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Compositional Quality of Camel Milk and Some Husbandry Practices Associated with Camel Milk Production in Two Production Systems in Sudan

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Abstract

Composition quality of camel milk and some husbandry practices associated with camel milk production under semi intensive and traditional nomadic production systems in Sudan were investigated. Bulk milk samples (n=80) were obtained from the two production systems (40 samples/system). Milk samples collected from the semi intensive system revealed significantly ($p<0.05$) higher total protein, solids not fat and lactose contents. Whereas fat was significantly ($p<0.05$) higher in milk samples collected from traditional nomadic system. Goal oriented management and better husbandry practices and employing laborers with experience in handling camels in addition to the regular two times milking/day were the major characteristics of the semi intensive system.

It is concluded that improved husbandry practices and management oriented towards milk production in the semi intensive system has positively influenced the compositional quality of camel milk. Also, the semi intensive system provides urban dwellers with camel milk which has high market demand. Nevertheless, considerable amount of milk that produced in the nomadic production system could not get to the market. Therefore, a bridge between the nomadic producers and urban consumers is highly needed.

Key words: Chemical composition, Husbandry practices, Rearing camel, Production systems

Introduction

The Sudanese national camel is mainly kept by nomadic pastoralist tribes in the arid and semi arid parts of the country (HCENR, 2009). Keeping camel under nomadic production system is well recognized in the region where camel exists such as Kenya and Ethiopia (Bekele *et al.*, 2002 and Mehari *et al.*, 2007). During the last decade, the situation starts changing especially in Gulf area and the world's first intensive camel dairy farm was established in Dubai, United Arab Emirates in 2006 (Juhasz and Nagy, 2012). Thereafter, Hammadi *et al.* (2010) reported existence of intensive camel dairy farms in Tunisia. Intensive camel dairy production system in Sudan, however, is

limited (Babiker and El Zubeir, 2014). Rather, camel dairy farms adopting semi intensive production system are widely recognized. In the semi intensive system, animals fed on cut forages and concentrates such as groundnut cake with continuous supply of water. In addition animals are also allowed going out to the natural pasture for about six hours daily or in some cases three to four times per week. In this system, only high milk yielded she camels are selected and kept in dairy farms in the pre-urban area of big cities. Camel herders adopting the semi intensive system make use of the increasing public awareness about nutritional and medicinal benefits of camel milk therefore milk production on commercial level is their main goal (Shuiep and El Zubeir, 2012). The climatic changes during the last decades characterized by decrease of mean rainfall coupled with acute periods of drought (HCENR, 2009) might also have a role in the establishment of the semi intensive production system of camel in Sudan.

Worldwide, milk is very important nutrient source for human. For nomadic communities in particular, camel milk represents the main source of protein especially during migration (Musa *et al.*, 2006). Moreover, camel milk has also been reported to have high nutritional value and strong similarity to human's milk (Halima *et al.*, 2012). The concentration of camel milk constituents reported to be influenced by many factors among which farming system, parity number and stage of lactation are well investigated (Nagy *et al.*, 2013, Babiker and El Zubeir, 2014 and Dowelmadina *et al.*, 2014).

The usual habitat of camel is characterized by high temperatures and scarcity of water. As a consequence of these environmental conditions, these areas are characterized by considerable variations in quantity and quality of available pastures. Seasonal quality and availability of feed have been reported to influence the compositional quality of camel milk (Haddadin *et al.*, 2008 and Shuiep *et al.*, 2008). Moreover, husbandry practices associated with camel milk production reflects some social and economical indicators. Hence, the aims of this study are to evaluate the compositional quality of camel milk under semi intensive and traditional nomadic production systems, and also to investigate some husbandry practices associate with camel milk production in the two systems.

Materials and Methods

Study population:

In this study, camel herders adopting semi intensive production system in the pre-urban area of west Omdurman (Khartoum State, n=40), and others practicing traditional nomadic production system around El Obied (North Kordofan State, n=40) were targeted. Settled families and selected she camels kept in dairy farms especially for milk production distinguished the semi intensive system herders. Whereas continuous mobility of both families and herds looking for free pastures and water is the major characteristic of the nomadic traditional herders.

Collection and analysis of camel milk samples:

Milk samples (n=80) in duplicates (100 ml each) were obtained in dry clean bottles, labeled and immediately transferred in icebox to the laboratory for chemical analysis. Each sample was analyzed for content of fat, protein, solids not fat (SNF) and lactose. The concentration of milk constituents were measured twice by LactoScan milk Analyzer (Milkotronic LTD, Europe) according to the manufacturer's instructions. The measurement is based on the principle of Fourier Transform Infrared Spectroscopy (FTIR) that combines the recording of infrared spectra and data processing with high precision and stability.

Questionnaire:

Information about activities associated with camel milk production in the two production

systems, such as frequency of milking, milking responsibility, selling camel milk and processing camel milk into other milk products were obtained by dispatching detailed structure questionnaire and conducting personal interviews with herders. Collection of information was also supported by personal observations.

Statistical analysis:

The Statistical Package for Social Sciences software (SPSS, v.13) was used in this study. The statistical analysis for chemical composition of camel milk was done using independent sample Student t- test. Information about practices associated with camel milk production that obtained by questionnaire was presented in form of descriptive tabular summaries.

Results and discussion
Chemical composition:

Chemical composition of camel milk samples obtained from semi intensive production system in west Omdurman (Khartoum State) and traditional nomadic production system around El Obied city (North Kordofan State) is shown in Table 1. Means of camel milk constituents in the current study were all within the range of camel milk constituents reported in the previous 100 years that have been reviewed by Konuspayeva *et al.* (2009). However, our result was higher than that reported by Nagy *et al.* (2013). The results revealed significantly ($p<0.05$) higher protein, solids not fat (SNF) and lactose contents in milk samples obtained from semi intensive system compared to that collected from traditional nomadic system. On the other hand, fat content was significantly ($p<0.05$) higher in milk samples from nomadic system. In this study, although milk yield was not measured due to lack of recording system in both semi intensive and traditional production systems, nevertheless, higher milk yield in the semi intensive system was observed. The high yield could be explained as it is the criterion of choosing the she camel to join the herd. Moreover, the improved husbandry practices in the semi intensive system could also explain the high milk yield. This observation is in line with Babiker and El Zubeir (2014). They concluded that improved husbandry practice has impact on milk yield and gross composition of camel milk. However, Dowelmadina *et al.* (2014) reported that the performance of camel is better under traditional management condition explainable by the high biodiversity in the natural pastures.

Chemical analysis of camel milk in Table 1 revealed significantly ($p<0.05$) higher protein content in milk samples obtained from the semi intensive system, where camels receiving adequate quantity of feed including concentrates. This result is in agreement with Parraguez *et al.* (2003) who concluded that availability of high feed quality explains the variations in milk protein content between different production systems.

Among the other constituents, milk protein is the most important one especially for nomadic camel herders. That is because it represents the single source of protein in their relatively poor environment. Been the only source of protein indicated that camel milk protein is of high biological value and could provide sufficient amount of amino acids. This is a further support to what has been previously mentioned, that camel milk has high nutritional value (Halima *et al.,* 2012).

Despite providing high energy diet, fat content of camel milk in the semi intensive system was significantly ($p<0.05$) lower than that found in the traditional nomadic system (Table 1). Our results showed that under traditional system, camels produce more fat in milk compared to those received concentrates in the semi intensive system. This finding is in line with Shuiep *et al.* (2008) who concluded that supplementation of energy concentrates

decreased fat content of milk. It is also in line with Dowelmadina *et al.* (2014) who indicated that she camel could perform better under traditional conditions. In the same context, lower milk yield observed in the traditional system in this study has previously been reported to associate with high fat content in camel milk (Nagy *et al.,* 2013)

In this study, SNF content of camel milk samples collected from semi intensive system revealed significantly ($p<0.01$) higher values than those obtained from the nomadic system (Table 1). This result is in agreement with Nagy *et al.* (2013) who stated that SNF in high milk yielded she camels was higher than in lower producing ones. It is also in agreement with Yagil (1982) who reported that camels under dry conditions produced milk with lower total solids. Higher SNF content in this study could also be attributed to the availability of water in semi intensive system, which leads to producing milk with high protein and lactose contents and accordingly higher total solids.

Lactose content in this study was significantly ($p<0.05$) lower in milk samples collected from nomadic system (Table 1). This result is in line with (Haddadin *et al.,* 2008 and Babiker and El Zubeir, 2014). They reported quantitative variations in the same fraction in camel milk. However, this result disagreed with Yagil and Etzion (1980) who reported that lactose content of camel milk remains almost unchanged under hydrated or dehydrated conditions. The lower lactose content of camel milk in nomadic system could be attributed to the fact that animals are walking daily for long distance searching for water and pastures. This exercise might cause more energy dissipation (Shuiep *et al.,* 2008). Compositional variations in camel milk between different production systems could be mainly attributed to the environmental conditions, management and husbandry practices since camels suffer extreme drought conditions, scarcity of feed and lack of water in nomadic production system, while in the semi intensive system, camels mostly kept in dairy farms where concentrates are supplemented coupled with continuous supply of water and improved husbandry practices. Moreover, under nomadic production system, in natural pastures in particular, quantity and quality of available feed and watering frequency are very important as these factors are highly influencing the compositional quality of the milk (Yagil, 1982).

From the available literature, wide range was reported for camel milk constituents compared to other species (Al Haj and Al Kanhal, 2010). This was attributed to different factors such as analytical procedures and geographical locations (Konuspayeva *et al.,* 2009). Moreover, physiological status of the animal, for example stage of lactation and parity number, and the genetic background (breed) were also reported to play a role (Nagy *et al.,* 2013 and Dowelmadina *et al.,* 2014). In addition to the above mentioned, production system was also reported to influence the compositional quality of camel milk (Babiker and El Zubeir, 2014).

Milk production:

The activities associated with camel milk production such as frequency and responsibility of milking, selling milk and processing milk into other products are presented in Table 2. Camel herders in the semi intensive system are adopting rational and goal oriented management strategies.

Therefore, improved feeding system, milk production on commercial level, regular two times milking/day (early morning and before sun set) and hired labourers responsible for husbandry practices including milking are the major characteristics of the system.

Table 1: Chemical composition of camel bulk milk samples collected from the semi intensive and the traditional nomadic production systems in Sudan

Production system	Protein			Fat			Lactose			SNF		
	mean+SD	Min	Max	mean+SD	Min	Max	mean+SD	Min	Max	mean+SD	Min	Max
Semi intensive	3.60±0.09*	3.35	3.8	3.63±0.17	3.3	4.55	4.74±0.17*	4.46	5.16	8.84±0.27**	8.38	9.77
Nomadic	3.42±0.11	3.25	3.93	3.93±0.26*	3.27	4.06	4.45±0.17	4.07	4.76	8.25±0.24	7.83	9.06
Total	3.51±0.13	3.25	3.93	3.78±0.26	3.27	4.06	4.59±0.22	4.07	5.16	8.55±0.39	7.83	9.77

* Significant (P<0.05)
** Significant (P<0.01)

In the traditional nomadic system, on the other hand, irregular milking (neither in duration nor frequency) was noticed. That is because nomads are usually collecting milk according to their needs. Therefore, it is very common practice among them to collect milk three times/day or even more. Important observation was that few amount of milk was collected each time. Also another interesting observation was that some she camels were not subjected to milking; either for been weak, or for given full chance to the weak or sick calves to have enough milk. One more thing in the traditional system, hired labourers were not observed. That is because owners or other family members are responsible for milking as well as the other husbandry practices.

Table 2: Frequencies of adopting some activities associated with milk production among camel herders in the semi intensive and traditional nomadic production systems in Sudan

Activity		Semi intensive system		Nomadic system	
		No.	**%**	**No.**	**%**
Frequency of milking/day	Once	0	0	18	44
	Two times	40	100	14	36
	≥ Three times	0	0	8	20
Milking responsibility	Laborers	40	100	0	0
	The owners	0	0	22	56
	family member	0	0	18	44
Selling milk	Yes	40	100	19	48
	No	0	0	21	52
Processing of milk	Yes	0	0	40	100
	No	40	100	0	0

Among other husbandry practices, nomads are widely using *surar* procedures to prevent kids from suckling. That is because nomads prefer milk of certain she camels i. e those gave birth for first time. For *surar* practice, small piece of wood (about 10 to 15 cm long) is tightly tied to two teats of the same side (usually the left side) by piece of cloth (Figure 1). This practice unfortunately, harms the teats after long application, which may lead to damage the teat at the end.

Figure1: *Surar* the very common practice among nomadic camel herders. It is applied when restricted suckling is planned.

Among nomads, camel milk is regularly processed into fermented camel milk, locally known as *gariss* as shown in Table 2. From observations and interviews with herders, it was noticed that drinking fresh unprocessed camel milk was very rare among nomads. That is because they believe that *gariss* is much healthier. Nevertheless, in the semi intensive system, it is possible to purchase either raw or heat treated camel milk directly from dairy camel farms. However, processing camel milk into other products such as cheese or yoghurt on commercial level does not exist yet. On the other hand, among nomads, camel milk is mainly consumed by households as it is not offered for sale. It is consumed without being subjected to any sort of heat treatment. Households interviewed in this study declared that they are not familiar with heat treated camel milk. This result is in agreement with that reported earlier by Yagil (1982) who concluded that camel milk is used to secure the family needs in most camel rearing societies. In general, camel milk either fermented or fresh, is the most important food for nomads (El Hag *et al.*, 2003).

Continuous water availability supplied by pipe lines is one of the major characteristics of camel dairy farms in the semi intensive system. The situation is however different in nomadic system. As for their domestic supply and to meet the needs of their livestock, nomads mainly depend on different sources of water such as naturally formed water, *hafir* and open shaft wells. Nomads are mainly depending on the first type, and then they shift to other sources during the dry months. According to the interviewees' watering interval, in nomadic system, varies from seven to nine days during summer months, whereas during winter season, when ambient temperature is low and succulent plants are available in natural pasture, watering intervals extended up to 20- 35 days (Musa *et al.*, 2006). Because of their unique physiology, camels are capable to handle dehydration for more than a month (El Zubeir and Nour, 2006).

Worldwide, camel milk is receiving more recognition as healthy and therapeutic food, therefore, in Sudan like elsewhere, the market demand on the product is rapidly increasing, consequently; the consumption of camel milk is highly increased. In Sudan particularly, changing of the traditional conserved attitude of camel herders against selling milk (Table 2) has led towards more commercialization of camel milk. However, although it has high

market demand, remoteness of camel rearing areas coupled with poor communication infrastructure especially in roads network and organized transportation systems is hindering large scale marketing of camel milk. Because of that there is still huge amount of camel milk produced in the rural areas but it cannot find the way to the urban markets. Looking more closely to the situation in Sudan, camel milk produced in the semi intensive system is increasingly consumed in urban areas, however, the amounts is not sufficient enough to meet the high demand. The consequence of that is clear in the price of camel milk, which is three times of cows (at the time of this study). Therefore a bridge between nomadic producers and urban consumers in terms of establishment of collection centers coupled with cooling facilities and transportation net work is highly needed. When such link is well developed, camel milk can easier reach the urban markets.

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التركيب النوعى للبن الإبل وبعض الممارسات الحقلية المرتبطة بإنتاجه فى نظامى إنتاج فى السودان

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المستخلص:

صُمم هذا البحث بغرض دراسة التركيب الكيميائى للبن الإبل و دراسة بعض ممارسات رعاية الحيوان المرتبطة بانتاج الألبان فى نظام الإنتاج شبه المكثف ونظام الإنتاج التقليدى الترحالى فى السودان. جُمعت عينات من اللبن المجمع (ن= 80) للتحليل الكيميائى من نظامى الإنتاج (بواقع 40 عينة من كلٍ). عينات لبن الإبل التى جمعت من النظام شبه المكثف أظهرت محتوىً أعلى معنوياً ($p<0.05$) من البروتين الكلى والجوامد غير الدهنية و اللاكتوز، بينما كان محتوى الدهن أعلى معنوياً ($p<0.05$) فى عينات اللبن التى جمعت من النظام التقليدى الترحالى. الإدارة الموجهة وممارسات رعاية الحيوان المحسنة وتوظيف عمال ذوى خبرة فى التعامل مع الأبل بالإضافة إلى الحلب المنظم بواقع مرتين فى اليوم كانت أهم سمات النظام شبه المكثف.

نخلص إلى أن ممارسات رعاية الحيوان المحسنة والإدارة الموجهة إلى إنتاج الألبان فى النظام شبه المكثف كان لهما تاثيراً ايجابياً على نوعية تركيب لبن الإبل. أيضاً، النظام شبه المكثف يوفر لبن الإبل والذى اصبح الطلب عليه عالياً من قبل سكان المناطق الحضرية. غير أن هناك كميات مقدرة منه تنتج فى النظام التقليدى الترحالى ولا تصل الى الاسواق. لذلك فان الربط بين المنتجين التقليديين و المستهلكين الحضريين أمر مطلوب بشدة.