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Some factors affecting dairy she-camel performance

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Abstract

In order to determine the effect of some factors, as different levels of energy and protein, milking interval, lactation stage, and lactation rank on she-camel performance after weaning of camel-calves, 20 lactating she-camels were divided into four groups, 5 animals each, according to age and weight at last parturition. Groups had randomly allocated to one of four treatments diets. Group A received diet with 13% Crude Protein (CP) and 2.4 MCal Metabolisable Energy (ME). Group B received diet with 13% CP and 3.0 MCal ME. Group C and D received diet with 15% CP and 2.4, 3.0 MCal ME respectively. Diets contain 35/65 (roughage/concentrate, respectively). After 14 days of adaptation period, individual feed offered and orts had been recorded, daily and continued up to entire experimental period of 10 months. Milk yield was recorded two milking time from three consecutive days. The results show that diet (B) gave higher milk yield (MY), Fat Corrected Milk (FCM), Energy Corrected Milk (ECM) and Feed Conversion Ratio (FCR) 8.32, 11.77, 7.47, and 1.38 respectively. Diet (A) has higher fat % content when comparing with the other diets. Treatment did not affect milk composition except on fat and ash percentage. Milk secretion rate for 10 hours milking interval "evening milking" was higher comparing with 14 hours milking interval "morning milking" 397, 353 g/h respectively. Maximum MY, FCM and ECM were at mid lactation. In late lactation MY, FCM, ECM decreased. Higher milk productivity was at 3rd and 6th season of lactation.

Key words: She-Camel, Feeding, Milk composition, Milking interval, Milk secretion rate

Introduction

The camel is a dairy animal with a good potential (Knoess, 1979; Breulmann et al., 2007), but the feeding is generally insufficiently defined for high dairy yield (Faye, 2004). If little is known about the nutritional physiology of the camel, it is probably true to say that even less is known about its requirements for energy. The camel is peculiar in being able to maintain its appetite even under harsh conditions. Yagil and Etzion, (1980) reported that in common with other animals under conditions where food is in short supply, camels are able to survive on diets well below maintenance requirements and compensate rapidly when conditions improve However, because of their large size, and its urea recycling capacity, camels should require less feed for maintenance (per unit of weight) than smaller animals such as sheep, goats etc. Thus a great amount of available food will support a greater weight of camel than other species of domestic livestock (Gihad et al., 1989).

Effects of milking interval on milk yield and milk composition depend on animal species, breed, and individuals. Accumulation of milk in the udder during extended milking intervals reduces the activity of mammary cells as a result of a local intramammary regulation (Stelwagen et al., 1997; Herndez et al., 2008). Moreover, there is a general agreement that increasing milking frequency to more than twice daily increases milk yield, but effects of both shortened and extended milking intervals are less marked in large-cisterned animals (Ayadi et al., 2003; Castillo et al., 2008).

Effect of milking interval on milk secretion rate in hand-milked camels was shown by Alshaikh and Salah (1994) in a study conducted in Arabian dromedaries for 4- to 16-h milking intervals in

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which the greatest milk secretion rate (585 g/h) was observed for the shortest milking interval. Although no differences between 8- and 12-h milking intervals were reported (76% on average), milk secretion decreased to 67% for the 16-h milking interval. Ayadi et al (2009) reported that milk secretion rate decreased according to increase in milking interval. No information is available on the size of the udder cisterns and the effects of machine milking and longer milking intervals (e.g., once-daily milking) in camels, the last being of especially practical interest at the end of lactation. Previous studies done on hand-milked dairy camels reported an increase in milk yield according to milking frequency (i.e., 3 times daily, 5 to 10%; 4 times daily, 30%; Alshaikh and Salah, 1994; Kamoun, 1995).

Milk constituents generally followed similar patterns of decreasing content with increasing milking intervals although there is little information available (Alshaikh and Salah, 1994). The decrease in milk yield observed as a result of long milking intervals (>16 h) is associated with the disruption of mammary tight junctions (TJ), which results in a rise in plasma lactose and Na:K ratio in milk and of serum albumin in milk, occurring at approximately 18 h in dairy cows (Stelwagen et al., 1994).

Camel's milk is much more nutritious than that from a cow. It is lower in fat and lactose, and higher in potassium, iron and Vitamin C (Konuspayeva et al., 2008). It is normally drunk fresh, and the warm frothy liquid, heavy and sweet, is usually an acquired taste for the Western palate (Yagil and Etzion, 1980). Knoess, (1979) reported that daily milk yield from she camel vary from 15 to 40 kg which means 3.3 to 8.9% of body weight. Faye (2004) and Hassan (1994) reported that the average of milk production of the she-camel was estimated at 1500-3000 kg/annum. At the world level, the estimated milk production for camel is 2500 kg/year on average in 2008 (FAOstat, 2010). The objective of this study is to evaluate the effect of some factors as, the dietary protein, energy levels, Parity, stage of lactation and milking interval on dairy she-camel performance.

Material and Methods

Animals and diet

These experiments had been conducted at Camel Breeding, Range Protection and Improvement Center in Al-Jouf area, K.S.A. Twenty lactating she-camels had been used in this study with lactation rank from 1 to 6. Camel-calves suckled *ad-libitum* from their dams during the first 3 months according to traditional Saudi camel breeders. The trial started after weaning of camel-calves. Dams had been divided to four groups, 5 animals each, according to age and their weight at last parturition. Average animal age and body weight in each group was similar. Group (A) received diet with 13% Crude Protein (CP) and 2.4 MCal Metabolisable Energy (ME). Group (B) received diet with 13% CP and 3.0 MCal ME. Group C, and D received diet with 15% CP and 2.4, 3.5 MCal ME respectively. Diets compositions are presented in Table (1). Animals' individual feed intake was calculated after 14 days of adaptation period. Feed offered and orts had been recorded daily and continue up to entire experimental period of 10 months. Animals had been fed diets contain 35:65 (roughage: concentrate, respectively). The choice of such ratio is due to the fact that milk yield in lactating animals and camel in this trial is dependent on energy, energy is the driving force for milk production. There is inverse relationship between milk yield and milk fat, as milk yield goes up, fat percentage goes down. Therefore, she-camel milk yields from this trial still lower when compared with cow milk yield. Thus, more energy is needed from concentrate to support higher milk yield. Roughage and concentrate were in one pellet. Effective fiber from *ad libitum* roughage can be met whether particle size in long hay or ground particles in pellet. Hence the milk fat within acceptable ranges is regarded as indicator to good rumen function.

Following parameters had been measured or calculated:

- Milk yields and milk samples were recorded and collected from two milking time of three consecutive days, two times a month.
- Milk secretion rate (ml/h).
- Milk composition from the collected milk samples every 15 days using ultrasonic milk analyzer lactoscan.
- Fat Corrected Milk (3.5% FCM) was calculated according to Nordlund (1987).
- Energy Corrected Milk (3.5% Fat, 3.2% Protein) (ECM) was calculated according Bernard (1997).
- Stage of lactation was divided into three stages according to days in milk (DIM). Early stage less than 101 DIM, mid stage from 101 to 200 DIM, and late stage more than 200 DIM.

Table 1. Diets composition and nutritive value (Dry mater bases).

	Diet (A)	Diet (B)	Diet (C)	Diet (D)
Raw Materials %				
Corn	.	26.47	.	26.09
Barley	.	18.0	.	16.0
Wheat Bran	15.0	10.0	15.0	10.0
Wheat Straw	13.64	.	13.56	.
Soya Meal	.	4.2	7.45	8.5
Soya Hulls	13.85	15.0	8.61	15.0
Canola Meal	4.2	.	.	.
Palm Kernel Meal	20.0	15.0	20.0	15.0
Salt	.	0.41	.	0.47
Limestone	1.47	1.22	1.5	1.24
Acid Buf	1.0	1.0	1.0	1.0
Alfalfa	27.14	3.0	29.18	3.0
Molasses	3.0	5.0	3.0	3.0
Binder	0.5	0.5	0.5	0.5
Premix	0.2	0.2	0.2	0.2
Nutrients % DM				
Dry Matter	93.36	89.71	93.34	90.09
Protein	12.85	13.06	14.72	14.91
Fiber	23.5	11.27	22.21	11.27
Calcium	1.39	1.11	1.38	1.11
Phos	0.46	0.44	0.46	0.46
ME /Mcal	2.37	3.00	2.38	2.99

ME= Metabolisable Energy

Average feed intake per groups A, B, C, D were 6.0, 5.9, 6.0, and 6.1 kg per head per day respectively

Fresh water was available all time. All the animals were under the farm veterinary observation and were in good health.

Statistical analysis

Data had been subjected to statistical analysis using the SAS program (SAS 2000). Data were analyzed according to the following model:

$$Y_{ijklm} = \mu + T_i + P_j + SL_k + MI_l + e_{ijklm}$$

Where Y_{ijklm} is the observation of the dependent variable obtained from M^{th} she-camel of I^{th} treatment, of J^{th} parity, K^{th} stage of lactation, of L^{th} milking interval; μ is the overall mean; T_i is the effect of i^{th} treatment (I = 1 to 4); P_j is effect of j^{th} parity (j = 1 to 6); SL_k is the k^{th} stage of lactation (k = E, M, and L); MI_l is the l^{th} milking interval (l = 10 or 14h); and e_{ijklm} is the residual term.

The General Linear Model (GLM), Least Squares Means (LSMEANS) procedures were used.

Results and Discussion

Milk yield and composition

Changes in the volume of daily milk yield (MY), Fat corrected milk (FCM), Energy corrected milk (ECM), Feed conversion ratio (FCR), Fat %, Protein , according to treatment are summarized in Table 2.

The diet (B) gave higher milk yield, higher FCM, higher ECM and higher FCR 8.32±0.17, 11.77±0.25, 7.47±0.16, 1.38±0.03 respectively. There was no significant difference in MY, FCM, ECM, Fat% and Protein % between diet B (low protein and high energy) and diet C (high protein and low energy). Milk secretion is an energy dependent process. Therefore increased energy in diet (B) with low protein level contributed to higher milk yield. Diet (A) had higher fat % content when comparing with the other diets.

Treatment did not affect milk composition except on fat and ash percentage (Table 3). The higher fat percentage was in group (A) and the lowest percentage was in C group. This could be explained that (A) group produced less milk than (C) group, and there were negative correlation between milk yield and fat percentage (Faye et al., 2008). Treatment C gave higher ash percentage comparing with the other treatments.

Table 2. Effect of treatments on mean of daily milk yield, FCM, ECM, Fat%, Protein%.

Parameters	A	B	C	D
MY kg	6.55±0.21^{b}	8.32±0.17^{a}	8.22±0.21^{a}	6.32±0.19^{b}
FCM kg	9.26±0.29^{b}	11.77±0.25^{a}	11.62±0.29^{a}	8.95±0.27^{b}
ECM kg	5.87±0.19^{b}	7.47±0.16^{a}	7.37±0.19^{a}	5.67±0.17^{b}
FCR kg milk/ kg feed	1.01±0.03^{b}	1.38±0.03^{a}	1.36±0.03^{a}	0.97±0.03^{b}
Fat %	3.27±0.18^{a}	2.77±0.16^{bc}	2.49±0.16^{c}	2.86±0.15^{b}
Protein %	2.91±0.06^{ns}	2.89±0.06^{ns}	3.03±0.06^{ns}	2.91±0.05^{ns}

Different letters within the row indicates significant difference ($P \leq 0.05$). MY=Milk Yield FCM=Fat Corrected Milk; ECM=Energy Corrected Milk

Table 3. Effect of treatments on mean of daily milk composition %.

Item	A	B	C	D
Fat %	3.27±0.18^{a}	2.77±0.16^{bc}	2.49±0.16^{c}	2.86±0.15^{b}
Protein %	2.91±0.06^{ns}	2.89±0.06^{ns}	3.03±0.06^{ns}	2.91±0.05^{ns}
Lactose %	4.09±0.10^{ns}	3.99±0.09^{ns}	4.07±0.09^{ns}	4.02±0.08^{ns}
SNF %	9.63±0.21^{ns}	9.61±0.19^{ns}	10.09±0.19^{ns}	9.57±0.18^{ns}
TS %	12.77±0.27^{ns}	12.21±0.24^{ns}	12.64±0.24^{ns}	12.28±0.23^{ns}
Ash %	2.48±0.12^{b}	2.53±0.11^{b}	3.05±0.11^{a}	2.53±0.10^{b}

Different litters within the row indicates significant difference ($P \leq 0.05$). ns = non significant. SNF=Solid Not Fat TS=Total Solids.

Effect on Milking within day

Regarding the treatment effect on morning milk yield, morning secretion rate “14 hours milking interval”, evening milk yield, and evening secretion rate “10 hours milking interval” (Table 4), it appears that treatment B and C gave more milk in the morning and evening; also milk secretion rate was higher comparing with the other two treatments A and D. Generally milk secretion rate for 10 hours milking interval “evening milking” was higher comparing with 14 hours milking interval “morning milking”. This result agreed with Alshaikh and Salah (1994) and Ayadi et al. (2009) who reported that milk secretion rate decreased according to increase in milking interval.

Table 4. Effect of treatments on mean of morning and evening milk yield and milk secretion rate.

Item	A	B	C	D
Morning MY kg	3.95±0.12^{b}	5.16±0.11^{a}	4.93±0.14^{a}	3.99±0.12^{b}
Evening MY kg	3.09±0.11^{b}	3.85±0.10^{a}	3.98±0.12^{a}	3.08±0.11^{b}
Morning SR g/h	284±0.01^{b}	385±0.01^{a}	353±0.01^{a}	285±0.01^{b}
Evening SR g/h	309±0.10^{b}	386±0.10^{a}	397±0.12^{a}	308±0.11^{b}

Different litters within the row indicates significant difference ($P \leq 0.05$). MY=Milk Yield SR=secretion rate

Effect of lactation stage

Maximum milk yield, FCM and ECM was at mid lactation (Table 5). In late lactation MY, FCM, ECM decreased. Increase in milk yield in mid lactation due to increased growth and number of secretory cells in the udder or increased secretory activity of the mammary tissue or both (Mannar et al., 1956; Stelwagen et al., 1997; Herndez et al., 2008). Treatment (B) gave higher MY, FCM, ECM, in all stage of lactation comparing with the other three treatments diets (Table 5). The peak of milk production in all of the treatments was at 150 days post calving (5 months), and persists for 100 days (Figure 1). Mid lactation gave higher milk yield, FCM, ECM and FCR. After which slight decrease in late lactation occurred (Table 5 and Figure 1). Generally milk secretion rate for 10 hours milking interval “evening milking” comparing with 14 hours milking interval “morning milking” was higher in all three stage of lactation. This result agreed with Alshaikh and Salah (1994) and Ayadi et al (2009).

Effect of lactation rank

Lowest milk yield was at 1^{st}, 2^{nd}, and 4^{th} rank (Table 7). Higher milk productivity was at 3^{rd} and 6^{th} season of lactation. This result agreed with Raziq et al. (2008) who reported that she-camel has higher milk production at the 3^{rd} season and longer. The higher FCR was at 6^{th} and 3^{rd} seasons. The interaction between the rank and treatment diet failed to be significant, for that the rank effect was studied without interaction with treatments effect.

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Table 5. Effect of stage of lactation on daily milk yield (kg).

Item	E	M	L
MY kg	7.11±0.28[b]	7.74±0.11[a]	7.21±0.11[b]
FCM kg	10.05±0.39[b]	10.95±0.15[a]	10.20±0.16[b]
ECM kg	6.38±0.25[b]	6.95±0.10[a]	6.47±0.10[b]
FCR kg milk/kg feed	1.19±0.04[b]	1.29±0.02[a]	1.20±0.02[b]
Fat %	3.27±0.18[a]	2.77±0.16[b]	2.49±0.16[b]
Protein %	2.91±0.06[b]	2.89±0.06[b]	3.03±0.06[a]

Different litters within the row indicates significant difference ($P \leq 0.05$) E= early M= medium L= late. MY=Milk Yield FCM=Fat Corrected Milk ECM=Energy Corrected Milk FCR=Feed Converted Ratio.

Table 6. Effect of stage of lactation on mean of morning and evening milk yield (MY) and milk secretion rate (SR).

Item	E	M	L
Morning MY/ kg	4.60±0.18[a]	4.59±0.07[a]	4.36±0.07[b]
Evening MY /kg	3.39±0.16[b]	3.66±0.06[a]	3.44±0.06[b]
Morning SR g/h	329±0.19[a]	328±0.01[a]	312±0.01[b]
Evening SR g/h	339±0.16[b]	366±0.10[a]	344±0.10[b]

Different litters within the row indicates significant difference ($P \leq 0.05$). MY=Milk Yield SR=Secretion Rate; E= early M= medium L= late.

Table 7. Effect of Parity on means of milk yield (kg) and FCR.

Parity	Milk Yield	FCR
1	6.53±0.50[b]	1.09±0.03[e]
2	6.79±0.29[b]	1.15±0.03[d]
3	8.50±0.57[a]	1.41±0.03[b]
4	6.87±0.36[b]	1.15±0.04[d]
5	7.17±0.30[b]	1.19±0.04[c]
6	9.12±0.29[a]	1.52±0.03[a]

Different litters within the column indicates significant difference ($P \leq 0.05$). FCR=Feed Conversion Ratio

Table 8. The interaction between treatment and lactation stage.

	MY Mean±SE	FCM Mean±SE	ECM Mean±SE
Treatment (A)			
Early L	8.05±1.10[a]	11.39±1.55[a]	7.22±0.98[a]
Medium L	8.32±0.27[a]	11.77±0.38[a]	7.47±0.24[a]
Late L	7.59±0.26[b]	11.25±0.37[b]	7.14±0.24[b]
Treatment (B)			
Early L	9.00±0.59[a]	12.72±0.83[a]	8.07±0.53[a]
Medium L	9.22±0.26[a]	13.05±0.36[a]	8.28±0.23[a]
Late L	8.14±0.27[b]	11.52±0.38[b]	7.31±0.24
Treatment (C)			
Early L	5.05±0.74[c]	7.15±1.05[c]	4.53±0.67[c]
Medium L	7.73±0.27[d]	10.94±0.39 [d]	6.94±0.25 [d]
Late L	7.28±0.28 [d]	10.30±0.39 [d]	6.53±0.25 [d]
Treatment (D)			
Early L	6.62±0.55 [d]	9.37±0.77 [d]	5.94±0.49 [d]
Medium L	7.59±0.26 [d]	10.73±0.37 [d]	6.81±0.23 [d]
Late L	7.41±0.27 [d]	10.49±0.39 [d]	6.65±0.25 [d]

Different litters within the column indicates significant difference ($P \leq 0.05$).

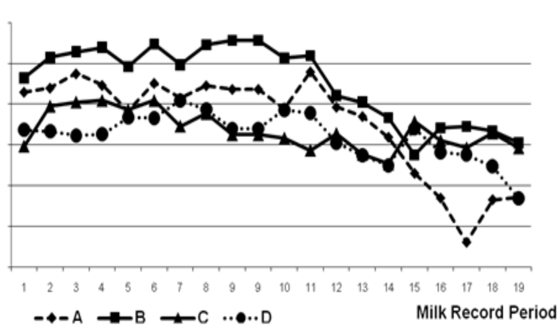

Figure 1. Lactation curve according to dietary protein energy level.

Conclusion

Our finding shows that lactating she-camel in Saudi Arabia gave good performance when comparing with the results of the literature. With the increase of in-door camel farming system, the diets are more often brought by commercial feeds and not with natural resources. In that condition, a good balance of the offered diet has to be searched. According to our results, the milk production could be optimized by a better energy supply rather than protein. The high capacity of camel to recycle urea is obviously an advantage. However, it still needs more improvement researches in that line, especially to assess the impact of different diets on body condition score (Faye et al., 2001) and on health status of the animals. A balance diet is a major constraint to achieve optimal milk and meat productivity. Thus, diet (B) with high energy level and low protein could be recommended under conditions prevailing in the kingdom.

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