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Chemical and Microbial Measurements of Fermented Camel Milk ''Gariss'' from Transhumance and Nomadic Herds in Sudan

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Abstract: The present study was conducted to assess the chemical composition and microbial contents of Gariss (fermented camels milk), collected from nomadic and transhumance herders. The results indicated differences in mean levels of total solids, ash and protein content for Gariss samples collected from both herders. Moreover significant variations (P< 0.01) between nomadic and transhumance Gariss were found in fat %, pH and lactic acid % of Gariss samples. The microbial content revealed low levels for log total bacterial count, log yeast count and log *Streptococcus spp.* count and higher log *Lactobacillus spp.* count in transhumance Gariss compared to nomadic Gariss samples. *Streptococcus lactis, Str. lactis sub spp diacetylactis, Lactobacillus planturum*, *Lact. brevis*, *Lact. casei*, *Lact. leichmanii*, *Lact. acidophilus* and *Lact. fermentum* were identified using conventional methods. The present study recommended further reaserch on identification and molecular characterization on the isolates from milk of camel and its products.

Key words: chemical composition, microbial contents, Gariss, fermented camel milk

INTRODUCTION

Sudan possesses large animal wealth of which camels constitute more than three million heads raised in north of 12° N latitude (Majid, 2002). Dromedaries' camels are natural browser and thrive on rough sparse pasture where other domesticated animals would virtually strave and are able to produce milk (Elamin, 1979). This characteristic makes the lactating she-camel a very valuable animal for the nutrition of the camel herder's family in this harsh environment. Camel milk has properties that it can be kept for long periods than cow's milk when refrigerated and even with the desert heat it does not spoil very soon (Thiagarajan, 2001). Moreover, the milk composition of dromedary is excellent from a nutritional view point (Gran *et al.,* 1991).

A variety of foods can be preserved by lactic acid fermentation Ahemd *et al* (2002) and the latter is the most widely used acidification process to coagulate milk during the manufacture of cultured dairy products (Attia *et al.*, 2001).

Fermented products of camel's milk vary according to the method of processing (Yagil, 1982). Shubat is camel's sour milk from Kazakhstan (Thapa, 2000). Kefir is the Caucasian fermented camel's milk (Yagil, 1982). Lehban is fermented products from camel's milk in Syria and Egypt (Wernery, 2003). In Mongolia "Tarag" is cultured milk which is similar to yoghurt, while Unda is a product produced by lactic and alcoholic fermentation of camel's and other animal's milk (Yagil, 1982). Ngurunit community is producing cultured camel's milk by straining the milk to remove dirt particles, boiling, cooling to ambient temperature and eventually culturing the fresh milk (Bruntse, 2002). Gariss is product made from camel's milk in Sudan; it is a fermented camel's milk, which is not always available for the family as camels are often driven far away in search of pastures (Dirar, 1993 and Abdel Gadir *et al*., 1998).

The method of Gariss preparation was described by Dirar (1993). Gariss is fermented in large skin bag (locally named "Si'in") which contains large quantity of previously sour product, while in the absence of starter from previous lot, fermentation is initiated by adding to the container a few seeds of Black Cumin (*Nigellica sativa*) and one onion bulb. Two large skin bags with fermented milk are hung on to the saddle of special camel called the Gariss camel. Moreover, fresh camel milk is added to the Si'in whenever part of the fermented product has been consumed.

Fermentation of Gariss takes place while the camels are on the move and due to the inherent jerk in the camel's walk; the milk in the bags is gently shaken during fermentation (Mirghani, 1994).

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The aim of the present study is to assess and compare the chemical composition of Gariss collected from transhumance and nomadic camel herders, in addition to isolation and identification of the lactic acid bacteria, which are responsible for the fermentation of camel's milk.

MATERIALS AND METHODS

Sources of Gariss:

A total of 28 Gariss samples that made from bulk milk were collected during the period from January to April 2004; in order to include different samples. Fourteen of the samples were obtained from transhumance camel herders in Khartoum State (East Nile Province– Biadah which is near Abu Dileig). The others fourteen samples were collected from nomadic herders in Butana area (Wad Fegiash - about 40 km east Tambool).

Analysis of the Samples:

The samples were collected into clean bottles (250 ml). The samples for microbial examination were collected in sterile MacCartney bottles (10 ml). The samples were transported in an ice bag to the laboratory of the Department of Dairy Production, Faculty of Animal Production, University of Khartoum for analysis, which were carried out within 12 hours of the collection of samples.

Chemical Analysis:

Fat % was determined by Gerber method and the protein % was by Kjeldahl method (Bradley, 1993). Similarly, total solids %, ash %, acidity as lactic acid % and pH were done according to Bradley (1993).

Microbial Examination:

Samples for microbial examination were examined for total bacterial counts, *Lactobacillus spp*., *Streptococcus spp*., coliform and yeast counts.

Sterilization, serial dilution and preparation of the media were done according to Harrigan and MacCance (1976). Standard plate count agar and Malt extract agar were used for total bacterial count and yeast counts, respectively (Harrigan and MacCance, 1976). Lactobacilli count was determined on MRS agar and the count of *Streptococcus spp*. was determined on M-17 agar as described by Attia *et al.* (2001). Isolation and identification of the purified colonies was carried out according to Barrow and Feltham (1993) and Harrigan and MacCance (1976).

Statistical Analysis:

Experiment was conducted using a completely randomize design. The analysis of variance and the significant differences between means were determined using Duncan Multiple range test using SPSS version10.

RESULTS AND DISCUSSION

Results:

Chemical Composition of Gariss Samples:

Data in Table (1) showed that the means of the total solids were 11.29% ±1.40% and 9.81%± 2.32% transhumance and nomadic camel herders, respectively. The average fat levels were 4.85%± 0.66% and 3.46%± 1.18%, protein content revealed means of 2.32%± 0.59% and 2.58%± 0.69% and the ash content were 1.30%± 0.17% and 0.87%± 0.13%, respectively. Table (1) also showed that the mean of pH of Gariss samples were 3.41± 1.12 and 3.82± 0.49 in transhumance and nomadic camel herders, respectively. The mean of acidity expressed as lactic acid percent of Gariss revealed 2.29%± 1.25% and 2.24%± 0.68% in samples collected from transhumance and nomadic camel herders, respectively. The results in the same table showed significant variations in pH and acidity ($P<0.01$).

Microbial Content of Gariss Samples:

Table (2) showed the mean log count of some microorganisms isolated from the samples obtained from transhumance and nomadic camel herders. The mean log of the total bacterial counts was 7.26± 0.49 and 7.56± 0.29 for transhumance and nomadic Gariss samples, respectively. The log *Streptococcus spp.* counts revealed 6.47± 0.35 and 6.85± 0.33, respectively. Similarly the mean log *Lactobacilli spp.* counts were 6.83± 0.33 and 6.55± 0.32, respectively. The log yeast counts comprised means of 6.99± 0.13 and 7.02± 0.3 for the Gariss samples obtained from transhumance and nomadic camel herders, respectively. However no growth of coliform bacteria in Gariss samples was observed.

Table 1: Comparison of chemical composition of Gariss samples collected from transhumance and nomadic camel herders

Contents	Mean ± standard deviation		Significant level
	Transhumance samples	Nomadic samples	
Total solids %	11.29± 1.40	9.81± 2.32	0.569
Fat %	4.85± 0.66	3.46± 1.18	0.413
Protein %	2.32± 0.59	2.58± 0.69	0.082
Ash %	1.30± 0.17	0.87± 0.13	0.167
pH	3.41± 1.12	3.82± 0.49	0.01**
Acidity (%)	2.29± 1.25	2.24± 0.68	0.01**

* Significant differences at (P<0.05).
** Significant at (P<0.01).

Table 2: Comparison of log microbial counts of Gariss samples collected from transhumance (Biadaha) and nomadic (Wadfegiash) camel herders

Microbial measurements	Mean ± std		Significant level
	Transhumance samples	Nomadic samples	
Log total bacterial counts	7.26± 0.49	7.57± 0.23	0.961
Log *Streptococcus spp.* counts	6.47± 0.35	6.85± 0.33	0.55
Log *Lactobacilli spp.* counts	6.83± 0.33	6.55± 0.32	0.181
Log yeast count	6.99± 0.12	7.02± 0.3	0.325

Table 3: *Streptococcus spp.* isolated from Gariss samples collected from transhumances and nomadic camel herders

Isolated organisms	Number of sample	*Streptococcus lactis*	*Str.lactis subsp diactylactis*
Source of Garris			
Nomadic herders	10	8 (80%)	2 (20)
Transhumance herders	14	4 (28%)	10 (74%)
Total	24	12 (50%)	12 (50%)

Identifications of the Isolated Organisms:

Table (3) showed the primary and confirmatory tests used for the identification of *Streptococcus spp.*. The results showed that 50% of the Gariss collected samples were identified as *Streptococcus lactis*, while the other 50% were identified as *Streptococcus lactis subsp diacetylactis*. The identification of *Lactobacillus spp.* revealed that 8 (33.3%) of the samples were found to be *Lac. planturum*, 4 (16.7) *Lac. casei*, 4 (16.7%) *Lact. brevis*, 4 (16.7%) *Lact. leichmanii*, 3 (12.5%) *Lact. fermentum* and 1 (4.16%) *Lact. acidophilus* (Table 4).

Discussion:

The present study showed significant variations between the collected Gariss samples from transhumance and nomadic camel herders in the level of pH and acidity (P<0.01) as shown in Table (1). The variations might be due to the differences in the methods of preparation and storage conditions. The agitation condition under which the nomadic herders produce Gariss, play a major role in the fermentation process of the product, by increasing the fermentability (Dirar, 1993 and Mirghani, 1994). Also the temperature is the most important factor in controlling the growth of the fermentative microorganisms in the milk and dairy products (Olson, 1950).

The high level of acidity (Table 1) might be due to the isolated lactic acid bacteria (Table 3 and 4). The low pH values could be due to the type of camel milk, as 'Gariss' means sour and it kept to ferment continuously by adding some fresh milk. Moreover this result agreed with the results which revealed a mean pH value of 3.4-3.7 for Gariss samples collected from Butana area and Northern Kordofan (Dirar, 1993). However, this might be due to the retrieving of fermented Gariss and addition of equal quantities of fresh milk, that the pH and acidity of the system remain more or less constant (Mirghani, 1994). The low pH values of Gariss indicate major contributions of lactic acid bacteria and yeast in the fermentation (Dirar, 1993).

The comparison of the microbial contents of Gariss samples, revealed significant variations. Similar organisms were reported previously from traditional dairy products in different countries (Road House and Henderson, 1950; Harrigan and MacCance, 1976, Elmardi, 1988; Dirar, 1993, Mirghani, 1994 and Perdigon *et al.,* 1995). Moreover, some lactic acid bacteria have potential health benefits, which include protection against enteric malnutrition and prevention of chemically induced tumors (Perdigon *et al.,* 1995).

The results obtained from the analysis of chemical composition of the collected Gariss samples (Table 1) were in the range of total solids content of fresh milk samples (Dirar, 1993). However the fat percent in collected Gariss samples, which were found to be higher than the fat percent (2.8- 3.6%) in the fresh camel milk samples reported by the same author. The variations might be due to the high fat percent of the milk used in the production of the Gariss, which affect the end product (Dirar, 1993).

Table 4: *Lactobacillus spp.* isolated from Gariss samples collected from transhumance and nomadic camel herders

Isolated organisms	Number of samples	*Lact. planturum*	*Lact. casei*	*Lact. brevis*	*Lact. leichmanii*	*Lact. fermentum*	*Lact. acidophilus*
Source of Garris							
Nomadic herders	10	3 (3%)	3 (3%)	1 (1%)	1 (1%)	2 (2%)	Zero
Transhumance Herders	14	5 (35%)	1 (7%)	3 (21%)	3 (21%)	1 (7%)	(1) 7%
Total	24	8 (33.3%)	4 (16.66%)	4 (16.66%)	4 (16.66%)	3 (12.5%)	1 (4.16%)

The results were also found to be in the range of chal (shubat) content except in the ash as recorded previously (Yagil, 1982). The variations might be due to the variations in chemical composition of the milk, which used in the preparation of the two products (Harding, 1999).

Little variations between Gariss samples from the transhumance and nomadic herders were observed (Table, 1). The results indicated a high level of total solids (11.29%±1.40%), fat (4.85%±0.66) and ash (1.30%±0.17) for transhumance herders' samples. However, the water availability, stage of lactation and availability of the green fodder as well as the differences in management system under which the herds are kept were the main factors which affect the composition of the camel's milk (Farah, 1996 and Backeit, 1998).

The fermented camel's milk (Gariss) was found to have high nutritive values, which is important for the desert peoples, since they depend only on it. However, the chemical composition and the microbial contents were affected by the management systems and the preparation conditions. Hence, the present study suggested that due to the special properties of camel's milk and its products, which made them important products it must be looked for them as industry of the future. More work is needed to identify and to characterize the LAB using modern molecular methods

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