

Effect of type of milk on the yield, physico-chemical and sensory characteristics of mudaffara cheese.

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ABSTRACT

The effect of type of milk on the yield, physico-chemical and sensory characteristics of mudaffara cheese were studied.

Mudaffara cheese was made from cow's goat's and mixed (1:1 cow's and goat's) milk. Starter culture (1:1 combination of *Streptococcus thermophilus* and *Lactobacillus bulgaricus*) at the rate of 2% (v/v) was added, followed by the addition of CaCl_2 (0.02% w/w) and rennet (1 tablet / 50 kg milk). After coagulation, the curd was cooked till the suitable acidity was reached, then it was immersed in hot water and braided.

Cheese was stored in polythene bags (thickness of 0.03 mm) at 6 °C for 8 weeks and analyzed for fat, protein, total solids, ash contents, titratable acidity and pH value, in addition to sensory evaluation (color, flavor, taste, texture and overall acceptability). In addition, cheese yield and weight loss were evaluated.

The results indicated that there was no significant difference between the three types of milk in the final cheese weight and percent weight loss ($P > 0.05$). The final cheese weight was 107.08, 107.33 and 106.70 gm, while the percent weight loss was 17.62, 17.43 and 17.9% for cow's goat's and mixed milk cheese respectively.

The type of milk significantly ($P < 0.001$) affected fat, protein, total solids and ash contents. The values for cow's, goats, and mixed milk cheese being 22.77, 20.09 and 22.7% for fat; 28.47, 30.26 and 29.68% for protein; 56.57, 55.76 and 56.05% for total solids and 3.63, 4.22 and 3.79% for ash content respectively. However, there no significant difference ($P > 0.05$) between the three types of milk cheese in acidity and pH value. Cheese from cow's milk had the highest acidity (0.88%) and lowest pH value (4.22), while goat's milk produced cheese with lowest acidity (0.79%) and highest pH value (4.26).

There was no significant difference ($P > 0.05$) between the three types of milk in sensory characteristics of mudaffara cheese.

INTRODUCTION

In Sudan the traditional cheese making is concentrated in El-Duem, El-Obeid and in some other areas where there is a surplus fresh milk and there is no suitable method of preservation (Macquart and Bujanbe, 1960; Ibrahim, 1970).-There are two types of local Sudanese cheeses: white cheese (Gibna Baida), a soft white cheese with a sour and salty taste, and mudaffara cheese, a local braided semi-hard unripened cheese with close texture and yellowish color, slightly acid and salt taste. It is known in the urban communities of Sudan (FAO, 1990).

In the urban areas, the consumption has always shown a particular preference to mudaffara cheese (Ahmed, 1987). However, the manufacture of this cheese needs highly experienced and skilled workers. In addition, the method of manufacture needs to be improved in order to produce a safe product with good quality (Ahmed, 1987).

Mudaffara cheese is thought to be either originated in the Middle East countries and introduced to Sudan from Syria, or originated in the Mediterranean areas (Ahmed, 1987).

The general practice used in the Sudan is that mudaffara cheese is made from raw whole milk, partially skimmed or a mixture of skim milk and whole cow's sheep's or goat's milk (Ahmed, 1995). In Sudan goat's milk has no great role in cheese processing although large quantities of milk are produced.

This research work was an attempt to improve the manufacturing method of mudaffara cheese from cow's and goat's milk and to evaluate the resultant cheese chemically and organoleptically.

MATERIALS AND METHODS

Source of milk, rennet, starter cultures, spices and salt

Milk samples (10 kg) each of whole cow's goat's and mixed (50:50 of cow's and goat's) milk were used. The cow's milk was brought from the University of Khartoum Farm, while goat's milk was brought from Animal Production Administration Farm at Kuku.

Rennet tablets (Chris Hansen's Laboratories. Copenhagen, Denmark) were obtained from the Ministry of Animal Resources (1 tablet coagulates 50 kg milk). The starter culture (1:1 combination of

Streptococcus thermophilus and *Lactobacillus bulgaricus*) was kindly supplied by Khartoum Dairy Products Company Ltd. (KDPC). Black cumin (*Nigella sativa*) and clean finely powdered sodium chloride (NaCl) were obtained from the local market.

Mudaffara cheese manufacture

Milk was heat-treated at 72 °C for one minute, poured into a double jacketed cheese vat and cooled to 40 °C. Active starter culture (2% v/v) was added to milk and left for 15 minutes to develop acidity (milk ripening period). Calcium chloride (CaCl₂) at the rate of 0.02% (w/w) was added. One tablet of rennet was dissolved in 10 ml cold tap water, and two ml were taken and added to 10 kg at 40 °C. Milk was stirred for 5 minutes to ensure uniform distribution of rennet, then the milk was left undisturbed to develop a curd.

After a smooth thick curd was formed (20-24 minutes), it was cut into small pieces (1.5 x 1.5 inch) and gently agitated in whey for 5 minutes. The curd was then left in the whey for 30 minutes, after which the whey was drained. The curd was scalded to 42 °C using warm water filled in double jacketed cheese vat. The curd was turned every 20 minutes during scalding. The titratable acidity of the whey was measured every 30 minutes for 2-2¹/₄ hours. When the acidity of the whey reached 0.54-0.64%, the curd became a smooth and an elastic mass. The curd was then cut into small cubes (3x3x3 inches). Four to five pieces were taken at a time and put in a hot water (80 °C) for 5-7 min using wooden paddles until the curd turned into a smooth paste that showed a satisfactory stretching to a rope of >4 meters long. Black cumin (*Nigella sativa*) was added to the hot paste at the rate of 4 gm/kg cheese curd before braiding.

The hot paste was braided by hand into a tress of 25-35 cm length. The tress was then washed with cold sterilized water. The braided cheese was immersed into 8% (w/w) pasteurized salted whey for two days in the refrigerator. The cheese samples (130 gm each) were packed in polythene bags (thickness of 0.03 mm). The samples were stored at 6 °C. The analysis was carried out at 0, 2, 4, 6 and 8 week intervals.

Chemical analysis of milk and mudaffara cheese

The fat content (Gerber method), the protein content (Kjeldahl method), ash content and acidity were determined according to AOAC (1990), while total solids content was determined according to the modified method of AOAC (1990). The pH value was measured using pH-meter (Model E390 Metrohm Ltd., Herisau, Switzerland).

Sensory evaluation

A panel of 10 untrained panelists were used to judge on the quality of cheese in terms of texture, flavor, color, taste and overall acceptability.

Statistical analysis

Statistical analyses were performed using the Statistical Analysis Systems (SAS, 1988). General Linear Models (GLM) were used to determine the effect of type of milk (cow's, goat's and mixed milk) on fat, protein, total solids, ash and titratable acidity as well as sensory characteristics (color, flavor, texture, taste and overall acceptability). Means were separated using Duncan Multiple Range test with an *as* 0.05 (SAS, 1988).

RESULTS AND DISCUSSION

Effect of type of milk on weight loss

There was no significant difference between the three types of milk (cow's, goat's and mixed) in the final cheese weight and percent weight loss ($P > 0.05$). The final cheese weight was 107.08, 107.33 and 106.7 gm for cow's, goat's and mixed milk cheese respectively, while the percent weight loss was 17.62, 17.43 and 17.90% for cow's, goat's and mixed milk respectively.

The yield of mudaffara cheese obtained in this study was higher than that reported by Ahmed (1987), which might be attributed to heat treatment of milk in this study that resulted in a better retention of protein and mineral salts in cheese curd (zaki, *et al.*, 1974; Patel *et al.*, 1986). Consequently this gave a significantly higher total solids content, in addition milk used in this study had a higher fat content than that used by Ahmed (1987). The high fat content lead to increased cheese yield (Patel *et al.*, 1986). The cheese yield expressed as kg/1000 kg milk was found 12.20, 11.49 and 11.89 for cow, goat and mixed milk respectively. Cheese yield from cow's milk was higher than that of goat's and mixed milk. This might be due to high total solids and fat contents of cow's milk (Table 1).

Effect of type of milk on the chemical composition of mudaffara cheese

The type of milk significantly affected ($P < 0.001$) fat, protein, total solids and ash contents. However, there was no significant difference ($P > 0.05$) between the three types of milk in acidity and pH (Table 2).

Table 1. Chemical composition of milk used for mudaffara cheese-making.

Item	Cow's	Type of milk Goat's	Mixed
Fat (%)	4.40	3.90	4.22
Protein (%)	3.45	3.59	3.52
Total solids (%)	12.75	11.95	12.62
Ash (%)	0.67	0.80	0.72
Titratable acidity			
(% lactic acid)	0.19	0.18	0.18
pH value	6.5	6.5	6.5

Table 2. Effect of type of milk on the chemical composition of Mudaffara cheese.

Type of milk			
Item	Cow's	Goat's	Mixed
Fat (%)	22.77 ^a	20.09 ^b	22.70 ^a
Protein (%)	28.47 ^b	30.28 ^a	29.68 ^a
Total solids (%)	56.57 ^a	55.76 ^b	56.95 ^a
Ash (%)	0.63 ^a	4.22 ^b	3.79 ^a
Titratable acidity			
(% lactic acid)	0.88 ^a	0.79 ^a	0.83 ^a
pH value	4.22 ^a	2.26 ^a	4.24 ^a

Means within the row bearing the same superscripts are not statistically significant ($P > 0.05$).

Table 3. Effect of type of milk on the sensory characteristics of Mudaffara cheeses.

Item	Type of milk		
	Cow's	Goat's	Mixed
Color	4.20 ^a	4.18 ^a	4.17 ^a
Flavor	3.87 ^a	3.88 ^a	3.97 ⁸
Texture	4.07 ^a	4.25 ^a	4.04 ^a
Taste	4.28 ^a	4.25 ^a	4.25 ^a
Overall acceptability	4.67 ⁸	4.65 ^a	4.63 ^a

Means within the row bearing the same superscripts are not statistically significant ($P > 0.05$).

Color, taste and overall acceptability:

1. Unacceptable. 2. Moderately unacceptable 3. Slightly acceptable 4. Moderately acceptable 5. Acceptable.

Flavor : 1. Bland 2. Slightly inter 3. Moderately inter 4. Externally inter.

Texture : 1. Hard. 2. Moderately hard. 3. Slightly soft. 4. Moderately soft. 5. Soft.

The fat content was highest when cheese was made from cow's milk (22.77%) and low when cheese was made from goat's milk (20.09%). Goat's milk produced cheese with highest protein and lowest total solids contents. The ash content was high when cheese was made from goat's milk. Cheese from cow's milk had the highest acidity and lowest pH value, while goat's milk produced cheese with lowest acidity and highest pH.

Cow's milk cheese had higher fat content which may be attributed to higher fat content in cow's milk compared to others. Abdel Razig (1996) reported higher fat content in white soft cheese made from cow's milk while Ahmed (1987) and El-Abid *et al.*, (1992) reported lower fat content in mudaffara and Rass cheeses respectively. The fat content increased as the moisture content decreased.

The protein content was higher in goat's milk cheese. This value was in agreement with the findings of El-Abid *et al.*, (1992) but in disagreement with those of Ahmed (1987). This might be due to high protein content in goat's milk in this study.

The total solids content of cow's milk cheese was higher than mixed and goat's milk cheeses. These results agreed with those of Ahmed (1987) and Abdel Razig (1996) and in disagreement with those of El-Abid *et al.*, (1992).

The ash content was higher in goat's milk cheese. This might be due to higher ash content in goat's milk, a result which agreed with the findings of Abdel Razig (1996).

The titratable acidity was highest in cow's milk cheese, while the pH was lower in cow's milk cheese. This result agreed with the reports of Abdel Razig (1996).

Effect of type of milk on sensory characteristics of mudaffara cheese

Table 3 showed that there was no significant difference between the three types of milk in the sensory characteristics of mudaffara cheese ($P > 0.05$).

Regarding the organoleptic properties of mudaffara cheese from the three types of milk, color and texture from the three milk samples gradually deteriorated to wards the end of storage period, while the flavor improved till the fourth week, and the taste improved till the second week of storage period, and thereafter both parameters gradually deteriorated till the end of the storage period.

Cheese from cow's milk scored better till the fourth week of storage period, followed by mixed milk and goat's milk cheeses. It was observed from the study that cheeses from the three types of milk

were of high quality, good color, attractive and glossy with firm texture, good consistency, good flavor and more elastic till the fourth week of storage period. Cheese from cow's and mixed milk had glistening yellow color, while that of goat's milk had white color. Goat's milk cheese had a sharp pungent flavor.

In conclusion, yield, total solids and acidity were higher in cow's milk cheese, while protein and ash contents and pH value of goat's milk cheese were higher. Cheese from the three types of milk was organoleptically acceptable with the best results being obtained from cow's milk cheese.

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