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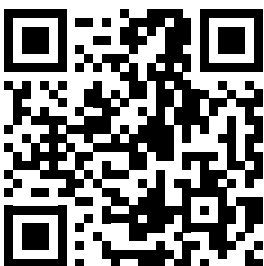
Traditional Practices of Production and Consumption of the Fermented Camel Milk “Gariss” in Al-Koma Locality, North Darfur State, Sudan

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Abstract

Information on camel production and the traditional practices for the preparation of the fermented camel milk (*Gariss*) were collected during February 2018 from 118 nomadic camel herders in Al-Koma Locality, North Darfur State via questionnaire and direct interveners. Fermented camel milk (*Gariss*) is the main staple food and sometimes considered as a source of water for the camel herders and is also used for honoring the guests. The survey also showed that the different type of containers used for preparing *Gariss* include plastic (85.5%), *Siin*; traditional tanned goat skin (11.8%) *Bokhsa*; Gourd (1.8%) and stainless steel (0.9%). There was a variation in the shelf life of *Gariss* and 91.8% of the camel herders believe that *Gariss* should not be discarded at all and about 92.7% consumed the camel milk in a fermented form. Moreover, 99.1% of the herders used camel milk as pure without mixing it with milk from other livestock and 97.3% ferment camel milk without boiling. This study concluded that camel milk is consumed mainly in fermented form locally using variable methods, different containers and few additives. Moreover, the use of the traditional natural pots such as *Siin* and *Bokhsa* is limited among the camel herders as they thought that they are women stuff. Hence it is recommended that extension services and awareness programs for capacity buildings to improve the management and utilization of the camels' dairy products among camel breeders and herders in nomadic communities are urgently needed in order to maximize its contribution in food security.

Keywords: Camel Production, Traditional Processing, *Gariss*, Consumption, Additives, Containers, Sudan.

Introduction

For desert people in Asia and Africa, camel is vital to daily life as a source of food and means of transportation, in addition its milk is used as medicines for diverse ailments since ancient times [1]. The contribution of camels is mainly in transport, racing and in offering milk and meat [2-4].

Sudan has the second largest number of camels in Africa. According to the estimates of livestock, the population of camels in Sudan was about 4.850.000 heads distributed around the country [5]. Because of its outstanding performance in the arid and semi-arid areas of Sudan where browsing pastures and water are limited, pastoralists rely mainly on camels for their livelihood. Moreover, in some of these areas, camels are mainly kept for milk production [6].

In the pastoral societies, camel milk is traditionally consumed predominantly in the form of fermented or fresh [7,8]. Although, fermented products of camels' milk vary according to the method of processing [8,9-12]. Traditionally, fermented camel milk is allowed to ferment naturally without prior heat treatment and without addition of starter cultures [8,10,12-14].

The fermented camel milk in Sudan (*Gariss*) is carried out in the field and is prepared by shepherds when driving the camels for pastures in far-away places [14]. *Gariss* is kept in two leather bags of tanned goat skin carried on the back of camel and subjected to continuous shaking by the jerky walk inherent to camels [15]. *Gariss* is



Plate 1: The map of Sudan illustrating the camel belt and the different study areas in North Darfur State



Plate 2: A group of camels' herds located in Om-Hageleeg area, North Darfur State

not always available for the family as camels are often driven far away in search of free pastures [8,10,12-14].

The method of *Gariss* preparation was described in previous reports [8,10,12-14,16]. *Gariss* is a special kind of full cream fermented camel milk in Sudan that is made by a semi-continuous or fed-batch fermentation that is widely used by the pastoralist living in the arid and semi-arid regions of the country [8,14].

Although there is a conserved attitude against selling milk in camels' herders in the nomadic system in Sudan, some of nomadic families in Kordofan State showed more flexibility towards selling camel milk as 48% of the nomadic interviewees are selling fermented milk [17]. Moreover, the fermented camel milk and butter oil are sold in the local markets of Darfur, Sudan [18]. On the other hand, in North Darfur State, the one-humped camel (*Camelus dromedaries*) is kept in nomadic systems in the semi-desert and Savanna belt of Darfur together with sheep and goat. Nomadic Sudanese Arab tribes that own camels include Maalia, Mahria, Umm Jallol, Awlad Zaid and Bani halba. Other tribes of the Midob and Zaghwa also own camels. Nomadic Arab tribes and some other tribes owning camels have entered Sudan through the west and north-western borders via Northern Chad and/ or southern Libya. The objective of this study is to collect some information about camel herders on management of camels and processing of *Gariss* as the main food for the

nomadic herders in Al-Koma Locality, North Darfur State.

Materials and Methods

The Study Area and Samples Collection

The area of study is Al-Koma Locality, North Darfur State, Sudan. Four locations; Sari, Om-Hageleeg, Om-Alhussain and Al-Koma were chosen to conduct this study (Plate 1). The camels are browsing the trees and grass lands without any supplementary feeding, except in Al-Koma town; where the camels that kept inside the city; are provided with extra feed or leftovers.

Data Collection and Survey

This study target 118 camel herders who are questioned directly in the fields through individual meetings. In the questionnaire, some husbandry practices and socioeconomic data were obtained that include grazing systems, gender, use of mineral as feed supplement and watering interval of camels. The type of milk used, milk consumption, traditional processing and preservation of *Gariss*, additives used, containers for *Gariss* preparation and storage period of *Gariss* were also included. Photographs were also used to document some of these activities.

Statistical Analysis

The obtained data were analyzed via Chi square test using SAS [19] with some modifications. The significant differences were considered at $P < 0.05$.

Results and Discussion

General Information About Camels Herding and Utilization of Their Milk

Grazing, Routes and Production Systems

The camel breeds found in the Locality of Al-Koma are belonging to some tribes that include Ziyadiya, Mehriya, Awlad Rashaid, Tuareg (in Darfur they named as Kenin) and Kababish. The main ecotype predominant in the Locality is Ziyadiya camels (Plate 2).

Feeding of camels is on open natural pasture, however the system of production adopted in Al-Koma Locality is mainly extensive (Table 1) with seasonal movement (transhumance), which is commonly practiced according to the pasture and water availability and absence of parasites. The camel pastoralists are always moving over large area in search of feed and water for their camels [18]. This because under nomadic system, feeding camels is mainly depends on natural grazing pasture, which is of zero cost [17]. It was suggested that the proper utilization of rangeland and provision of veterinary health supervision and vaccination of livestock will improve the wealth both at micro- and macro-levels [4]. This especially will restore the economical value of the camel, among other natural resources because camels are roaming wide areas in the country within the different production systems [6]. It is therefore pertinent that the national works towards boosting the camel populations and also focusing on tapping into the economic potential of this very unique animal [4]. On the other hand, the system of seasonal movement of cattle and camel herders from the dry northern areas to the wetter southern areas of the western or southern region represented a traditional management system that is practiced to reduce the pressure on the carrying capacity of grazing areas [20]. Generally, the feeding of camels under nomadic system is depending on natural grazing pasture by utilizing grasses and browsing trees

Table 1: General information about camels' husbandry in Al-Koma Locality, North Darfur State

| Items | Area | | | | Total | Chi square | Significant level |
|---|------------------|------------------|------------------|------------------|------------------|--------------|-------------------|
| | Sari | Om-Hageleeg | Om-Alhussain | Al-Koma | | | |
| Production system | | | | | | | |
| Natural grazing | 30(26.5%) | 30(26.5%) | 30(26.6%) | 23(20.4%) | 113(95.8%) | | |
| Addition of supplementary feeding | 0(0.0%) | 0(0.0%) | 0(0.0%) | 5(100%) | 5(4.2%) | 16.78 | 0.001*** |
| Total | 30(25.4%) | 30(25.4%) | 30(25.4%) | 28(23.7%) | 118(100%) | | |
| Gender participation in camels' herding | | | | | | | |
| Males | 30(27.8%) | 25(23.1%) | 27(25%) | 26(24.1%) | 108(98.2%) | | |
| Females | 0(0.0%) | 0(0.0%) | 0(0.0%) | 2(100%) | 2(1.8%) | 5.96 | 0.113NS |
| Total | 30(27.3%) | 25(22.7%) | 27(24.5%) | 28(25.5%) | 110(100%) | | |
| Use of minerals (Atron) as feed supplement | | | | | | | |
| Yes | 30(27.3%) | 25(22.7%) | 27(24.5%) | 28(25.5%) | 110(100%) | | |
| No | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | - | - |
| Total | 30(27.3%) | 25(22.7%) | 27(24.5%) | 28(25.5%) | 110(100%) | | |
| Watering interval for camels | | | | | | | |
| 10 days | 0 (0.0%) | 0 (0.0%) | 27(49.1%) | 28(50.9%) | 55(50%) | | |
| 14 days | 30(54.5%) | 25(45.5%) | 0 (0.0%) | 0 (0.0%) | 55(50%) | 110 | 0.001*** |
| Total | 30(27.3%) | 25(22.7%) | 27(24.5%) | 28(25.5%) | 110(100%) | | |

***= P<0.001

NS = Non significant



Plate 3: Some of natural browsing pasture utilize by the camels in Sari area, North Darfur State

and when climatic conditions become harsh during the dry season; camel herders settle near water sources mainly around the cities or cultivated areas to make use of crops residues [21]. However, during their continuous transhumance, camels are affected by many production limiting factors such as diseases,

range and pasture limitations, water scarcity, high calf mortality and security problems [6,18, 22-24]. Camel can browse on low productive pastures on which the production of milk is possible and economically profitable [14]. The camels browse trees and grasses (Table 1 and Plate 3) and the plants which were reported to be preferred by the camel in Al-Koma Locality were similar to those described previously [25].

Gender as Camels' Herders

The *Gariss* produced by the camel herders in Al-Koma Locality showed that 98.2% of camel herders in Al-Koma Locality are men, while the study found that only 1.8% of the women are camels' herders (Table 1). However, in Kordofan State, the nomadic women are found to be involved in handling the camel herds either alone (8%) or helping the men (40%) in feeding and caring of the newborn animals, but, they rarely participate in milking [17]. However, among camel herders, some women are responsible for processing and marketing of fermented milk, while rarely allowed to participate in milking and that all the traditions laid down by the ancestors are honored for the sustainable livelihood [21]. The low participation of women in camel husbandry is due to the customs and beliefs prevalent in the Bedouin area that all women should be far from men and there are separate reception areas for guests.

Table 2: Comparison of utilization of camel milk by herders in four areas of Al-Koma Locality, North Darfur State

| Items | Area | | | | Total | Chi square | Significant level |
|---|-----------|-------------|--------------|-----------|------------|------------|-------------------|
| | Sari | Om-Hageleeg | Om-Alhussain | Al-Koma | | | |
| Types of milk used | | | | | | | |
| Pure camel | 30(27.5%) | 24(22.0%) | 27(29.8%) | 28(25.7%) | 109(99.1%) | | |
| Mixed milk | 0(0.0%) | 1(100%) | 0(0.0%) | 0(0.0%) | 1(0.9%) | 3.43 | 0.330NS |
| Total | 30(27.3%) | 25(22.7%) | 27(24.5%) | 28(25.5%) | 110(100%) | | |
| Milk consumption | | | | | | | |
| Fermented | 25(24.5%) | 22(21.6%) | 27(26.5%) | 28(27.5%) | 102(92.7%) | | |
| Fresh | 5(62.5) | 3(37.5) | 0(0.0%) | 0(0.0%) | 8(7.3) | 9.06 | 0.028* |
| Total | 30(27.3%) | 25(22.7%) | 27(24.5%) | 28(25.5%) | 110(100%) | | |
| Traditional preservation of Gariss | | | | | | | |
| Boiling | 2(66.7%) | 1(33.3%) | 0(0.0%) | 0(0.0%) | 3(2.7%) | | |
| Fermentation | 28(26.2%) | 24(22.4%) | 27(25.2%) | 28(26.2%) | 107(97.3%) | 3.45 | 0.327 NS |
| Total | 30(27.3%) | 25(22.7%) | 27(24.5%) | 28(25.5%) | 110(100%) | | |

* = Significant at $P < 0.05$

NS = Non significant



Plate 4: Hafier as a source of water in Om-Alhassain area, North Darfur State

Use of Minerals for Supplementing Camels Feed

All camel herders interviewed use Atron; local salts of calcium; as a mineral supplementary feed (Table 1). Camel herders use it as an alternative to the commercial salts due to its availability in rural markets and the lack of knowledge about the usefulness of commercial mineral block. Similar observation was also reported by other authors [2, 17, 18, 26]. Moreover, all nomadic herders purchase salt and Atron as mineral supplement for their camels; it was dissolved in the drinking water [21].

Watering Intervals for Camels

Highly significant ($P < 0.001$) differences were found for watering

interval of camels (Table 1). Moreover, the data showed that 50% of the camels in Al-Koma and Om-Alhassain areas are drinking water every 10 days. This due to their proximity to the water sources as both Al-Koma and Om-Alhassain are near the main national road and hence water sources are available as shown in Plate 1 and Plate 4. However, 50% of the camels drinking water every 14 days in Sari and Om-Hageleeg, which are located at the far north and northeast of Al-Koma city (Plate 1). The reason could be attributed to the limited and scares water resources, which are at far distances. This regardless of the fact that the available grazing pasture lands are rich and green, which allowed the camels to withstand drinking water every 14 days. Similar watering intervals were also reported for the camels reared in South Darfur State [18]. The camels are capable to handle extreme dehydration without drinking water for more than a month [23]. However, the watering interval in nomadic system varies from 7 to 9 days during summer months, while the camels kept in the semi-intensive system drinking water daily [2, 17]. Similarly, the camels kept in semi-intensive and intensive systems are provided with drinking water daily [27]. Most of the responders stated that the water and feed availability were the major constraints for camels rearing in the different locations. Also, similar results were found in a previous study [24].

Consumption Pattern of Camel Milk

About 99.1% of camel herders in Al-Koma Locality use camel milk as pure, while 0.9% use it mixed with those from other species of animals (goats, cows, sheep) as shown in Table 2. Also, the camel milk in Ethiopia is mixed with that of cows, goats and sheep particularly when intended to make products such as butter and cheese [28]. In rare cases when the demand

Table 3: Different conditions for preparation of *in Butana area, Al Gadarif State* by camel herders in Al-koma Locality, North Darfur State

| Items | Area (%) | | | | Total | Chi square | Significant level |
|---|------------------|------------------|------------------|------------------|------------------|--------------|---------------------------|
| | Sari | Om Hageleeg | Om Alhus-sain | Al-Koma | | | |
| Additive used | | | | | | | |
| No additive | 27(25.2%) | 25(23.4%) | 27(25.2%) | 28(26.2%) | 97(97.3%) | | |
| Lemon | 1(0.9%) | 0(0.0%) | 0(0.0%) | 0(0.0%) | 1(0.9%) | | |
| Onion | 1(0.9%) | 0(0.0%) | 0(0.0%) | 0(0.0%) | 1(0.9%) | | |
| Dates | 1(0.9%) | 0(0.0) | 0(0.0%) | 0(0.0%) | 1(0.9%) | | |
| Total | 30(27.3%) | 25(22.7%) | 27(24.5%) | 28(25.5%) | 110(100%) | 8.22 | 0.512^{NS} |
| Containers for <i>Gariss</i> preparation | | | | | | | |
| Plastic | 26(86.7%) | 16(64%) | 27(100%) | 25(89.3%) | 94(85.5%) | | |
| Siin | 2(6.7%) | 8(32%) | 0(0.0%) | 3(10.7%) | 13(11.8%) | | |
| Bokhsa | 1(3.3%) | 1(4.0%) | 0(0.0%) | 0(0.0%) | 2(1.8%) | | |
| Steel | 1(3.3%) | 0(0.0%) | 0(0.0%) | 0(0.0%) | 1(0.9%) | | |
| Total | 30(100%) | 25(100%) | 27(100%) | 28(100%) | 110(100%) | 19.27 | 0.023* |
| Storage period for <i>Gariss</i> produced by camel herders | | | | | | | |
| Months | 1(100%) | 0(0.0%) | 0(0.0%) | 0(0.0%) | 1(0.9%) | | |
| 3 months | 1(100%) | 0(0.0%) | 0(0.0%) | 0(0.0%) | 1(0.9%) | | |
| 5 months | 4(100%) | 0(0.0%) | 0(0.0%) | 0(0.0%) | 4(3.6%) | 26.13 | 0.037* |
| 6 months | 1(100%) | 0(0.0%) | 0(0.0%) | 0(0.0%) | 1(0.9%) | | |
| A year | 2(100%) | 0(0.0%) | 0(0.0%) | 0(0.0%) | 2(1.8%) | | |
| Forever | 21(20.8) | 25(24.8%) | 27(26.7%) | 28(27.7%) | 101(91.8%) | | |
| Total | 30(27.3%) | 25(22.7%) | 27(24.5%) | 28(25.5%) | 110(100%) | | |

NS = Non significant

* = Significant at P<0.5

for milk is increased in the market, the milk of camel is also mixed with cow' and buffalo' milk and sold to the urban markets to fulfill the need of human consumption [29-30]. In the present study, the camels' herders were found to have other kinds of animals such as sheep and goats, which graze beside the camels in the same pasture. Similarly, the camel heeders in South Darfur are keeping sheep and camel together [18]. This practice of rearing both sheep and camels in one flock is practiced mainly in western part of Sudan by Kababish tribe in Kordofan and Darfur regions [21]. The nomads in Kordofan preferred rearing sheep beside camel rather than goat to satisfy their demand of sheep' meat, while goats are kept for milk production [17]. Nevertheless, goat milk is not preferred by camel herders who believe that camel milk is the best milk; as it is the gift from the God that should never been sold; This statement is documented previously [18, 21].

Mixing the milk from different livestock with that of camel milk is practiced in the study area; intentionally or unintentionally in pots used for the direct consumption, and this is clearly evident in the preservation of the *Gariss* and its storing period pattern (Table 2). Most of camel herders interviewed in this study stated that camel milk is usually consumed in a fermented form by most of herders and their families (92.7%), while those who consume it as fresh were only 7.3%. Moreover, the data showed

significant (P<0.05) variation between the different locations regarding utilization of camel milk (Table 2). This might be because fermented products can be kept for a longer time, which supported previous findings [8, 12, 31-34]. It worth to mention here that the variations in milk components, together with the variations in the production processes have created a great diversity of traditional fermented milk products worldwide [35].

The different consumption pattern in the different investigated locations (Table 2), could be attributed to the seasonal availability of milk, and to how far the camels' herds are, as the degree of movement of camels' herders depends mainly on the availability of water and free pasture. Moreover, the nomadic herders depend mainly on *Gariss* for sustaining their live. The fermented camel milk is considered as a sole source of food for herders who travels far away with their camels searching for free pasture and water [8, 13-14]. The people of nomads made special meals from camel milk for themselves and to their special guests as well as for the sick and weak calves [8, 17]. Additionally, they also supply their surplus camel milk to their neighbors who does not have sufficient milk for their family needs and also offered for free to those people who need it for the medicinal purpose [21, 23, 36-37]. Moreover, a lot of scientific reports indicate that both the fermented and fresh camel milks have therapeutic properties against different

diseases [1, 28, 36, 38-43]. Hence, the fermented camel milk possesses a very eminent position across the world as it is a quite worthy therapeutic product [44]. Some camels' herders are currently keeping few high producing she-camels in the semi-intensive system around the big cities of Sudan to provide milk to the urban consumption at price, which is 3 times higher compared to that of cow's milk in order to sustain food security for the families in the home lands [26]. Moreover, despite the fact that camel milk is being used as a source of nutrients and a medicinal product, about 50% of it goes into waste in Kenya due to low hygiene levels, long distance transportation of milk at ambient temperatures, lack of milk handling equipment, and poor infrastructure [45]. Moreover, higher loss of camel milk also occurs in Sudan, which is due to more or less the same reasons in addition to lack of proper policy as well as the social attitudes towards commercialization of camel milk. This was in accord to those mentioned previously [21]. The present study suggested the proper production and processing of this valuable product to ensure food security to the herders.

Traditional Utilization of Camel Milk

The results showed that 92.7% of camel milk is fermented without boiling, while only 7.3% of camel herders boiled the milk before its fermentation (Table 2). These findings although revealed less percentages than it should be, yet it is promising that some of nomadic herders use boiling and give up their reserve towards boiling of camel milk. According to the interviews during the survey dealing with processing conditions and additives used for preparing *Gariss* in Butana area of Sudan, a lady told that (personal communication) the camel milk is ready cooked from the udder of she camel, so no need for its boiling. On the other hand, some differences were reported between boiled camel milk and the raw camel milk samples in ash, casein, whey protein and vitamin C content [46]. In the present survey, when boiling the camel milk before making *Gariss*, the herders usually added Atron in order to prevent the milk from coagulation. Moreover, the traditional fermented milk products are usually primitive, compared to modern ways of food preparation [14]. The camel herders interviewed in the



Plate 5: *Gariss* kept in large containers (plastic and *Siin*) in Al Koma Locality

present study are constantly fermented camel's milk. They use *Gariss* in many meals in Al-Koma and they use it as a substitute for water. It was also used in the cooking of meat and the preparation of millet porridge, in addition it is also drink with water and sugar by the thirsty persons. This study also found that camel herders ferment the camel milk on daily basis by adding milk to large storage containers with previously fermented milk or in daily consumption containers with an old previous product (Table 2 and Plate 5). This might be because camel fermented milk has significant impact of food security for camels herders [8,12-14]. Also, the manufacture of fermented milk products has a long history, and these products were initially produced either from spontaneous fermentation or using a batch of previously produced product [35].

Additives Used for Preparation of *Gariss*

Table 3 showed very few additives (2.7%) are used by the camel herders in Al-Koma Locality for *Gariss* that include dates (*Phoenix dactylifera*) fruits, lemon (*Citrus limon*) juice and onion (*Allium cepa*) pulp that are added into the small pots for the instant consumption of *Gariss*. However, nomadic women usually processed camel milk into *Gariss* with variable flavoring additives [8, 12, 47]. In the present study, most of the herders (97.3%) do not add any additive to the camel milk during fermentation (Table 3). This may be because most of the prepared *Gariss* in this study was done by men herders during their transhumance movement. However, there are wide varieties of additives used for preparing *Gariss* in Butana area; eastern Sudan; where only 31.58% of the nomadic women households prepared *Gariss* without additives (plain), 21.05% of them used black cumin (*Nigella sativa*) seeds and onion (*Allium cepa*) pulp and 10.53% used ginger (*Zingiber officinale*) mixed with black cumin seeds [8]. Also, mixing of onion and fenugreek (*Trigonella foenum-graecum*) are practiced by 15.78% of the women, while 10.53% used onion, ginger, fenugreek and grangal (*Alpinia galangal*) in one mixture [8]. Moreover, black cumin, fenugreek and garlic have significant effects as additives on the compositional quality of fermented milk [48]. In this study, camel herders add additives in the containers for direct consumption when they drink *Gariss* along the day; while, no additive was used during the prolong storing of *Gariss* (Table 3). However, it was observed that the dates, lemons and onions are added directly to *Gariss* without washing and cleaning.

Types of Containers Used for *Gariss* Preparation in Al-Koma Locality

Table 3 showed significant ($P < 0.05$) differences for the containers used for preparation of *Gariss* in all selected areas of Al-Koma Locality. The utensils used by camel herders in Al-Koma area are mainly plastic (85.5%) followed by *Siin* (11.8%), *Bokhsa* (1.8%) and stainless steel (0.9%) as shown in Table 3. The camel herders in Sari area use the 4 types of containers; plastic (86.7%), *Siin* (6.7%); *Bokhsa* (3.3%), and stainless steel (3.3%). In Om-hageleeg area, they use 3 types of containers for storing their *Gariss*: plastic (64%), *Siin* (32%) and *Bokhsa* (4%). Camel herders in Al-Koma area used plastic (89.3%) and *Siin* (10.7%) to store *Gariss*. However camel herders in Om-Alhussain area use only plastic containers (100%) for storing of *Gariss* (Table 3). Similar to the present study, *Gariss* was prepared mainly into plastic, *Bokhsa* and *Siin* and to less extend in stainless steel containers by nomadic camel woman herders in Al Gadarif State in Butana area [8]. However, in the present study, *Bokhsa* is used by women only and that why they are found rarely in Al Koma Locality. Meanwhile, the fermented camel milk (*Suusac*) in Somali is traditionally prepared by

spontaneous fermentation in smoke-treated gourds [11]. On the other hand, *Chal* is typically prepared by fermentation of camel milk in Iran by adding the previously fermented acidic milk as inoculums, in earthen ware jug for 1 or 2 days depending on the season of the production [49].

The Storage Period of in Butana area, Al Gadarif State Produced by Camel Herders in Al-Koma Locality

As for storing of the fermented camel's milk, all the camel herders in Om-Hageleeg, Om-Alhussain and Al-Koma areas (100%) and 91.8% in Sari area emphasized that the fermented camel's milk would not be discarded at all unless other milk (goats, cows, sheep) or water are added to it (Table 3). The results of the questionnaire revealed that the storing of fermented milk for a month, 3 months, 5 months, 6 months and a year revealed 3.3%, 3.3%, 13.3%, 3.3% and 6.7%, respectively (Table 3). Moreover, data in Table 3 showed significant variations ($P < 0.05$) for the storage period of *Gariss* in Al-Koma Locality. Also, the data showed that *Gariss* have a longer shelf life and storage period than fresh milk. This supported the reports indicated that fermented camel products are generally showed longer shelf life than fresh or raw milk [32-34]. Moreover, camel milk has properties such as lactoperoxidase enable it to be kept for long periods than cow's milk [31, 36, 50, 51]. Also, the camel milk has antimicrobial activity, a good conservation aptitude and health promoting efficiency besides its contribution in the main staple diet in some areas of Africa and Asia [52].

Conclusion

Camel milk is consumed mainly in fermented form (*Gariss*) by camel herders in Al-Koma Locality beside the majority of the local population and visiting guests. *Gariss* preparation conditions and methods are variable using different containers and additives. This study recommended that extension services and more veterinary supervision are needed to increase the awareness of camel breeders and herders on the best farming practices including accurate methods of making and preservation of fermented milk. Also benefiting from camel milk in the desert and semi-desert areas by providing means of transporting camel milk and fermented products to the urban areas for consumption to take the advantage of the value of camel milk as organic and functional food should be addressed in order to promote its contribution in the food security.

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