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Impact of Management System on Milk Performance and Lactation Curve of Camel in Sudan

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ABSTRACT

This study was carried out to determine the effect of management systems on milk production performance and lactation curve of camel in Sudan. Records of 22 lactating she-camels covered the period between 2012- 2014 were obtained, of which 15 records from Camel Research Centre (CRC) and 7 records from Tumbool Camel Research Center farm (TCRC). Camels of CRC were assigned to semi intensive management, while camels of TCRC were allocated in intensive system management. The lactation curve was estimated according to Wood function. T test was performed to assess the impact of the management systems on production performance and lactation curve parameters. The results revealed that averages total milk yield, daily milk yield and lactation length were 1378.00 litter, 3.89 litter and 347.45 days, respectively. The results indicated that the intensive system had significantly ($P<0.01$) higher total milk yield than semi intensive system (2386.29 liter versus 907.00 liter), daily milk (6.22 liter versus 2.80 liter) and insignificantly lactation length (391.00 versus 328 days). The study showed significant and positive phenotypic correlations among milk production traits. Moreover, the study determined the lactation curve parameters, α (initial milk yield) was 4.21 and 2.10 in intensive system and semi intensive system, respectively; the corresponding values of β (increasing slope) were 1.00 and 0.86; the corresponding values of γ (decreasing slope) were -0.08 and -0.08; time to reach peak yield (weeks) were 11.72 and 11.23; and corresponding values of determination factors (R^2) were 0.64 and 0.74, respectively. The study concluded that the intensive system had greater milk performance, and the lactation curve model (incomplete gamma) used in this study was suitable and appropriate.

Keywords: Camel, lactation curve, management system, milk performance

INTRODUCTION

Sudan is rated as the second highest world size of camel population in the world. According to recent estimation of camels in Sudan there are about 4.623 million heads (Ministry of Animal Resources and Fisheries, 2011). In Sudan, four camel management systems were identified. These systems are: Traditional nomadic system (Shuiep and El

Zubeir, 2008 and 2012; Ishag and Ahmed, 2011); Transhumance or semi nomadic system (Musa *et al.,* 2006a; Eisa and Mustafa, 2011); Sedentary or semi-sedentary system (Ishag and Ahmed, 2011; Shuiep and El Zubeir, 2012) and the Intensive system (El Zubier and Nour, 2006; Eisa and Mustafa, 2011). The milk production is one of the main objectives of the camel producers. The camel milk in Sudan is consumed fresh or fermented (*gariss*) mainly processed under traditional manner. The camel is a diary animal with a good potential (Knoess, 1979; Breulmann et al., 2007), but the feeding is generally insufficiently defined for high dairy yield (Faye, 2004). Kamoun and Jemmali (2012) reported that the milk yield of camel varies greatly depending on the region, these variation in milk yield due to breed or types (Wernery *et al.*, 2004), stage of lactation (Musa *et al.*, 2006b; Raziq *et al.*, 2008; Al-Saiady *et al.*, 2012); parity numbers (Al-Saiady *et al.*, 2012) and the production systems (Musa et al., 2006b; Bakheit *et al.*, 2008).The term lactation curve refers to the graphical representation of the relationship between milk yield and length of time since calving. The lactation curve is composed of three segments or phases the first phase from initial yield postpartum up to peak yield, the second phase is the persistency of peak yield and the third phase is the decline from the peak to the end of lactation. There are few works related to lactation curve in camels, the present work give chance to estimate lactation curve and determine milk performance in camels under different management systems. The aims of the present study are to assess milk production performance of camel raised under intensive and semi intensive management. And to estimate lactation curve in camel and determine the impact of management systems on lactation curve parameters.

MATERIALS AND METHODS

***Study areas*:** This study was carried out on data collected from two research farms

***Camel Research Centre** (CRC) **farm*:** The farm belonging to the University of Khartoum. It was located at Shambat (Khartoum North) on the Eastern bank of the Nile, at latitude 15˚-40 N longitude 32˚-32E and about 376 meter above sea level. The prevailing climate is semi-arid. The CRC was established in 2004. The types of camels kept belong to the Arabi and Rashaida ecotype. The management system adopted in farm is a semi-intensive one (semi-closed). The animals were housed in open-shaded yards constructed of iron pipes and roofed with local materials. The animals were allowed to graze during the day and concentrate mix was offered individually for lactated camels and calves during the evening. Milking was practiced twice a day.

Tumbool Camel Research Centre farm (TCRC): This farm lies 3 kilometers north Tumbool rural town, 27 kilometers to the east of the Blue Nile River and 145 kilometers south to Khartoum; at latitude 14° 55' N, longitude 33° 25' E and an altitude of 401.5 m above sea level. The climate is mainly of poor Savannah Zone. The concentrate feeding offered to the animals was formulated based on sugar cane by-products (molasses & bagasses) and urea salt. Crushed sorghum grain, ground nut cake and wheat bran were added, while mineral lick, normal salt and bicarbonates were provided. The meal was given twice a day. While green fodders were provided in forms of Abu-70 (*Sorghum bicolor*), Pioneer (*Sorghum bicolor x Sorghum sudanense* hybrid), Clitoria (*Clitoria ternate*) and Berseem

(*Medicago sativa*) but still, the major filling material was the sorghum residues. Milking was practiced twice a day.

***Milking practice*:** The animals in two farms were manually milked. Because of the height of the udder the milking process is done in standing position with one knee raised to support the plastic pail. The milker stands on one leg and balancing the plastic pail in his bent other leg and uses both hands for milking.

Data collection: Data of milk production were obtained from records of the above two farms. The collected data covered records of twenty two she-camels. Of which fifteen she-camel records of milk production covered the period between 2012 and 2014; from Camel Research Center (CRC). The rest seven she-camel records were randomly collected from Tumbool Camel Research Centre (TCRC); covered the same period 2012-2014, under intensive system management. The collected data include were milk production as daily milk yield in CRC and monthly milk yield from TCRC. From these data the total milk production, lactation length and daily milk production were calculated.

Estimation of lactation curve parameters: The lactation curve was described using model known as the incomplete gamma model due to its relation to the incomplete gamma function and as Wood's function (Wood, 1967).

$$\eta = \alpha x^{\beta} \exp(\gamma x)$$

By taking logarithms the model became as linear model as:

$$\log(\eta) = \log(\alpha) + \beta \log(x) + \gamma x$$

Where:

Log (η) = logged milk yield.
Log (α) = logged initial milk yield.
β = slope of increase milk yield.
Log (x) = logged number of month.
γ = slope of decrease milk yield.

From above model the lactation parameters (α, β, and γ) were estimated from individual animals and lactation was fitted. The time to reach peak milk yield was also calculated by divided the slope of increase milk yield over the slope of decrease milk yield as

Time of peak milk yield = β/γ

The determination coefficient (R^2) was obtained for each animals between actual milk production and predicted milk production by the curve components.

Statistical analysis: The data were subjected to statistical analysis using SPSS computer software (version, 17). Data of milk production and lactation curve were classified according to management system into two groups (semi-intensive of CRC and intensive of TCRC). T-test for independent samples was performed.

RESULTS

The results in Table 1 showed that the means of total milk yield, lactation length and daily milk yield were 1378.00±806.35 liter, 347.45±107.82 days and 3.89±1.80 liter, respectively. Also the results showed the minimum and maximum of total milk yield (490 and 3181.0 liter), daily milk yield (1.64 and 8 liters) and lactation length (203 and 587 days).

Table 1: Descriptive statistics of milk production trait:

Trait	N	Minimum	Maximum	Mean	SD
Total milk yield (liter)	22	490	3181.0	1378.00	806.35
Lactation length (day)	22	203	587	347.45	107.82
Daily milk yield (liter)	22	1.64	8	3.89	1.80

Table 2 explains the influence of management systems on milk production traits of camels. The statistical analysis revealed the management system had significant (P<0.01) influence on total and daily milk yield, but had no significant (P>0.05) effect on lactation length. The results (Table 2) revealed that the she-camels in intensive system produced significantly (P<0.01) higher total milk yield and daily yield (2386.29±213.76 and 6.22±1.2 liters) than those she-camels in semi-intensive system (907.00±304.99 and 2.80±0.53 liters). On the other hand, she-camels in intensive system insignificantly (P>0.05) lactated more period (391.43±98.35 days) than those she-camels in semi intensive system (326.93±108.97 days).

Table 2: Effect of management systems on milk production trait of camels (mean ± SE)

Trait	Management system		Sig. level
	Semi intensive	Intensive	
Total milk yield (liter)	907.00^{b}± 304.99	2386.29^{a}± 213.76	*
Lactation length (day)	326.93^{a}±108.97	391.43^{a} ± 98.35	NS
Daily milk yield (liter)	2.80^{b}±0.53	6.22^{a}±1.2	*

NS: not significant P>0.5; *: Significant at P<0.05

Table 3 shows the phenotypic correlations among total milk yield, daily milk yield and lactation length. The results showed that the total milk yield was significantly and positively correlated with daily milk yield (0.85) and lactation length (0.60), while daily milk yield was positively and insignificantly correlated with lactation length.

Table 3: The phenotypic correlations among milk production traits (total milk yield, daily milk yield and lactation length) in she-camel

Traits	Daily milk yield (liter)	Lactation length (day)
Total milk yield (liter)	0.85*	0.60*
Lactation length (day)	0.15^{NS}	

NS: Not Significant at P>0.05; *: Significant at P<0.01

Table 4 shows the effect of managements systems on parameters of lactation curve in camels. The results revealed that α parameter (initial milk yield) was significantly (P<0.01) affected by management systems and the value was higher in intensive systems than semi-intensive, while β and γ parameters and coefficient of determination of variation (R^2) were not significantly (P>0.05) affected by management system.

Table 4: Effect of management systems on parameters of lactation curves of dairy camels (mean±SD)

Parameters	Management system		Significant level
	Intensive	Semi intensive	
A	0.58±0.20	0.31±0.11	**
B	1.00±0.59	0.86±0.35	NS
Γ	-0.08±0.05	-0.08±0.05	NS
Timeto milk peak $^{\psi}$	11.72±2.16	11.23±4.56	NS
R^2	0.64±0.12	0.74±0.19	NS

**= significant at P<0.01 NS=Not significant (P>0.05).
α = the initial yield; β = the increasing slope of the curve, γ= the decreasing slope of the curve; R^2 = coefficient of determination of variation

Figure 1 illustrates the lactation curve of camels raised under semi-intensive system at Camel Research Center farm, University of Khartoum. While **Fig 2** showed lactation curve of camel raised under intensive system at Tumbool Camel Research Centre (TCRC). Figure (3) illustrates the lactation curve of camels in two systems.

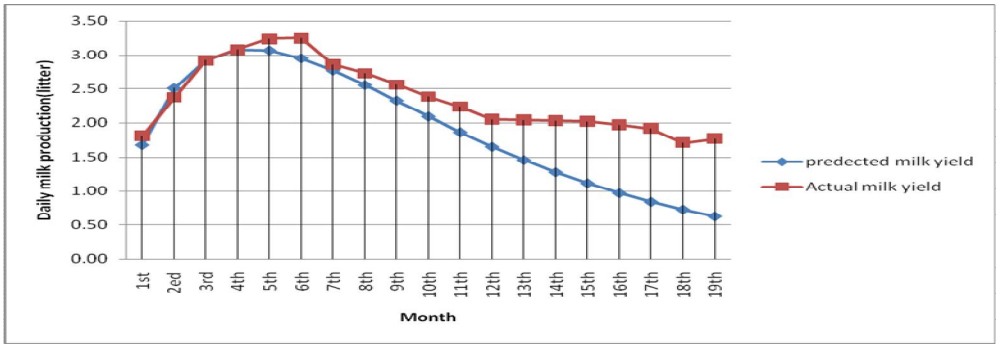

Figure 1: Lactation curve of camels from Camel Research Centre (CRC) farm.

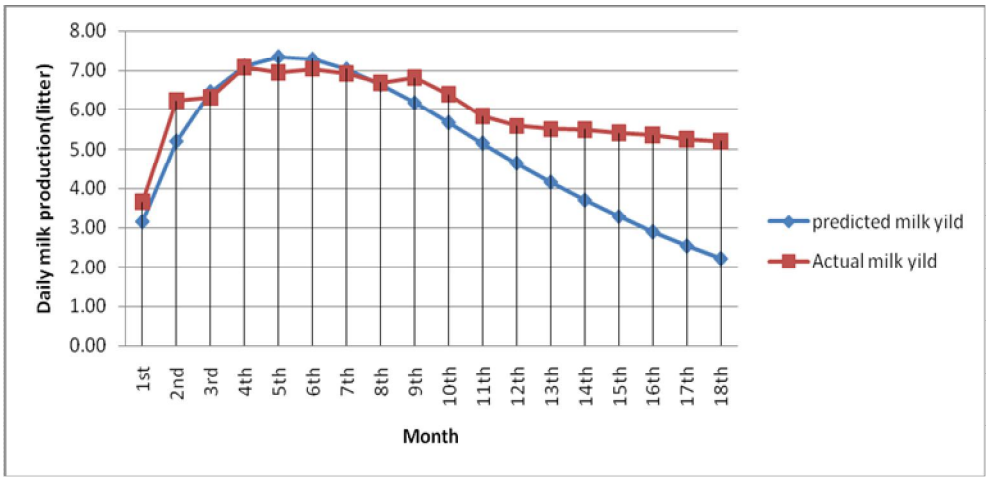

Figure 2: Lactation curve of camels under intensive management (Tumbool Camel Research Centre (TCRC) farm).

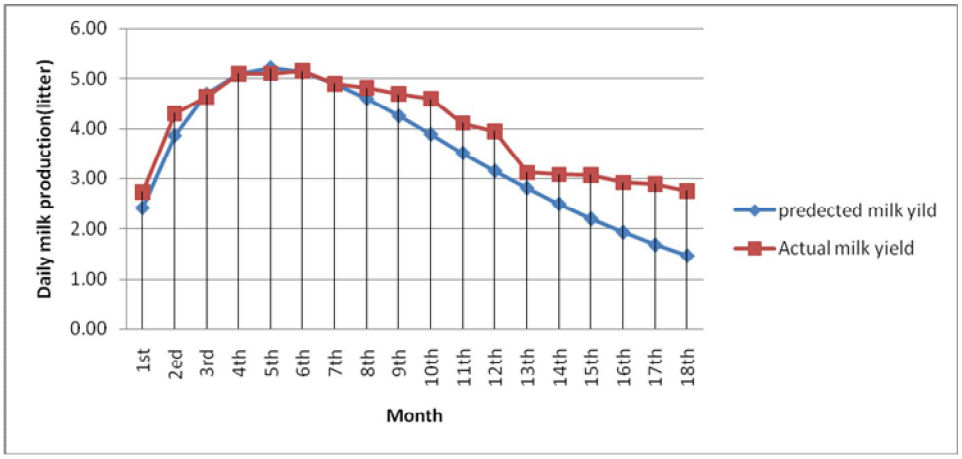

Figure 3: Lactation curve of camels under two systems (intensive and semi intensive)

DISCUSSION

The camel is one of the most neglected domestic animals in the Sudan, with regard to research pertinent to its milk production potential under different systems of management. This is an endeavor to throw some light on the milk potential in Sudanese camels managed under semi-intensive and intensive system and compared the impact of the management system on daily, total milk yield and lactation length. The average milk yield in this study in general without differentiation between the two systems of management was 1378.00 liter/ lactation and 3.89 liter/day. These results complied with the findings of Ghol (1979), Knoess (1979), and Shareha (1990) who reported that the total milk yields produced ranging from 800- 3600 liters and daily milk yields varied between 2.8 to 11 liters. The present data also were within the range obtained by Eisa (2006), Salman (2002), Mussad *et al.* (2013) and Bakheit *et al.* (2008), who mentioned that the total milk yield 2633.37 liters in semi- intensive system and 1204.05 liters in traditional system during a lactation period of 12 months.

The results of the present study reflected clearly the significant contribution of the farming or management systems on milk production and lactation length. The actual milk secreted is higher than the recorded figures presented in this study, because the calves shared the milker when the milk let down and they suckled faster than the milker. Moreover, milk yield was calculated from only twice milking per day, with consideration that she-camel might milked four times or more in some areas. The results showed there was significant difference ($P<0.05$) within the daily milk yield and total milk yield in semi-intensive and intensive system that was in line with that reported by Bakheit *et al.* (2008), and agree with findings of Faye and Esenov (2005) who reported that, some intensified systems occurring in many places showed good prospects in camel milk production to supply populations from arid lands. The average lactation length was found 347.45 day and averages the same traits in intensive and semi intensive systems were 326.93 and 391.43 days, respectively. These results were in agreement with these reported by Farah (1996) and Shareha (1990) who reported that the lactation period in camel varied from 9 to 18 months. According to the results the daily and total milk yield of camel

under semi-intensive system were significantly lower than milk production of the camel raised under intensive system and this may be due to some reasons which include in semi-intensive management the camels are partly depending on the natural pastures (grazing on the acacia trees) and partly receiving food supplementation in the evening, while camels raised under intensive system were raised under closed system and fed roughages and supplementary diets through the day and able to produce more milk (significantly higher).

The lactation curve parameters were described by gamma function. The three parameters or consists of lactation curve were studied are (α) initial yield, (β) increasing slope of the curve and (γ) the decreasing slope of the curve. Also the time to reach peak yield and determination coefficient were estimated. In the present study the means of α-parameter (initial milk yield) were 2.1±0.56 and 4.21±2.31 liter in semi-intensive and intensive system, respectively. In this study the means of β-parameter (increasing slope) were 1.00±0.59 and 0.86±0.35 in intensive and semi-intensive system. In the current results showed that γ-parameter (decreasing slope) had same value in intensive and semi-intensive system (0.08±0.05). The present parameters of lactation curve are not in line with findings of Zayed et al. (2014), who found that the overall means of a, b and c parameters were 45.4±20.8, 0.304±0.238 and 0.038±0.020, respectively. This study showed that the averages time to reach peak yield (in week) were 11.72±2.16 and 11.23±4.56 in intensive and semi-intensive system, respectively and were slightly similar to the finding of Faye and Chaibou (2003) and Khan and Iqbal (2001) who mentioned that the lactation peak was observed at the 3rd month of lactation. In this study the coefficients of determination (R2) were 0.64±0.12 and 0.74±0.19 in intensive and semi-intensive, respectively; and were accordance with findings of Fadlelmoula (2007) who found that the mean of R2 was 0.69 in their study on crossbred cattle in Sudan. The persistency in dairy she-camel in this study was found high (169.77±84.00 for intensive and 128.90±86.02 for semi-intensive), due to the ability of these camels to maintain their milk production throughout the lactation period. Also highest value of persistency estimates were reported by Akpa et al. (2001) who found the persistency was 143.2±0.02 in Red Sokoto does, and Wood (1967), who found 128.0 in Friesian cows.

From the results of this study it can be concluded that camel under intensive management system produce significantly more milk than semi-intensive system. Therefore the improving management system increased milk yield about 2.6 times from that produced under semi-intensive system, that means any development in management and farming system of camels could be increase milk performance of lactated camels and which reflect the good advantages to the calf and economic value. The results of lactation curve in this study concluded that model or function used (incomplete gamma function) was suitable and appropriate in description of lactation curve of camels.

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Comparative Gross Anatomical Studies of Parotid Gland of Camel and Economic Ruminants

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ABSTRACT

The present investigation was carried out to study the comparative anatomical features of parotid gland of camel and economic ruminants (ox, sheep and goat). Twenty heads of adult camels, oxen, sheep and goats (five heads of each) were used in this study. The samples were collected randomly from Alssalam slaughter house, Omdurman, Sudan. The parotid gland was partially covered by parotidoauricularis muscle in camel, completely covered in ox but absent or superficial in sheep and goat. It was irregularly rectangular in camel, rectangular in ox, irregularly-shaped in sheep and triangular in goat. It was located under the ear ventral to auricular cartilage. The gland was dark brown to red in camel, dark red in ox, brown in sheep and goat. It was lobulated in camel, ox, sheep and goat. The gland weighed 12±4.455g in camel, 11.6±0.671g in ox, 5.9±0.418g in sheep and 7.18±0.641g in goat. The length measured 11.3±0.770cm, 5.94±0.186cm, 6.04±0.576cm and 6.56±0.327cm in camel, ox, sheep and goat respectively. The width of the gland was 7.52±0.344cm in camel, 3.78±0.655cm in ox, 2.74±0.152cm in sheep and 3.06±0.364cm in goat. The thickness was 0.78±0.228cm in camel, 0.4±0.070 in ox, 0.3±0.070cm in sheep and 0.27±0.044cm in goat. All measurements of weight, length, width and thickness were analyzed. The duct left the gland from the medial surface and crossed the lateral surface of the masseter muscle with some branches of dorsal buccal nerve in the camel, sheep and goat and ventral buccal nerve in the ox. It opened at oral mucosa in papilla opposite the second upper molar tooth in the camel, sheep and goat and opposite the fifth upper molar tooth in the ox.

Keywords: Anatomy- Parotid- Camel- Economic ruminants.

INTRODUCTION

The salivary glands are known as multifunctional organs that perform many important digestive, protective, excretory and endocrine functions (Miletich, 2010). They collectively produce and secrete saliva, a fluid that assists in the initial activities of digestion (Micheal and Valerie 2006). This secretion has an important role in the moistening and swallowing of newly ingested food and maintenance of oral hygiene. Moreover in ruminants the salivary secretions regulate the digestion in the forestomach (Kay and