

Original Research Article

Physicochemical and Sensory Characteristics of Sudanese White Cheese made from different Type of Milk

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Abstract

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The study was conducted in the Dairy Production Department of the College of Animal Production, University of Sinnar, to examine the effect of milk type (sheep's, goat's and cow's milk) on Physicochemical and sensory characteristics of Sudanese white soft cheese. Ten (10) liters of fresh cow's full cream milk were obtained from the farm of College of Animal Production, University of Sinnar, and (10) liters of goat's milk and (10) liters of sheep's milk were purchased from a private farm at Abu Naama area. Cheese were made from the three types of milk using the standard procedure followed in the production of Sudanese White soft cheese manufacture. After milk pasteurization, 0.02% CaCl₂ and starter culture (1:1 combination of *Streptococcus thermophilus* and *Lactobacillus bulgaricus*) at the rate of 2% (v/v) were added, followed by the addition of rennet. After coagulation, the white cheese made was stored at 4°C. Physicochemical and sensory evaluation was done for the cheese samples. The cheese showed that milk type significantly ($p < 0.01$) affected the chemical composition of the cheese except the fat. The results also showed that crude protein and total solids were significantly ($P < 0.01$) affected by milk type, whereas the titratable acidity showed a significant difference at ($p < 0.05$) in the chemical composition of the manufactured cheese. The sensory evaluation was assayed for color, flavor, taste, texture and the overall acceptability and showed no significant ($p > 0.05$) variation. Data from this study may contribute to improve the cheese-making process in small scale, using milk from different species (sheep and goat) not from cow only.

Keywords: Milk type, Physicochemical characteristics, Sensory characteristics, Sudanese white cheese

INTRODUCTION

Cheese is the important food made from the milk of cows, goats, sheep and it is lighter weight, more reliable and has a longer shelf-life than the milk from which it is made (Smith, 2005). Cheese is the popular milk products, which is produced from raw or pasteurized cow's milk, but also from other species such as sheep and goats (Bennett and Johnston, 2004; Johnson, 2017; Khattab et al., 2019), The contributions of cheese as source of

proteins, calories, minerals and some vitamins are essential to the development of a good health (Talib et al., 2009). Cheese is a rich source of essential nutrients; in particular, proteins, bioactive peptides, amino acids, fat, fatty acids, vitamins and minerals (Walther et al., 2008).

Cheese can differ from each other by their making process, ripening time (if applied), type of milk used,

texture, color, flavor, microbial counts and diversity, coagulation type (enzymatic and/or acid)... etc (Kamimura et al., 2019).

However, each type of milk imparts the characteristics quality of cheese made from it and the resulting cheese will diver in its physicochemical and sensory proprieties (Andrew, 2010).

The major type of cheese in Sudan is Sudanese white cheese (Gibna bayda), that is produced traditionally with slight variations among the producers (El owni and Hamid, 2007; Mohamed and Elzubeir, 2018).

In Sudan cheese processing is a major preservation method of surplus milk in rural areas especially during rainy seasons when plenty of milk is available. The product is an important nutrient for humans especially under conditions where other animal proteins are not available (Kosikowski, 1982). El-Owni and Hamid (2007) stated that the most popular type of cheese produced in Sudan is the white cheese locally known as Gibna Bayda. It is generally consumed fresh or matured for a period of several months.

Although the production and consumption of cow milk is the largest throughout the world, one may observe a growing demand for milk of other farm animals, such as goats, which is recognized in developed countries as a "niche" product (Haenlein and Wendorff 2006; Krzyżewski et al., 2009). In the past the goat was known as the "poor man's cow" because people who were too poor to keep cows could support less-fussy goats.

The milk type significantly affected the cheese yield, where the cheese made from cow milk had higher yield compared to that obtained using other types of milk. Although many studies have been carried out on manufacture soft white cheese during storage, relatively few studies have been carried out in cheese processing from different milk sources; (Alizadeh and Lavasani, 2013; Ama and Iem, 2014; Kabsoun, 2016). Also according to (Assia and Omer, 2018) that milk type had significant effect on the sensory attributes of the white cheese mainly the colour and flavour of the cheese.

Therefore, the main aim of this study was to evaluate the effect of milk type on physicochemical and sensory characteristics of Sudanese white cheese using cow's , sheep's and goat's milks.

MATERIALS AND METHODS

Materials

Fresh whole cow's milk (10 liters) was obtained from College of Animal Production farm, University of Sinnar, while fresh goat's milk (10 liters) and sheep's milk (10 liters) were purchased from a private farm at Abu Naama area, Sinnar, Sudan. All samples of milk were filtered and kept at 4°C. Clean and fine sodium chloride was purchased from local market. Rennet powder was

obtained from Chr. Hansen's lab, Denmark. Three treatments were carried out for cheese processing as follows: First treatment (A), in which cheese was made with sheep's milk and second one (B), cheese was made with goat's milk, third one (C), cheese was made with cows' milk.

Cheese making

The cheese was manufactured according to the following procedure of Ibrahim (2003) with slight modifications. Briefly, 10 liters of fresh cow's, sheep's and goat's milk were heated at 72°C for 15 second and then cooled to 45°C and CaCl₂ was added at the rate of 0.02%. Addition of 5 % NaCl for each treatment then, starter culture of lactic acid (*Lactobacillus bulgaricus* and *Lactobacillus thermophilus*) were added at the rate of 2.0% and left for 30 minutes to develop acidity. Rennet tablets (one tablet / 50 liter milk) were added to the milk. The milk were mixed and left until coagulation completed. After coagulation the curd was cut vertically and horizontally into 5 cm³ with a sharp knife. The whey obtained from the cheese curd was drained and the curd was poured into small wooden boxes lined with cloth and pressed overnight. The curd was removed from the wooden boxes and cut into small cubes. The whey of each batch was collected in a separate container, boiled for five minutes, cooled and used for preservation of the particular cheese. All samples transported to the laboratory of the Department of Dairy Production, Faculty of Animal Production, University of Sinnar for chemical analysis.

Cheese samples analysis

The cheese samples were analyzed for chemical composition (total solids, protein content, fat content and titratable acidity) and sensory evaluation

Chemical analysis

The fat content was determined by Gerber's method, the protein content was determined by Kjeldahl method (AOAC, 2003). The total solids content was determined according to the modified method and the titratable acidity of the cheese was determined according to AOAC (2003).

Sensory evaluation

Samples were subjected to descriptive sensory analysis using the 5 point hedonic scale (Singh-Ackbarali and Maharaj, 2014), where 5= Excellent, 4= very good, 3= good, 2= bad, 1= very bad. Ten untrained panelists were

chosen to evaluate the quality of cheese (colour, flavour, texture, taste and overall acceptability) using a sensory evaluation sheet.

Statistical analysis

Statistical analysis programme (SPSS) Social Package for Statistical Science was used. General Linear Model was used to determine the effect of milk type on the Physicochemical and sensory evaluation of white cheese. Duncan multiple range test was used for the mean separation between the treatments.

RESULTS AND DISCUSSION

Effect of milk type on physicochemical characteristics of cheese

Table 1 and Figure 1 showed the chemical composition of different types of cheese under study. The total solids content was significantly ($P < 0.01$) higher in Sudanese white cheese made from sheep's milk (65.00%) compared to cheese made from cow's milk (54.16%) and cheese made from goat's milk (45.67%). These result of total solids content of cheese made from cow's milk (54.16%) in line with those found by Zakaria., et al (2020) and Fawaz, et al. (2011), which were (59.04%) and (60.54%) in control sample respectively. The total solids content of cheese made from goat's milk (45.67%) was in accordance of those reported by El Zubeir and Hashim (2013) who reported 46.31-46.81% for cheese made from goat milk. The total solids contents for three types of cheeses were higher than those reported by Suliman et al. (2013) who found 31.76±0.47%. Total solids of the cheese samples were affected by type of milk (cow, sheep and goat) (Table 1 and Figure 1) the highest total solids with type of milk could be attributed to the increased the total solids in cheese.

The fat content was significantly ($P < 0.01$) affected by the type of milk being high in white cheese made from sheep's milk (19.67%) followed by cheese made from goat's milk (15.34%) compared to cheese made from cow's milk (14.00%). These low fat percentages preferred for the health benefits as the less fat that would reduce the risk of obesity. The fat value of cheese made from all types of milk were in line with those reported by Warsama et al. (2006) and Suliman et al. (2013) who found 14.0% and 4.20±0.41% respectively, for white cheese. However the fat values of the three types of cheeses were lower than those reported by Hamid and El Owni (2008); Abdalla and Mohamed (2009); Elkhider et al. (2011); Sulieman et al. (2011) and Zakaria., et al (2020) who found 23.79%, 25.13%, 23.38±4.8%, 29.0-29.83% and 25.44±0.17% respectively. The high average fat content in this study for white cheese might be due to

high fat content of raw milk (Shuiep et al., 2016). The milk with different fat percent for cheese making showed significant differences ($P < 0.05$) on the total solids, ash and fat contents of cheese (Nour El Diam et al., 2010). The fat levels of milk showed significant differences ($P < 0.05$) in content of total solids, protein, fat, ash, acidity and total volatile fatty acids of Sudanese white cheese (Suliman et al., 2013)

The data presented in Table (1) and figure (1) also, showed that the protein content of cheese sample was (17.99%) in cheese made from sheep's milk and 14.80%, 13.89% in cheese made from goat's milk and cheese made from cow's milk, respectively. The highest protein content recorded in cheese sample produced by sheep's milk which was (17.99 %), while the lowest one in cheese made from cow's milk was (13.89%). This finding agreed with those of 15.9% protein content for Sudanese white cheese (Warsama et al., 2006). The protein content value of 13.07±2.17% with a range of 7.7 to 17.2% for traditional cheese and value of 15.36±6.83% with a range of 7.1 to 29.1% were reported for modern produced cheese (Mohamed and Elzubeir, 2018). On the other hand, the protein values of the cheese produced by the three types of milk were lower than those reported by Hamid and El Owni (2008); Abdalla and Mohamed (2009); Elkhider et al., (2011) and Salih et al. (2008) who found 20.41%, 23.26%, 20.20±3.68% and 22.12% values in white cheese, respectively.

Statistically, significant differences ($p < 0.01$) in protein content of cheese made from different types of milk in were found. This might be due to high protein content of raw milk which cheese made from it.

The titratable acidity (lactic acid %) of cheeses was significantly ($P < 0.05$) high in white cheese made from sheep's milk (0.84%) followed by the white cheese made from goat's milk (0.76%) compared to white cheese made from cow's milk (0.71 %). (Table 1 and Figure 1). Similarly, significant ($P \leq 0.05$) differences in the acidity of Sudanese white cheese samples that was produced by traditional and modern processing was reported (Mohamed and Elzubeir, 2018). The increase in the acidity is due to increase in lactic acid by the action of lactic acid bacteria present in the raw milk (El owni and Hamid, 2007; Hayalogou., et al. 2005). Abdalla and Ahmed (2010) reported that the high acidity of raw milk cheese could be due to the fact that storage temperature activated the natural microflora of raw milk and resulted in the development of acidity as a result of lactose fermentation.

Effect of milk type on sensory characteristics of cheese

Results in Table 2 and figure 2 present the effect of milk type on sensory characteristics of cheese. The milk type did not significantly ($p > 0.05$) affect the quality of cheese

Table 1: Chemical composition of Sudanese white cheese produced from Sheep's, Goat's and Cow's milk

Cheese type	Parameters			
	Total solids (%)	Protein (%)	Fat (%)	Acidity (%)
sheep's milk cheese	65.00 ^a	17.99 ^a	19.67 ^a	0.84 ^a
Goat's milk cheese	45.67 ^c	14.80 ^b	15.34 ^b	0.76 ^{ab}
Cow's milk cheese	54.16 ^b	13.89 ^b	14.00 ^b	0.71 ^b
SE	0.42	0.32	1.67	0.02
LS	**	**	**	*

SE = Standard Error

LS = Level of Significance

** : significant at (P<0.01)

* : significant at (P<0.05)

NS: no significant

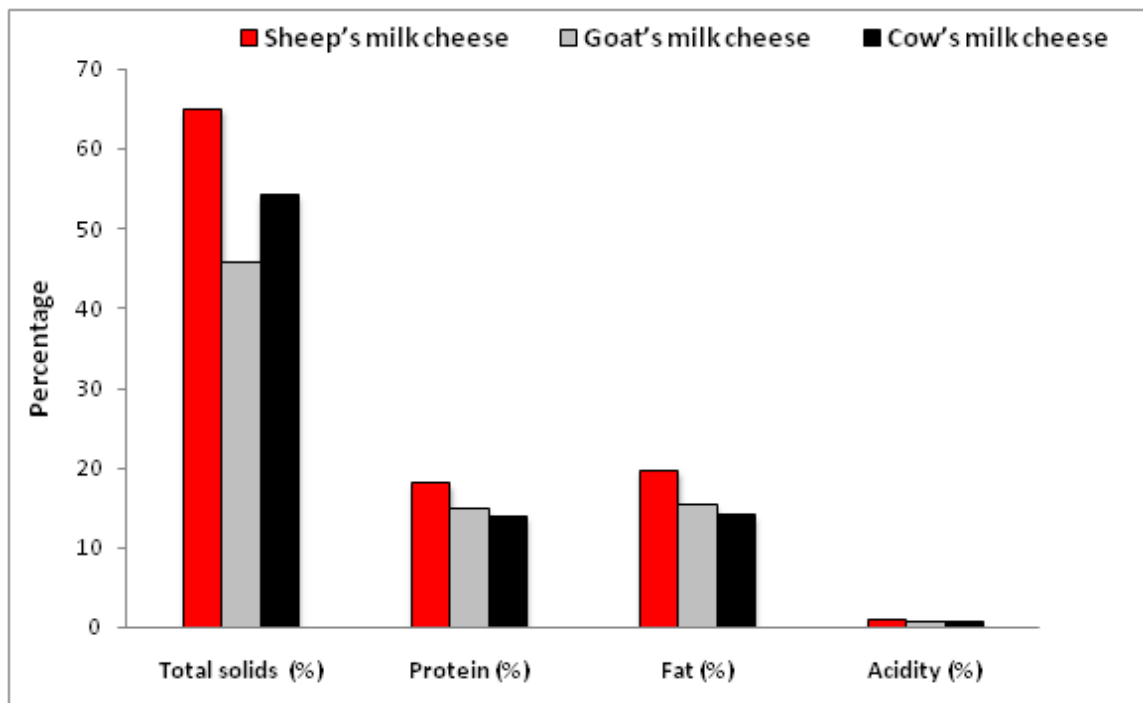


Figure 1. Comparison of chemical composition of Sudanese white cheese produced from Sheep's, Goat's and Cow's milk

Table 2 Sensory characteristics of Sudanese white cheese produced from Sheep's, Goat's and Cow's milk

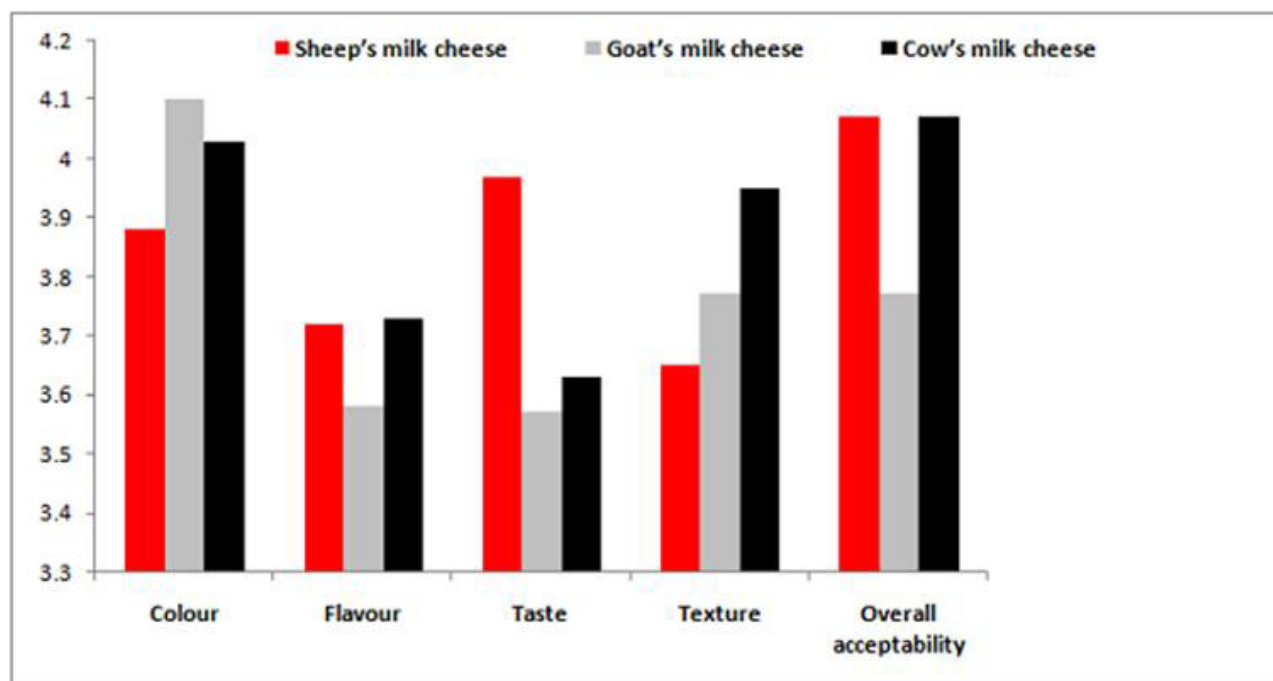
Cheese type	Parameters				
	Colour	Flavour	Taste	Texture	Overall acceptability
sheep's milk cheese	3.88	3.72	3.97	3.65	4.07
Goat's milk cheese	4.10	3.58	3.57	3.77	3.77
Cow's milk cheese	4.03	3.73	3.63	3.95	4.07
SE	0.08	0.16	0.09	0.08	0.90
LS	NS	NS	NS	NS	NS

SE = Standard Error

LS = Level of Significance

NS = no significant

5= Excellent, 4= very good, 3= good, 2= bad, 1= very bad

**Figure 2.** Comparison of Sensory characteristics of Sudanese white cheese produced from Sheep's Goat's and Cow's milk

in terms of colour, flavor, taste, texture and overall acceptability. However, the present result were in line with (Abdalla and Abdel Razig, 1997) they stated that the best cheese was obtained from cows' milk, followed by goats' milk and mixed one; and also with the findings of (Queiroga et al., 2013) who concluded that cows' and goats' milks had significant differences in sensory characteristics of Coalho cheese. The variation of colour and flavor of cheese may be attributed to the variation of fat composition of milk (Carpino et al., 2004).

CONCLUSION

The present study concluded that there were significant variations in the chemical composition of cheeses, which were manufactured from different types of milk. Significantly higher protein content was recorded in the cheese manufacture from sheep's and cow's milk. Hence it was recommended that sheep's and cow's milk is good source of high-quality protein that should be encouraged to be use in cheese manufacturing.

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