# Camels (*Camelus dromedarius*) under pastoral systems in North Kordofan, Sudan : Seasonal and parity effects on milk composition

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## Abstract

Milk samples were obtained from 44 camels (*Camelus dromedarius*), in three different herds, belonging to a Kababish pastoral tribe in North Kordofan, Sudan. Sampling started one month postpartum and continued, at a 3-month interval, for twelve months. Camels were used in different parities, ranging from primiparous to those in their 6th parity. Samples collected were analyzed for milk chemical composition. Least squares mixed models procedures were used for the statistical analyses. The objective was to study the effects of seasons and parity on milk chemical composition. Milk CP, fat, lactose and ash contents were all significantly ($P < 0.05$) affected by season. CP, fat and ash contents were higher ($P < 0.01$) during hot summer (May - July) and decreased during winter (Nov -Jan) and rainy (Aug - Oct) seasons. However, lactose contents showed an opposite trend, being higher ($P < 0.01$) during the rainy season and decreased during the summer seasons, with hot dry summer recording the lowest ($P < 0.01$) values. The highest milk CP contents were recorded in primiparus camels compared to those in other parities ($P < 0.01$). Parity seemed to have no effect ($P < 0.05$) on milk fat contents. Nonetheless, relatively higher values were observed with advanced parities, same as lactose contents. Total solids and pH values were not significantly ($p > 0.05$) affected by parity or season. Herd differences ($P <0.01$) in milk CP, lactose & total solids content were observed. However, there were non-significant ($P > 0.05$) herd x season, herd x parity or season × parity interaction effects on milk composition. It was concluded that camel milk composition was a reflection of seasonal and parity variations. However, more work is needed to elucidate breed and management effects on camel milk composition in local Sudanese conditions.

Key words: camel, milk, chemical composition, parity and season.

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## 1. Introduction

Camel's milk constitutes an important part of the diet in pastoral societies in arid and semiarid regions in western Sudan. It is of vital importance in drought areas (Yagil, 1986). Kon (1972) reported that camel milk contained fairly high vitamin C content. This is important as there are few alternative source of this vitamin in the diet of transhumant camel herders.

According to Nawito et al., (1967) the percentage of fat, protein and lactose in dromedary milk are 3.8, 3.5 and 3.9 % respectively. During subsequent lactations, the level of protein and fat were elevated and those of lactose and pH witnessed a decline (Sheriha, 1986). However, limited information is available on camel milk composition under pastoral systems in North Kordofan, Sudan. The objectives of this study were to determine the effects of season and parity on camel milk composition.

## 2. Materials and Methods

2.1. Study area:

The study was conducted on 44 she-camels from three herds, belonging to to Kababish tribe in North Kordofan, Sudan. North Kordofan lies between latitudes 11°: 15` and 16°: 30`N and longitude 27-30°E. Mean daily temperature is about 26.5° C with beak above 40° C during the hot summer (April-June) and an average minimum temperature of below 15° C during the cool winter months ( El Tahir et al,. 1999).

Most of north Kordofan falls within the arid and semiarid ecological zones on sand. The soils are sandy interspaced by silt depressions and characterized by stabilized and disturbed sand dunes. The dominant over story vegetation are *Acacia tortilis, Maeura crassifolia, leptodania pyrotechnica* and *Acacia seyal*. The grasses are mainly *Panicum turgidum, Aristida spp*. and *Cympogen spp*. Low lying areas and seasonal water courses carry *Acacia seyal, Faidherbia albida, Balanites aegyptiaca, Adansonia digitata, Tamarindus indica* and *Ziziphus spina-christi* (Technoserve, 1987; El Tahir et al. 1999).

### 2.2. Milk sampling and storage

Forty-four she-camels, ranging from primiparous to camels in their 6th parity, were selected from three herds belonging to Kababish tribe. Milk samples were collected from these camels one-month postpartum and three-month interval thereafter. Half a liter of milk was collected from each camel kept in insulated boxes using freeze packs and transferred to the laboratory. At the laboratory, the samples were stored in a refrigerator at 4-5 ° C for later analysis.

### 2.3 Chemical composition determinations

Milk fat content was determined using Gerber method. Milk crude protein (CP) was calculated from total nitrogen contents using Kjeldahl method (Marshall, 1993). Lactose was determined according to Taylor (1970). Water and total solids (TSS) contents were determined using the forced draft oven method (Marshal, 1993). PH values of the milk samples were read by a pH meter as described by New Land and Athorton (1960). Ash content was determined through burning away all the organic matter at 540-550 ° C in a muffle furnace (Marshall, 1993).

### 2.4. Data arrangement and statistical

Data were arranged according to four seasons; rainy season (Aug – Oct), winter (Nov – Jan), warm dry summer (Feb – Apr) and hot dry summer (May – July). All the experimental camels spent period of two months (Oct – Nov) at the Gizzu grazing area. Least squares mixed models procedures (Harvey, 1977) were used for the statistical analyses. Models used incorporated the fixed effects of seasons and the random effects of herd and parity. This was done due to unequal and disproportionate subclass frequencies. The model used was:

$$Yij\kappa = \mu + Xi + \beta j + (X\beta)ij + \varepsilon ij\kappa$$

Where:

$Yij\kappa$ = Dependent variables

$\mu$ = Over all means

Xi = Fixed effects due to season or parity

$\beta j$ = Random effect due to herd

$(X\beta)ij$ = interaction effect ( herd × parity, herd x season, or parity × season)

$\varepsilon ij\kappa$ = Error

## 3. Results and Discussion

Milk fat content was highest ($P < 0.01$) in hot summer and decreased significantly during both winter and rainy

seasons (Table 1). This might due to the high milk yield during rainy & winter seasons indicating a negative correlation between yield and milk contents (Martin, 1993). However, lactose contents showed an opposite trend compared to that of fat and protein. Lactose was significantly ($P< 0.01$) higher during rainy season and decreased during summer season summer seasons, with hot dry summer season recording the lowest values. Availability of good feed resources during the rainy season (Knoess et al., 1986) could be the cause for the higher milk lactose content.

Total solids contents and pH values were not significantly ($P > 0.05$) affected by season. However, relatively higher total solids contents were recorded in winter (Table 1).

Table 1. Least square means for camel milk composition (%DM-basis) as affected by herd, season and parity.

| Variable | N | CP | Fat | Lactose | Ash | TSS | Moisture | pH |
|---|---|---|---|---|---|---|---|---|
| Overall mean | 44 | 3.4 | 3.4 | 3.6 | 0.8 | 10.9 | 89.3 | 6.6 |
| **Season:** | | | | | | | | |
| Rainy | 44 | 3.0a | 3.1a | 3.9a | 0.7a | 10.7 | 89.3 | 6.6 |
| Winter | 44 | 3.3ab | 3.2ac | 3.8a | 0.7a | 11.4 | 89.4 | 6.6 |
| Warm Summer | 44 | 4.5b | 3.5ac | 3.5b | 0.8b | 10.6 | 89.3 | 6.5 |
| Hot Summer | 44 | 3.7b | 3.7ac | 3.2c | 1.0c | 10.9 | 89.2 | 6.5 |
| Mean(season) | | 3.4 | 3.46 | 3.6 | 0.8 | 10.9 | 89.3 | 6 |
| SE± (season) | | 0.15 | 0.2 | 0.08 | 0.03 | 4.74 | 0.5 | 0.05 |
| **Parity:** | | | | | | | | |
| Primiparus | 8 | 3.8a | 3.5 | 3.6ab | 0.8ab | 11 | 89.1 | 6.5 |
| 2nd Parity | 8 | 3.3b | 3.4 | 3.5ab | 0.8ab | 11 | 89.1 | 6.5 |
| 3rd Parity | 8 | 3.3b | 3.5 | 3.6ab | 0.9a | 11 | 89.2 | 6.5 |
| 4th Parity | | | | | | | | |
| 5th Parity | 6 | 3.3b | 3.1 | 3.8cb | 0.7b | 10.5 | 89.6 | 6.7 |
| 6th Parity | 6 | 3.2b | 3.1 | 3.9c | 0.8ab | 10.9 | 89.2 | 6.6 |
| Mean (parity) | | 3.4 | 3.3 | 3.5 | 0.8 | 10.9 | 89.3 | 6.6 |
| SE± (parity) | | 0.23 | 0.17 | 0.12 | 0.04 | 4.74 | 0.5 | 0.05 |
| **Herd:** | | | | | | | | |
| Herd One | 16 | 3.3ab | 4.5a | 3.6ab | 0.8 | 10.9 | 89.2 | 6.5 |
| Herd Two | 14 | 3.2a | 3.1b | 3.5a | 0.8 | 10.5 | 89.7 | 6.6 |
| Herd Three | 14 | 3.6b | 3.5c | 0.7b | 0.8 | 11.3 | 88.9 | 6.3 |
| Mean (herd) | | 3.4 | 3.4 | 3.6 | 0.8 | 10.9 | 89.3 | 6.6 |
| SE± (herd) | | 0.11 | 0.08 | 0.07 | 0.02 | 0.32 | 0.35 | 0.05 |

a, b, c Means in the same column, under the same variable, that have no letter in common are significantly different.

Crude protein contents were similar (P > 0.05) across milk samples from camels in different parities, with the exception of milk from primiparous ones which recorded the highest contents (P < 0.01) in comparison to milk from camels in the other parities. Parity seemed to have no effect (P > 0.05) on milk fat contents (Table 1). Nonetheless, relatively higher milk fat contents were observed with advance parities (Fig. 2). Martin (1993) and Sheriha (1986) reported a negative correlation between lactose, protein and milk fat contents with advancing lactation and parity.

Herd x parity, herd x season or parity x season interaction were found to have non-significant effects (P > 0.05) on milk composition (Table 2). However, the overall camel milk composition found in this study (Table 1) was in line with values reported by many authors (El-Bahy 1982, Khan and Apor, 1964; Abdel-Rahman 1987).

It could, therefore, be concluded that camel milk composition was a reflection of seasonal changes in quality feed availability and parity differences. However, more work is needed to study the effects of management and breed differences on milk composition.

Table 2. Mean squares from the analysis of variation for camel milk constitutes as affected by season, parity, herd and their interactions.

| Source of variation | df | CP | Fat | Lactose | Ash | TSS | Moisture | pH |
|---|---|---|---|---|---|---|---|---|
| Season | 3 | 3.84** | 3.16** | 4.40** | 0.66** | 4.20** | ns | ns |
| Parity | 5 | 1.38** | 1.20** | 0.89** | 0.15** | ns | ns | 0.08** |
| Season × Parity | 15 | ns | ns | Ns | ns | ns | ns | ns |
| Error | 27 | 0.25 | 0.13 | 0.07 | 0.01 | 1.01 | 1.20 | 0.01 |
| Herd | 2 | 2.35** | 2.40** | 0.47** | ns | 8.32** | 7.66** | 0.06** |
| Herd×Season | 6 | ns | ns | Ns | ns | ns | ns | ns |
| Error | 32 | 0.25 | 0.13 | 0.10 | 0.01 | 0.97 | 1.21 | 0.02 |

ns = not significant (P> 0.05), ** = highly significant (P< 0.01) and *** = very highly significant (P< 0.001).

## 4. Acknowledgements

Kababish Tribe Civil Administration help in providing the camels highly appreciated. Thanks extended to the Technicians, at El-Obeid Research Station, for their help in milk analysis.

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