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Processing, composition and sensory characteristic of yoghurt made from camel milk and camel–sheep milk mixtures

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ABSTRACT

The present study was conducted with the objective of improving the processing properties of camel milk yoghurt by mixing with sheep milk and comparing 2 different starter cultures. Six types of yoghurts were produced from camel and camel–sheep milk mixture as follows: As1, As2, Bs1, Bs2, Cs1 and Cs2. Where A: pure camel milk, B: 60% camel milk + 40% sheep milk and C: 40% camel milk + 60% sheep milk. The s1: (YC-X11 Thermophilic Yoghurt Culture) and s2: (CH-1 Thermophilic Yoghurt Culture). The milk samples were first pasteurized at 63 °C for 30 min and then cooled to 43 °C before adding the starter culture. The incubation was carried out in plastic cups at 43 °C. The chemical composition and sensory evaluation were carried out for the produced yogurts. The coagulation time were: 17 ± 0.50, 15 ± 0.058, 10.5 ± 0.29, 9 ± 0.50, 6 ± 0.29 and 5 ± 058 h for As1, As2, Bs1, Bs2, Cs1 and Cs2, respectively. Yoghurts consistency was fluidic in As1 and As2, slightly firm in Bs1 and Bs2, and firm in Cs1 and Cs2. Yoghurt made from camel–sheep' milk mixtures had higher total solids, fat and protein content compared to those made from pure camel milk ($P < 0.05$). The acidity level was significantly affected ($P < 0.05$) by the percentage of sheep milk in the yoghurt. In conclusion, camel milk can serve as suitable source for processing into fluidic or drinking yoghurt. However, mixing with sheep milk (40–60%) improves its composition and acceptability, which improves the marketability of camel and sheep milk.

1. Introduction

The composition and consistency of fermented products made from camel milk vary according to the method of processing (El Zubeir and Ibrahium, 2009; Ahmed et al., 2010 and Suliman and El Zubeir, 2014). Processing methods and geographical localities affect microflora composition (Beukes et al., 2001; Mathara et al., 2004; Chammas et al., 2006; Zamfir et al., 2006; Dewan and Tamang, 2007; Hassan et al., 2008; Suliman and El Zubeir, 2013). Traditionally, fermented camel milk is allowed to ferment naturally without prior heat treatment and without addition of starter cultures (Hassan et al., 2008 and Shori, 2012). The mean log of the *Streptococcus* spp. and *Lactobacilli* spp. counts from non-cultured fermented camel milk ranged from 7.3 to 8.4 and 7.8 to 8.7 respectively (Abdelgadir et al., 2008; Hassan et al., 2008 and Suliman and El Zubeir, 2013).

The milk of dromedary is considered as nutritious food, particularly when converted into yogurt. However, frequently it is described as substance that is not processed easily into yogurt (Attia et al., 2001 and Hassan et al., 2006). In particular, in order to be accepted by consumers, there is a need to improve its consistency (Hashim et al., 2008; Abdel Rahman et al., 2009; El Zubeir et al., 2012a,b). Textural attributes, including the desired oral viscosity, are important criteria for quality and consumers acceptance of yoghurt (Walstra, 1998).

Sheep milk is an excellent raw material for processing milk into yoghurt (Park et al., 2007). Ewe's yoghurt has a pleasant creamy–sour flavor, considered by many to be better than cows' yoghurt (Kurmann, 1986). Yoghurt made from sheep milk form firm acceptable texture and the best flavor score was reported (El Zubeir et al., 2012b).

The aim of the present study was to improve the processing properties of yogurt made from camel milk by mixing it with various proportions of sheep milk. The suitability of 2 cultures was evaluated. Products were evaluated by chemical composition and consistency.

2. Material and methods

The experiment was carried out at the Department of Dairy Production, Faculty of Animal Production—University of Khartoum during the period from April 2012 to May 2012.

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2.1. Source of milk

Camel milk (10 L) and sheep milk (5 L) were obtained from local farm at Khartoum North. Both milk samples were examined by using milk analyzer Lactoscan 90 according to the manufacture instructions (Milkotronic Ltd., Europe) to determine fat, protein, lactose, SNF contents and density of the milk samples. Then mixtures (3 replicates, 5 L for each combination) of camel and sheep milk were prepared as follow: (A) 100% camel milk, (B) 60% camel milk, and (C) 40% camel milk.

2.2. Preparation of yoghurt

Yoghurt samples were made from camel and camel–sheep milk mixture by several percentages as shown in Table 1. The milk samples were pasteurized at 63 °C for 30 min according to Attia et al. (2001) and cooled to 43 °C. Then the starter cultures were added at a concentration of 0.140 g/L for AS1 and 0.042 g/L. The incubations were carried out into plastic cups at 43 °C and proceeded until formation of the coagulum. The formation of the coagulum was observed visually together with the measurement of the acidity by titration (AOAC, 2003). The chemical composition and the sensory evaluations were done on the formed yoghurts. Determination of the shelf life was based on titratable acidity, sensory evaluation, microbiological examination (data is not shown) and the visual examination.

2.3. Chemical analysis of yoghurt

Total solids content was determined by forced draft oven method, the fat content was determined by Gerber method, the protein content was determined by Kjeldahl method and the ash was determined by gravimetric method (AOAC, 2003). The titratable acidity was determined by titration according to AOAC (2003).

2.4. Sensory evaluation

Ten unprofessional panelists were asked to score the quality of yoghurt according to: color, flavor, texture, taste, and overall acceptability. The score was based on the ranking method described by Ihekoronye and Ngoddy (1985).

2.5. Statistical analysis

The data were analyzed using statistic version 8 (2003). Analysis of variance was run according to the following statistical model

$$Y_{ij} = \mu + T_i + e_{ij}$$

where:
Y_{ij} = the observation
μ = overall mean
T_i = the fixed effect of treat (1,2,3 . . .. 6)
e_{ij} = random error term
The significant differences between means were separated by LSD and determined at $P \leq 0.05$.

3. Results

3.1. Chemical composition of milk

Yoghurts made from sheep milk had higher content of lactose, fat, protein, density and solids non fat, than in camel milk (Table 2).

3.2. Coagulation of yoghurt

The Cs1, Cs2, Bs1 and Bs2 yoghurts had shorter coagulation time compared to As1 and As2. Yoghurt made from pure camel milk (As1 and As2) tend to be more liquidic than those made from camel–sheep milk mixtures (Table 3).

3.3. Titratable acidity during incubation of yoghurt samples

Fig. 1 depicts the rate of increase of lactic acid content in the tested yoghurts. The lactic acid percentage at the start of the processing (0 h) were: 0.25 ± 0.012%, 0.26 ± 0.012%, 0.27 ± 0.012%, 0.29 ± 0.012%, 0.31 ± 0.012% and 0.34 ± 0.012% for As1, As2, Bs1, Bs2, Cs1 and Cs2, respectively. Sharp increase in lactic acid content was observed up to third hour of fermentation. After 5 h of incubation, it was noticed that Bs1, Bs2, Cs1 and Cs2 yoghurts had higher content of lactic acid than As1 and As2 (Fig. 1).

3.4. Chemical composition of yoghurt samples

Significant variations ($P < 0.05$) and chemical composition of As1 and As2, Bs1, Bs2, Cs1 and Cs2 yoghurts were found. Similarly, there were significant ($P < 0.05$) variations between chemical composition of yoghurt made by using YC-X11 (s1) and CH-1 (s2) starter cultures. The content of total solids, fat and protein were higher in Bs1, Bs2, Cs1 and Cs2 yoghurts compared to As1 and As2 yoghurts. However, ash content was similar in all type of yoghurts (Table 4).

3.5. Sensory evaluation of yoghurt made from camel and camel–sheep milks

The panelists scored similarly the colors of As1 and As2, Bs1, Bs2, Cs1 and Cs2 yoghurts (Table 5). However, the score of flavor of As1 and As2 differed significantly from those of Bs1, Bs2, Cs1 and Cs2 yoghurts. The score of flavor in Bs1 and Cs2 yoghurts was higher than in As1 and As2 yoghurts. Increasing of the percentage of sheep milk significantly ($P < 0.05$) affected the texture of yoghurt. The texture with the lowest consistency was found in As1 and As2 yoghurt samples. Significant ($P < 0.05$) variations were found between scores of the taste among As1, As2, Bs1, Bs2, Cs1 and Cs2 yoghurts. The lower score of taste was in As1 yoghurt (Table 5). Significant ($P < 0.05$) variations among scores for the overall acceptability of As1, As2, Bs1, Bs2, Cs1 and Cs2 yoghurts were found. Increase in the proportion of sheep milk in mixture was associated with higher score for acceptability; As1 and As2 yoghurts had the lowest acceptability due to their watery texture.

Table 1
Description of the milk and starter cultures used for yoghurt preparation.

Type of milk	A: pure camel milk		B: 60% camel milk + 40% sheep milk		C: 40% camel milk + 60% sheep milk	
Starter cultures used	s1: (*Streptococcus thermophilus* and *Lactobacillus delbruckii* sub spp. *bulgaricus* (YC-X11 thermophilic yoghurt culture–Yo-Flex CHR HANSEN)			s2: (CH-1 thermophilic yoghurt culture–Yo-Flex CHR HANSEN)		
Types of yoghurt produced	As1	As2	Bs1	Bs2	Cs1	Cs2