and 2.750 Kg and 1.50 Kg respectively, while that made from 2.2 fat % yielded 2.0 Kg and 1.25 Kg and 2.0 Kg and 1.2 Kg, respectively. On other hand as judged by the panelists the colour, taste, flavour, texture and saltiness of the processed cheese showed noticeable changes during storage period. The processed cheese made from Sudanese white cheese after 15 days ripening was more stable and acceptable. Also glass packaging was more acceptable compared to plastic packaging (70% and 30%, respectively). The overall acceptability showed that the processed cheese made from white Sudanese cheese after 15 days ripening from milk with 2.2 fat % was the best of the cheese tried (4.4%). Hence, the present study concluded that the Sudanese white cheese could be further reprocessed to obtain the processed Sudanese cheese.

Keywords: Sudanese white cheese, processed cheese, yield, sensory evaluation, storage, ripening, packaging

INTRODUCTION

There are two main types of cheeses in Sudan namely Sudanese white cheese (Gibna bayda) and braided semi hard cheese (Mudaffarra). Other types of cheese provided recently by Sudanese industries, are Mozzarella and Roome. However the processed cheese is not yet produced by the Sudanese industry, as this cheese could be stored for longer periods and excess milk could be converted into processed cheese.

Traditionally, processed cheese was made by heating and stirring mixture of natural cheese, chelating salts, fat and water at temperature between 70 and 95º C for short time about 5 to 10 minutes[13]. Turhan and Dervisoglu[17] reported that processed cheese made by using Ior cheese (produce from skim milk), butter, dried skim milk and tri sodium citrate. They concluded that 20% Ior cheese addition resulted in a high quality and spreadable processed cheese. Soft cheese was used to manufacture spreadable processed cheese by adding 3.5% emulsifying salts and 15– 25% water and 0.08% Arabic gum[5]. They concluded that locally produced soft cheese in Iraq could be used instead of imported semi-hard cheese to make processed cheese of acceptable quality.

White cheese made by coagulating heated milk (90 ºC) with a 2.5% citric acid solution to pH 5.5 have been reported to be used in a processed cheese formulation blend up to level of 33%[6]. They concluded that the appropriate levels and the right kind of the emulsifying salt, together with an optional proportion of white cheese in the blend, could produce processed cheese product with good rheological characteristics. There are other reports of cheese like, Queso blanco cheese and a Latin American Counter part of Asian Paneer, have also been used for processed cheese manufacture[9]. Moreover, emulsifying salt and water were added in varying proportions before processing for 15– 25 minutes at 85º C. Their results indicated that the cheese with 1.5 % sodium citrate + 35 % water and 3.0 % sodium citrate + 50% water yielded the best products with smooth texture and mouth feel and good flavour characteristic.

Cheese made from pasteurized milk received the highest organoleptic scores after 90 days at room and refrigerator temperature (92% and 88%, respectively). However cheese made from raw milk received the highest organoleptic scores after 60 days at room and after 90 days at refrigerator temperature[3]. The storage at room temperature for 4 months of market processes

Corresponding Author: El Zubeir Ibtisam, E.M., Department of Dairy Production, Faculty of Animal Production, University of Khartoum. P. O. Box 32, Postal code 13314, Khartoum North, Sudan.
E-Mail: Ibtisammohamed@hotmail.com Fax: +249 185 321246

cheeses had a more pronounced effect on the quality and reheological properties of processed cheeses[4]. On the other hand Singh and Kanawjia[14] concluded that the sensory characteristics of flavour and texture of processed cheese decreased during storage at 37º C. Similarly Hamed *et al.*[4] reported that the score for flavour, texture, colour and general appearance of fresh and stored processed cheese showed a general tendency to decrease throughout the storage period.

Tewari *et al.*[16] used trisodium citrate and disodium hydrogen phosphate as emulsifiers in 1: 0, 0: 1, 2: 1, 1: 1 and 1: 2 and they found that the most suitable TSC: DSHP combination was 1: 2, when added at 3%. Disodium phosphate and trisodium citrate produced properties closest to those of all fat reference cheese with trisodium citrate providing the most meltability[15]. On the other hand Siew *et al.*[13] reported that the dairy proteins play the important role of emulsifiers the majority of the proteins are caseins, the emulsification potential of which is improved by the use of chelating salts. They added that the solubilized casein is able to interact with water and fat under agitation and heating and on cooling will form a gel structure.

This study is a trial to produce processed cheese from Sudanese white cheese with different fat levels and different ripening periods. Also the shelf life and package materials for the processed cheese were evaluated.

MATERIAL AND METHODS

Sources of Milk Rennet and Salts: Fresh cow's milk (30 liters) was brought from Khartoum University farm, Rennet tablets were obtained from Chr- Hansen's Lab (Denmark), the salt was purchased from the local market and di-sodium phosphate was a product of Sigma Chemical Company.

Adjustment of Milk Fat and Cheese Manufacture: The adjustment of milk fat to be processed and the manufacture of cheeses were done at the Department of Dairy Production, Faculty of Animal Production, University of Khartoum during the period of November 2002 to February 2003. The milk was adjusted to two different fat % (4.4 and 2.2) using the cream separator.

Manufacture of the Sudanese White Cheese: Sudanese white cheese was made as described by Osman[11] from the milk with the two levels of fat %. Milk was heated to 45° C then rennet (0.07% gram/L) was dissolved in little amount of water and added to the milk at 40º C. Salt (7% gram/ L) and the milk were stirred for 5 minutes then the mixture was left to develop a curd. The curd after coagulation was cut by stainless steel kitchen knife and kept for 5 minutes to separate the whey, which was collected and kept in room temperature. The curd was collected and transferred into clean wooden moulds lined with clean clothes then pressed with 1 kg weight over night. In the next day the curd was cut to cubes and weighted then transferred into plastic cans and the whey was added. The cheeses that made from low (2.2 %) and high fat (4.4 %) content of milk were stored at room temperature for ripening to both 15 and 30 days.

Manufacture of the Processed Cheese: The cheeses were cut into small pieces using stainless steel. Then 3% of di-sodium phosphate and 50% of distilled water were added. It was then mixed using a mixture at water bath steam (80º C for 5 minutes). Processed cheese were packed into two types of packaging (plastic pack and glass pack) and stored at 4º C.

Sensory Evaluation: Panels of 10 untrained panelists from the staff and students of the Faculty of Animal Production who are familiar with cheeses were asked to judge on the quality of the processed cheese using a sensory evaluation sheet.

RESULTS AND DISCUSSIONS

Comparison between white Sudanese cheese and Processed Cheese Yield: As shown in Table 1 the yield of Sudanese white cheese made from 30 liters milk with 4.4 fat % was 1.750 Kg after 15 days ripening and was 1.5 Kg after 30 days ripening. Moreover the yield of Sudanese white cheese made from 30 liters milk with 2.2 fat % was 1.250 Kg after 15 days ripening and was 1.2 Kg after 30 days ripening. The yield of the processed cheese made from Sudanese white cheese with milk fat of 4.4% after 15 days ripening was 2.850 Kg and after 30 days ripening was 2.750 Kg. Moreover, the yield of the processed cheese made from Sudanese white cheese with milk fat of 2.2 % after 15 days ripening was 2.0 Kg and at 30 days ripening was 2.0 Kg (Table 1). The Sudanese white cheese which was very popular in Sudan was used in this study (Table 1) as a raw material to manufacturing the processed cheese that has an increasing acceptability in Sudan now a days. This is due to the greatest shifts that happen in the feeding habits of a lot of consumers and the change towards the fast food is increasing and become so common due to shift of live as most of households went to work and/or study. This leads to the increasing demand of such cheeses, in addition to the increased numbers of foreigners in the country.

The present study revealed that it was reasonable to produce the processed cheese with acceptable quality from the Sudanese white cheese. The processed cheese

Table 1: Effect of repining and fat level of milk on yield of processed and non processed Sudanese white cheese

Cheese type	4.4% milk fat		2.2 % milk fat	
	15 days repining	30 days repining	15 days repining	30 days repining
Sudanese white cheese (Kg)	1.75	1.50	1.25	1.20
Processed cheese (kg)	2.85	2.75	2.00	2.00

Table 2: Sensory evaluation for the processed cheese

Measurements				Colour				Flavour				Taste				Body				Overall acceptability			
Ripening	Packaging type	Fat	Storage period	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
15 days	Glass	4.4 %	1	-	-	-	100	-	20	80	-	100	-	-	-	100	-	-	-	-	-	40	60
15 days	Glass	4.4 %	2	-	-	-	100	-	50	50	-	40	60	-	-	100	-	-	-	-	10	40	50
15 days	Glass	4.4 %	3	-	10	40	50	20	30	30	20	-	40	50	10	80	20	-	-	10	40	50	-
15 days	Plastic	4.4 %	1	-	-	-	100	-	20	80	-	100	-	-	-	100	-	-	-	-	10	30	60
15 days	Plastic	4.4 %	2	-	-	-	100	-	50	50	-	40	60	-	-	100	-	-	-	-	30	50	30
15 days	Plastic	4.4 %	3	-	20	30	50	30	50	10	10	-	20	40	40	70	30	-	-	40	40	20	-
15 days	Glass	2.2 %	1	-	-	-	100	-	50	50	-	100	-	-	-	100	-	-	-	-	-	40	60
15 days	Glass	2.2 %	2	-	-	-	100	-	40	60	-	50	50	-	-	100	-	-	-	-	-	50	50
15 days	Glass	2.2 %	3	-	10	30	60	10	40	50	-	-	40	60	-	90	10	-	-	10	40	50	-
15 days	Plastic	2.2 %	1	-	-	-	100	-	50	50	-	100	-	-	-	100	-	-	-	-	20	40	40
15 days	Plastic	2.2 %	2	-	-	-	100	-	50	50	-	30	70	-	-	100	-	-	-	-	30	40	30
15 days	Plastic	2.2 %	3	-	20	30	50	50	20	30	-	-	40	30	30	80	20	-	-	40	40	20	-
30 days	Glass	4.4 %	1	-	-	-	100	-	10	60	30	-	90	10	-	100	-	-	-	-	-	30	70
30 days	Glass	4.4 %	2	-	30	70	-	10	40	50	-	-	40	60	-	60	30	10	-	20	40	40	-
30 days	Plastic	2.2 %	1	-	-	-	100	-	10	60	30	-	90	10	-	100	-	-	-	-	-	30	70
30 days	Plastic	2.2 %	2	-	50	50	-	50	50	-	-	-	30	70	-	70	20	10	-	40	40	20	-
30 days	Glass	4.4 %	1	-	-	40	60	-	50	50	-	-	70	30	-	100	-	-	-	-	-	30	70
30 days	Glass	4.4 %	2	-	50	50	-	-	50	50	-	-	50	50	-	60	30	10	-	20	40	40	-
30 days	Plastic	2.2 %	1	-	-	40	60	-	50	40	10	-	70	30	-	100	-	-	-	-	-	30	70
30 days	Plastic	2.2 %	2	-	80	20	-	-	40	60	-	-	40	60	-	60	30	10	-	40	40	20	-

Colour :-
1/ Un acceptable
2/ Moderately unacceptable
3/ Slightly acceptable
4/ 4/ Acceptable

Flavour :-
1/ Bland
2/ Slightly intense
3/ Moderately intense
4/ Extremely intense

Taste :-
1/ Absent acid
2/ Slightly acid
3/ Acid
4/ Excessive acid

Body :-
1/ Smooth body
2/ Slightly body
3/ Harsh body
4/ Pasty

Over all acceptability :-
1/ Not acceptable
2/ Moderately unacceptable
3/ Slightly acceptable
4/ Acceptable

is considered as a stable product with reasonable shelf life, moreover different types cheese can be used in the processed cheese[5]. This is a very promising result since it would help to minimize and stop the importation of the expensive processed cheese. This also utilize and safe the huge quantities of milk which produce in the rural areas and further processing it in towns to reasonable longer shelf life cheese (processed) instead of the Sudanese white cheese.

During the present study comparison between the processed cheese and white Sudanese cheese on the yield showed that the processed cheese yielded more quantities. This is acceptable result as the Sudanese white cheese was the raw material for the processed cheese. In spite of the lost of moisture during heating, there was 50 % of the distilled water added, which gives more yield. However the fat level did not affect significantly (P> 0.05) the yield of the processed cheese, which supported Dimitreli and Thomareis[1] who reported that fat was found to have non significant effect on the rheological behaviour of processed cheese. Similarly Lee *et al.*[7] reported that the change in the viscosity profile during cooking occurred in processed cheese made from a typical formulation as well as from a fat-free model system. They concluded that this might indicated that the 'creaming reaction' is primarily a protein-based interaction, which takes places with or without the presence of fat and the observed viscosity profile can be explained in terms of changes in the protein structure of the molten processed cheese during processing. On the other hand the reduction in fat content resulted in significant increases in the mean

Table 3: Acceptability of salt level and packaging of the processed cheese

Measurements				Saltiness			Packaging		
Ripening	Packaging type	Fat	Storage period (month)	1	2	3	4	1	2
15 days	Glass	4.4 %	1	-	50	50	-	20	80
15 days	Glass	4.4 %	2	-	70	30	-	20	80
15 days	Glass	4.4 %	3	40	60	-	-	20	80
15 days	Plastic	4.4 %	1	-	50	50	-	20	80
15 days	Plastic	4.4 %	2	-	70	30	-	20	80
15 days	Plastic	4.4 %	3	40	60	-	-	20	80
15 days	Glass	2.2 %	1	-	50	50	-	20	80
15 days	Glass	2.2 %	2	-	70	30	-	20	80
15 days	Glass	2.2 %	3	40	60	-	-	20	80
15 days	Plastic	2.2 %	1	-	50	50	-	20	80
15 days	Plastic	2.2 %	2	-	70	30	-	20	80
15 days	Plastic	2.2 %	3	40	60	-	-	20	80
30 days	Glass	4.4 %	1	20	40	40	-	20	80
30 days	Glass	4.4 %	2	70	30	-	-	20	80
30 days	Plastic	2.2 %	1	20	40	40	-	20	80
30 days	Plastic	2.2 %	2	70	30	-	-	20	80
30 days	Glass	4.4 %	1	20	40	40	-	20	80
30 days	Glass	4.4 %	2	70	30	-	-	20	80
30 days	Plastic	2.2 %	1	20	40	40	-	20	80
30 days	Plastic	2.2 %	2	70	30	-	-	20	80

Saltines :-
1/ Moderately salted
2/ Salted
3/ Over salted
4/ Too salty

Packaging :-
1/ Plastic
2/ Glass

melt time and a decrease in the mean flowability of the melted cheese and the stretchability of the full fat cheese (FFC) increased most rapidly attaining mean values which were significantly higher than those of the other cheeses at 15 and 30 days[2].

Processed Cheese Acceptability: Sensory evaluations of the processed cheese for all tried cheeses showed decrease values during storage (Table 2 and Table 3). According to the panelist, the best colour score was found in the processed cheese made from Sudanese white cheese after 15 days ripening from milk with 2.2 fat % and packed in glass (Table 2). The processed cheese made from Sudanese white cheese after 15 days ripening from milk with 4.4 fat % and packed into glass revealed the best flavour during the storage (Table 2). This supported Muir *et al.*[10] who reported that differences in cheese flavours are due to fat content. The taste of the processed cheese showed increase scores from absent of acid to excessive acid during storage period (Table 2). It was clear that the processed cheese that packed into plastic showed increase in acid taste compared to the glass packaging (Table 2). This might be due to the glass packaging that was sterilized before used and they were more tied than the plastic ones.

The texture changed during storage periods showed decrease (Table 2). The processed cheese made from Sudanese white cheese after 15 days ripening revealed the best score even with different fat % and different packaging. This agreed with Singh and Kanawjia[14] and Hamed *et al.*[4] who reported that the sensory

characteristic of flavour and texture of the processed cheese decrease during storage of the cheese. However Schar and Bosset[12] mentioned that structure and flavour of processed cheese during storage at room temperature were slowly changed.

The saltiness taste was found to be clear and that slight changes in salt was noticed by the panelist. This might be due to added emulsifier salts or it might be due to the differences between the panelist tastes. However, no changes in salt were found during processing of the processed cheese (Table 3). Swenson *et al.*[15] added that however significantly higher concentration of ash and phosphorus were detected in bitter cheese samples as it was noticed that the respective batches of processed cheese slices had been produced apparently using an over does of specific emulsifying agent[8]. On the other hand Siew *et al.*[13] reported that the dairy proteins play the important role of emulsifiers the majority of the proteins are caseins, the emulsification potential of which is improved by the use of chelating salts.

Packaging of the processed cheese into glass showed more acceptability than the plastic (Table 3). Moreover, they reported that sensory scores of the processed cheese were decrease during storage and the rate of decrease being slowest in samples stored in glass. Moreover Schar and Bosset[12] reported that the changes with age of processed cheese are influenced by four main factors: product composition, processing, packaging and storage conditions (time and temperature).

The present study concluded that there is possibility of using the Sudanese white cheese as a raw material for preparation of the processed cheese. Moreover it yielded more quantity that will increase the incomes, in addition to the high prices of the processed cheeses. However, the panelist showed that the most acceptable sample of the overall acceptability was the processed cheese made from Sudanese white cheese with 15 days ripening with 2.2 fat% of milk and packed in glass material (70%). This might indicated that the higher present of fat on cheese is not required so the excess fat could be manufactured into the expensive products (butter, cream and ghee). The shorter ripening time is better than the longer as long as pasteurization is not practiced, in order to obtained good quality products with maximum duration. From the results of the present study we encourage production of the processed cheese in Sudan from the Sudanese white cheese as the processing of the cheese maximizes the utilization of all produced cheese, since the small on uneven pieces can be use. Further work are needed and recommended on using the natural sources in Sudan as emulsifiers to produce the processed cheese from Sudanese white cheese and to understand in more details the optimum conditions for its manufacturing.

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