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The Effect of Storage on Chemical, Microbial and Sensory Characteristics of Goat's Milk Yoghurt

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ABSTRACT: Goat's milk yoghurt was evaluated during storage at the laboratory of Department of Dairy Production, Faculty of Animal Production, University of Khartoum. The total solids, fat, protein, lactose, ash and acidity of goat's milk yoghurt percent results are, 13.73±0.10, 4.58±0.10, 3.48±0.18, 4.81±0.14, 0.74±0.03 and 1.18±0.07 respectively. Total bacterial count, *Streptococcus theromphilus* count and *Lactobacillus bulgaricus* count and sensory evaluation (color, flavor and texture) were estimated on the zero, 3rd, 6th, 9th and 12th days of storage. Results obtained revealed significant ($p< 0.05$) variation in total solids, fat, titrable acidity, TBC, *Streptococcus thermophilus* count, color, texture and flavor w. Moreover high significant ($p< 0.01$) variations in protein, lactose and *Lactobacillus bulgaricus* count and non significant variation was noticed in ash content.

***Keywords*:** Cow's milk yoghurt, chemical, microbiological, sensory characteristics.

INTRODUCTION

Yoghurt is a fermented and coagulated milk product with a smooth texture having mild sour taste and pleasant flavor. It's obtained from pasteurized or boiled milk by natural souring or by using lactic acid fermented bacteria (Soomro *et al.*, 2003). The nutritional and health benefits of yoghurt are numerous. It is a good source of proteins, energy (calories), vitamins and minerals. As a fermented product, it may also have therapeutic value and may also result in reduced incidences of lactose intolerance (Fernandez-Garcia. *et al*., 1994 and Robinson and Dombrowski, 1983). France and Spain established the requirement of a minimum viable lactic acid bacteria number during yoghurt's shelf-life of $5x10^8$ cfu/ml^{1-} (IDF, 1988). Other countries have established values of 10^6 cfu/ml^{1-} (Switzerland and Italy), 10^7cfu ml^{1-} (Japan), 10^8 cfu/ml^{1-} (Portugal) and 10^7cfu/ml^{1-}(Turkey) (Birollo *et al*., 2000 and Anonym, 2001).

Today goat milk and its products play an important role in certain parts of the world due to their beneficial health effects. Goat milk is preferred more in the nutrition of babies, children and patients in many countries like Germany and France according to it's outstanding physiological, microbiological and technological properties (Haenlein, 1993). The feeding of goat milk instead of cow milk as part of the diet resulted in significantly higher digestibility and absorption of iron and copper, thus preventing anemia (Barrionuevo *et al*., 2002).

Goats are reported to play special role in the life of small holder farmers. Their small size makes it possible for farmers to keep a large herd in small area (Boylan *et al.*, 1996). Goat milk is known to have better qualities such as digestibility and longer shelf life when processed than cow milk. Goat's milk can be processed into yoghurt, fermented milk, cheese, butter and cream (Ohiokpehai, 2003)

Knowledge of the behavior of yoghurt during storage is important, because its shelf life is based on whether the product displays any of the physical, chemical, or sensory characteristics that are un acceptable for consumption (Salvador and Fiszman, 2004).

Goat in Sudan provides milk for people in different areas, most of these areas lack infrastructure, so faces with many problems to keep milk and milk products in a good quality. The aim of this work was to study the effect of the chemical, microbial and sensory characteristics of goat's milk yoghurt during storage.

MATERIALS AND METHODS

Source of milk: Goat's milk was obtained from a local farm at Shambat, Khartoum North.

Manufacture of yoghurt

The milk was heated to 95°C for 10 minutes. A yoghurt themophilic starter culture YO-MIX 505 LYO DCU which is a mixture of Streptococcus thermophilus and Lactobacillus bulgaricus ssp in freeze dried form, Danisco France. Culture was added at rate of 3% (w/v). The inoculated milk was incubated at 45°C for four hours. Then the set yoghurt was cooled to 10°C and kept for 12 days.

Chemical analysis

The total solids content, ash and protein were determined according to the methods of AOAC (1990). The fat was determined by Gerber methods described by Bradley et al. (1992). The acidity was determined according to Foley et al. (1974). The lactose content was determined by subtracting fat, protein and ash from total solids.

Microbial analysis

Samples were examined for total bacterial count (TBC) according to Houghtby et al. (1992), Streptococcus thermophilus and Lactobacilus bulgaricus was determined according to Frank et al. (1992). Plate count agar (Scharlau 01-161) was used for enumeration of total bacterial count (TBC). M17 medium (Scharlau 01-247) was used for enumeration of Streptococcus thermophilus (IDF, 1981). MRS broth (Scharlau 01-135) was used for enumeration of Lactobacilus bulgaricus.

Sensory evaluations

The sensory evaluation of yoghurt was done by participants uses a nine-point scale (9 for 'like extremely' down to 1 for 'dislike extremely') to score each attribute (Lawless and Heyman, 1999).

Statistical analysis

The data were analyzed statistically using complete randomized design (CRD). ANOVA test was used to determine the significance level of the treatments, while the least significant difference (LSD) was used for mean separation at $P \leq 0.05$. The analysis was carried out using SPSS for Windows 10.0 package program.

RESULTS AND DISCUSSION

Total solids content was affected significantly during storage (Table 1). The result was in agreement with that of Anjum *et al*. (2007) who reported that total solids decreased gradually during storage period. The result was disagreed with that of Kavas *et al*. (2003) who reported that it is accepted that the increase during 14 days on total solids content was not significant and attributed to the evaporation, it's supported Akalin (1993) who reported that the increase determined during the storage period is normal.

The fat content was significantly affected during storage (Table 1). This could be attributed to the breakage of lipid during fermentation process, so that fat content decrease (Koestanti and Romziah, 2008). The result was disagreed with Anjum *et al*. (2007) who reported that fat percent did not change during storage. On the other hand the present result showed higher value than that of Guler and Mutlu (2005) who reported that the fat content of bio-yoghurt made from goat's milk was 3.1%.

Table (1) shows the higher variation in protein during storage. The result was in agreement with that of Serra *et al*. (2009) who reported that in all treatments studied, caseins were hydrolyzed and hydrophobic peptides were increased during storage, as reflected by the increase in soluble nitrogen at the end of the storage. The result disagree with Koestanti and Romziah (2008) who reported that during the fermentation process, the *Lactobacillus bulgaricus* and *Streptococcus thermophilus* microbe biomass were increased, thus the sum of microbe protein was increase, that automatically increasing protein inside the yoghurt.

Table (1) presents the higher variation in lactose during storage. This could be attributed to the lactose content decreased as dose of starter culture and storage period increased (Anjum *et al*. 2007). This was supported Goodenought and Kleyn (1976) who reported that the decrease in lactose content during storage is due to production of lactic acid.

Ash content was not significantly affected during storage. (Table 1). The ash result disagree with that of Hidiroglou and Proulx (1982) who reported that milk Ca, P and Mg contents were all highest during the first day of storage then decrease sharply at 2nd day. The ash result was lower than that of Nahar *et al*. (2007) who reported that the ash percent of goat's milk Dahi was 0.784±0.06.

The study revealed significant increased in acidity during storage (Table 1). This could be attributed to the changed of organic acids content in yoghurt during fermentation and cold storage. In addition to decrease in pH of yoghurt during storage (Fernandez-Garcia *et al*. 1994).

Table (2) shows high significant variations of TBC numbers during storage. The cell numbers significantly decreased due to the over produced lactic acid and decreased pH during storage (Sun and Griffiths 2000) and Sofu and Ekinci (2007). On the other hand the present result was of higher value than that of Nahar *et al*. (2007) who showed that the total viable bacteria count per ml of Dahi prepared from goat milk was 5.859±0.05 (log value).

Table (2) reflects significant variations in numbers of *Streptococcus subsp*. and *Lactobacillus subsp*. during storage. The results were in accordance with that of Ekinci and Gurel (2008) who reported that the viable counts of *Streptococcus thermophilus* in control during storage changed from 8.33 log (cfu g^{1-}) on day 1to 6.33 log (cfu g^{1-}) on day 15. The decrease in bacterial numbers during storage, could be due to the lower storage temperature and over acidification have been reported to limit the growth of *Lactobacillus delbureckii spp*. *blugaricus* (Kenifel *et al*.1992). In addition yoghurt which is produced by starter culture has high numbers of yoghurt bacteria means that yoghurt produced by using starter culture has higher therapeutic and/or antimicrobial properties beside their organoleptic characteristics (Irkin and Eren, 2008).

Table (3) showed significant variations of colors during storage. The result agreed with Sofu and Ekinci (2007) who reported that the color block with grayish-greenish yellow color was dominant in both whole- and low-fat yoghurts at the end of storage. The presence of these colors is associated with microbial spoilage of the food product. The color analysis data were parallel to pH and microbial count data. The result obtained was disagreed with the finding of Salvador and Fiszman (2004) who reported that no significant changes in relation to time were found in color, flavor intensity and sweetness for either type of yoghurt. The score of all sensory parameters significantly decreased after the addition of goat milk, except whiteness and creaminess which increased significantly when more goat's milk was added.

Table (3) demonstrates significant variations of flavor during storage. The result observed confirmed the finding of Ekinci and Gurel (2008) who reported that, in general, the level of carbonyl compounds decreased during cold storage. This could be associated further with metabolic activity of the starter cultures during the storage period. It's also supported Ozer (2006) and Radi *et al*. (2009) who reported that acetaldehyde, which is main flavor substance in yoghurt, metabolized to ethanol via alcohol dehydrogenase of *Streptococcus thermophilus*. Flavor scores at zero time were significantly higher than of two weeks.

Table (3) shows significant variations of texture during storage. The result was in accordance with Mumtaz *et al*. (2008) who reported that texture was affected significantly during storage in all experimental yoghurts. The result was in disagreement with those of Radi *et al*. (2009) who reported that the different yoghurt samples showed similar texture after two weeks of storage as that of zero time. Also it's supported by Herrero and Requena (2006) who found that the texture properties were maintained constant throughout the shelf- life of the product.

The present study concluded that the yoghurt qualities were clearly affected during storage. These expressed in high significant effect of protein, lactose and numbers of *Lactobacillus bulgaricus* and significant effect in total solids, fat, acidity, color, flavor, texture, numbers of *Streptococcus thermophilus* and numbers of TBC. Moreover the viable lactic acid was in line with that required by international standards. Therefore yoghurt must be kept under good conditions.

Table 1. Variations of chemical composition of goat's milk set yoghurt during storage

Items	(0) mean±sd	(3) mean±sd	(6) mean±sd	(9) mean±sd	(12) mean±sd	L.S
Total Solid (%)	13.73±0.10 c	13.60±0.09 b	13.55±0.10 b	13.27±0.29 b	13.10±0.32 a	*
Fat (%)	4.58±0.10 b	4.60±0.14 b	4.58±0.10 b	4.55±0.20 b	4.40±0.08 a	*
Protein (%)	3.48±0.18 b	3.53±0.17 b	3.44±0.22 b	3.66±0.31 c	3.31±0.10 a	**
Lactose (%)	4.81±0.14 b	4.73±0.20 b	4.69±0.30 b	4.31±0.38 a	4.68±0.17 b	**
Ash (%)	0.74±0.03 a	0.74±0.04 a	0.73±0.02 a	0.73±0.03 a	0.71±0.02 a	N.S
Acidity (%)	1.18±0.07 a	1.31±0.10 b	1.43±0.19 b	1.51±0.13 b	1.51±0.15 b	*

*= p≤0.05
**= p≤0.001
NS=P>0.05
Means with the same raw being similar subscript letter are not significantly affected (P> 0.05).

Table 2. Variations of microbial of goat's milk set yoghurt during storage

Items	(0) mean±sd	(3) mean±sd	(6) mean±sd	(9) mean±sd	(12) mean±sd	Total Mean mean±sd	L.S
Log Streptococcus	9.62±0.21 a	11.59±0.30 b	9.92±0.40 a	10.61±0.24 a	9.41±0.10 a	10.23±0.85	*
Log Lactobacillus	10.11±0.36 b	11.68±0.31 c	10.32±0.43 b	10.59±0.29 b	8.85±0.59 a	10.31±1.00	**
Log TBC	11.30±1.00 a	12.16±0.03 b	12.20±0.11 b	11.80±0.43 b	11.18±0.12 a	11.73±0.60	*

*= p≤0.05
**= p≤0.001
Means with the same raw being similar subscript letter are not significantly affected (P> 0.05).

Table 3. Variations of sensory evaluation of goat's milk set yoghurt during storage

Items	(0) mean±sd	(3) mean±sd	(6) mean±sd	(9) mean±sd	(12) mean±sd	L.S
Color	7.73±0.83 c	7.50±1.10 b	7.53±1.40b	7.33±0.99 a	7.27±0.98 a	*
Flavor	6.43±1.25 d	6.53±1.14 d	6.03±1.19 a	6.40±1.16 c	6.20±1.40 b	*
Texture	7.07±0.91 b	6.83±0.83 a	6.63±1.16 a	6.60±1.04 a	6.70±1.15 a	*

*= p≤0.0
Nine-point scale (9 for "like extremely" down to 1 for" dislike extremely")
Means with the same raw being similar subscript letter are not significantly (P> 0.05) affected.

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