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PERFORMANCE OF LACTATING DROMEDARY CAMELS MAINTAINED ON DIFFERENT ENERGY RATIONS UNDER ARID ECOSYSTEM

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ABSTRACT

In a lactation trial of 194 days, 10 Jaisalmeri breed camels aged 10-20 years having body weights of 607.90 ± 24.63 kg in their 2-4 parity were fed on iso-nitrogenous (12%) complete feed blocks having 50 (G1), 55 (G2) and 60% (G3) levels. Milk yield of group G1 was minimum 7.69 litres per day and it was maximum of 8.44 litres /d in group G3 indicating positive effect of higher dietary energy level. During the experimental period group G1 lactating camels lost their body weights (49 kg or -256.54 g/d), group G2 camels maintained whereas the lactating camels of group G3 lost marginally (-5.75 kg or -29.64 g/d) live weights. The dry matter intake (DMI) kg/d or kg/100 kg body weight was 9.77 ± 0.07 or 1.72 ± 0.03 in group G1 and 9.84 ± 0.12 or 1.65 ± 0.04 in group G 2 which were statistically similar but significantly (P<0.5) increased to 11.57 ± 0.81 or 1.99 ± 0.08 in group G3, respectively. Digestibility coefficients of OM and NFE proximate principles differed significantly (P<0.05) among three groups which increased from group G1 to group G3. The digestibility of DM, CP, EE and CF was similar among group G1 and G2 but was significantly (P<0.05) different and lower than that in group G3. The daily intake of DCP (g), TDN (g) and ME (MJ) /kg metabolic body weight was significantly (P<0.05) different among 3 groups and increased from group G1 to G3 with increase in dietary energy level. The daily intake of DCP (g), TDN (g) and ME (MJ) /kg metabolic body weight was 5.07 ± 0.07, 43.19 ± 0.53 and 0.65± 01 in group G1; 5.32 ± 0.13, 44.19 ± 1.12, 0.67 ± 0.02 in group G2 and 6.79 ± 0.03, 60.32 ± 1.53 and 0.91 ± 0.03 in group G3, respectively. It was inferred that lactating camels of group G3 given complete feed block containing 6.97% DCP and 107.21 ME MJ performed better in terms of milk yield, body weight maintenance and nutrient utilisation.

Key words: Body weight changes, camel, digestibility, milk yield, nutrient intake

Camel plays an important role in desert ecosystem and used mainly as draft camels since ages but can also be a good milch animal. Camel milk which is normally consumed in Gulf and African countries but in India, only camel owners have been using camel milk for drinking, tea or rice pudding but not used by the general public because of its salty taste. Recent reports from India and abroad have shown the high nutritional (Stahl *et al,* 2006; Wernery, 2006) and therapeutic (Agrawal *et al,* 2005) value of camel milk. Previous reports have also indicated that camels are efficient milk producers if fed scientifically (Basmail, 1989; Jakhmola, 1990-91; Nagpal and Jabbar, 2005). The nutritional research on lactating camel is very scarce, hence present study was undertaken to study the effect of differnt energy rations in these camels.

Materials and Methods

Ten healthy Jaisalmeri lactating camels (age 10-20 years; 607.90 ± 24.63 kg body weight) after 68 days of calving were selected from NRCC herd and effect of three dietary energy levels on body weight changes, milk yield and nutrient utilisation, was studied for 194 days. The lactating camels were randomly allotted to 3 groups, 3 camels calves each in group G1 and G2 and 4 in group G3 and fed feed blocks containing 50, 55 and 60% TDN and almost similar crude protein (12%) level. Feed blocks were made on feed block making machine at 4000 psi. Physical composition (%) of feed blocks given to animals of various groups are is given in Table 2. The animals were housed individually in separate pens on soft or sandy floor with asbestos roofing. The animals were provided fresh drinking water 2-3 times daily. Daily feed intake, twice a week milk yield and monthly body weights were recorded. The milk yield of lactating camels was recorded twice a week at 0700 and 1600 hrs. The calves were allowed to suckle two teats of one side, whereas the teats on other side were milked by stripping method. At the end of feeding

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period, a conventional 5 d digestibility trial on all the camels was conducted. Representative samples of feed and faeces were analysed for proximate principles as per standard methods of AOAC (1995) and data were subject to statistical analysis as per Snedecor and Cochran (1994).

Results and Discussion

The data on monthly intakes of dry matter intake kg/d showed decrease with increase in lactation period from April to October. The overall or average DM intake kg/d was minimum in group G1 (9.42 ± 0.10 kg/d) as compared to G2 (9.84 ± 0.50 kg/d) and maximum in G3 (10.66 ± 0.34 kg/d) over 7 months (Table 1). In case of G1 lactating camels, average daily milk yield was observed to range between 7.18 to 8.29 litres/d in different months from April to October while it ranged between 7.19 litres/d to 8.97 litres/d in G2 and between 7.34 to 8.94 litres/d in G3 (Table 1 and Fig 1). Overall milk yield of 3 lactating camel groups varied between 7.40 to 8.54 litres/d in different months. Milk yield of group G1 was minimum with value of 7.69 litres/d and was maximum of 8.44 litres/d in group 3 indicating positive effect of higher dietary energy level. The initial body weights of group G1, G2 and G3 lactating were 614, 596 and 613 kg, respectively. During the course of 194 days study, group G1 lactating camels lost their body weights (49 kg or -252.58 g/d), group G2 camels maintained their weights whereas the lactating camels of group G3 lost marginally (-5.75 kg or -29.64 g/d live weight during the lactation period (Fig 2). Similar observations were made by Jakhmola (1990-91) and Nagpal *et al* (1998). Lactating camels lose their body weights during early lactation because of milk production stress which was observed to be higher on sole moth chara roughage ration (667 g/d) and it became less on concentrate supplementation (583 g/d) and green barley supplementation (458g/d), and combined supplementation of green barley and concentrate, reduced the loss to 317 g/d indicating the need of higher plane of nutrition during early lactation (Jakhmola, 1990-91) and the feed intake varied from 1.42 to 2.74 kg DM/ 100 kg body weight. Milk yield of Bikaneri lactating camels kept on sole dry chaffed moth fodder was observed to increase from 5.42 litres to 7.04 litres/d in 7th month and declined thereafter to 3.99 litres/d in 10th month with an average milk yield of 5.5 kg, dry matter intake of 8.52-10.04 kg/d, and body weight loss of 13.8% indicating ration was insufficient to maintain the normal live weight and there was scope for higher milk production (Nagpal *et al*, 1998). These lactating camels consumed 8.78 kg or 1.77 kg DM/100kg body weight, 0.44 kg digestible protein , 5.0 Kg TDN and 76 MJ ME. Shareha (1987) observed that stimulation by calves was essential for milking camels and reported milk yield of Naga camels to be 3.5 to 6.51 litres/d. Zia-Ur_Rahman and Haq (1994) also reported average lactation yield of camel 4-7 kg/d fed on non-irrigated

Table 1. Dry matter intakes, milk yield and body weight changes of lactating camels.

Month	G 1	G 2	G 3
Dry matter intakes (kg/d)			
April, 2010	10.74±0.03	11.30±0.09	12.12±0.24
May, 2010	10.60±0.04	10.49±0.60	11.60±0.34
June, 2010	9.58±0.06	9.20±1.14	10.50±0.45
July, 2010	9.33±0.19	9.90±0.49	11.01±0.18
August, 2010	8.92±0.19	9.19±0.64	9.54±0.32
Sept, 2010	8.03±0.11	8.89±0.52	9.31±0.51
April, 2010	8.71±0.10	9.92±0.05	10.57±0.33
Average	9.42±0.10	9.84±0.50	10.66±0.34
Milk yield (litres/d)			
April, 2010	7.68±0.29	7.19±0.82	7.34±.0.15
May, 2010	8.29±0.33	7.76±1.30	8.47±0.22
June, 2010	8.12±0.10	8.71±0.79	8.64±0.24
July, 2010	7.44±0.28	8.87±0.84	8.72±0.69
August, 2010	7.18±0.39	8.40±0.96	8.41±0.67
Sept, 2010	7.39±0.36	8.50±0.63	8.59±0.55
Oct.,2010	7.70±0.57	8.97±0.83	8.94±0.26
Average	7.69±0.13	8.34±0.87	8.44±0.38
Body weigh changes (kg)			
14.04.10	613.67±26.85	596.00±39.37	612.50±30.50
01.05.10	604.00±23.08	594.33±22.56	620.33±36.96
18.05.10	600.00±22.01	606.67±19.38	611.25±35.07
04.06.10	603.67±19.84	612.00±15.72	602.00±31.32
16.06.10	598.67±18.22	595.00±15.59	588.50±26.58
01.07.10	597.33±18.98	588.00±11.85	583.25±27.37
16.07.10	595.00±16.26	593.00±9.71	588.25±26.76
03.08.10	580.33±17.90	580.00±9.29	577.25±25.16
17.08.10	563.33±18.70	563.67±5.61	569.00±27.04
01.09.10	561.33±22.32	566.67±6.69	559.75±26.83
17.09.10	554.67±19.40	573.67±7.88	562.50±26.52
01.10.10	557.67±16.01	585.67±7.88	570.50±27.29
17.10.10	568.67±17.37	595.00±13.58	579.25±27.29
24.10.10	564.67±14.31	597.00±13.32	606.75±8.00
Gain kg. over 194 days	-49.00±14.18	1.00±26.06	-5.75±36.77
ADG g/d	-252.58±73.08	5.15±134.32	-29.64±137.98

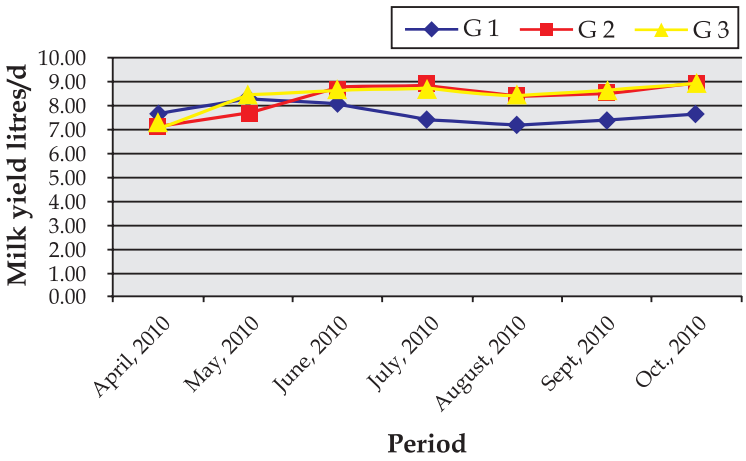

Fig 1. Milk yield (litres/d) pattern of different groups of lactating camels.

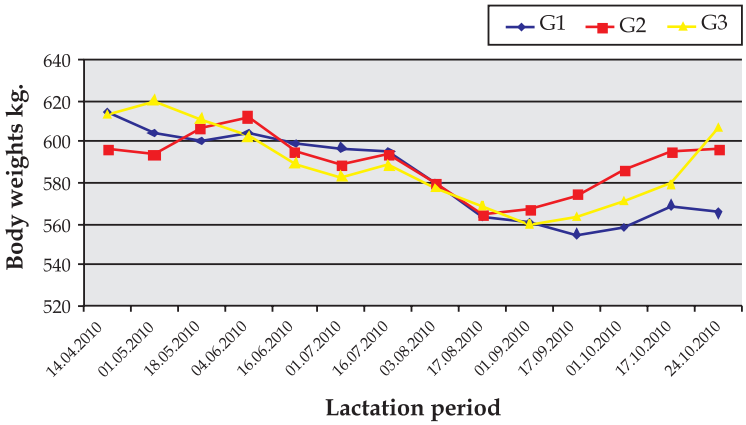

Fig 2. Body weight changes of lactating camels.

land and 7-12 kg/d fed on irrigated land indicating further scope of camel milk production by provision of better ration. For milk volume yield and milk constituents, the review of the literature showed milk yields ranging from 735 to well over 5000 kg over 305 days or 16.4 kg/d (Yagil, 1982) in a feeding trial in which lactating dromedary camels were stall fed and offered wheat straw ad libitum and daily concentrate rates of 5 kg per head containing 10.5 MJ ME during lactation In general, lactation yield varies with breed, individual parity, stage of lactation, milking frequency and plane of nutrition. Lactation length of Indian camel varies from 12 to 18 months. Milk yield increases upto 6-7 month and declines thereafter. In the present study, the milk yield was maintaining its level even in 9-10 month of lactation.

The ingredient/physical and chemical composition of different feeds and fodders used for feed block making and feeding different camel groups is given in Table 2 while the data on feed intake, digestibility coefficients and nutrient intakes of different camel groups are presented in Table 3. The dry matter intake (DMI) kg/d or kg/100 kg body weight was 9.77 ± 0.07 or 1.72 ± 0.03 in group G1 and 9.84 ± 0.12 or 1.65 ± 0.04 in group G2 which were statistically similar but significantly (P<0.5) increased to 11.57 ± 0.81 or 1.99 ± 0.08 in group G3 which might be due to higher energy contents of diet. Digestibility coefficients of OM and NFE proximate principles differed significantly (P<0.05) among three groups and was observed to increase from group G1 to group G3. The digestibility of DM, CP, EE and CF was similar among group G1 and G2 but was significantly (P<0.05) different and lower than that in group G3. The daily intake of DCP (g), TDN (g) and ME (MJ) / kg metabolic body weight was significantly (P<0.05) different among 3 groups and increased from group G1 to G3 with increase in dietary energy level. The daily intake of DCP (g), TDN (g) and ME (MJ) /kg metabolic body weight was 5.07 ± 0.07, 43.19 ± 0.53 and 0.65±0.01 in group G1; 5.32±0.13, 44.19 ± 1.12, 0.67±0.02 in G2 and 6.79 ± 0.02, 60.32 ± 1.90 and 0.91± 0.03 in G3, respectively. Significant by higher digestibility and intake of nutrients in camels given higher plane of nutrition has been observed by various workers which corroborate and support the present findings (Jakhmola, 1990-91; Nagpal *et al,* 2003; Nagpal and Jabbar, 2005). Basmaeil (1989) estimated metabolisable energy requirement for 528 kg lactating camels as 93.3 MJ producing 7.3 litres milk /d and observed that lactating camels may require as much

Table 2. Composition and parameters of experimental diets (on% DM basis).

Feed ingredients	**G1**	**G2**	**G3**	
G.N. haulms	88.0	80.0	69.0	
Bajra grains	-	12.0	25.0	
Cotton seed cake	10.0	6.0	4.0	
Mineral mixture	1.0	1.0	1.0	
Common salt	1.0	1.0	1.0	
Parameters	**G1**	**G2**	**G3**	**GN haulms**
CP	11.80	12.39	12.15	10.70
EE	2.28	2.79	3.53	1.86
CF	27.80	23.35	21.98	26.47
NFE	47.15	50.06	52.25	47.99
Total ash	10.98	11.42	10.09	10.99

as 1600 g CP depending on their age, body weight, feeding management and milk yield. In another study at Bikaner (Nagpal *et al,* 2003) the lactating camels in their 2nd-3rd lactation on complete ration produced higher milk yield of 6.07 litres/d, maintained live weights with an intake of 3.06 kg DM/100 kg body weight, 1.144 DCP, 9.74 kg TDN, 146.17 MJ ME in comparison to lactating camels given mixed ration which produced 5.67 litres milk /d, consumed 2.35 kg DM/100 kg live weight, 0.50 kg DCP, 6.56 kg TDN, 98.80 MJ ME and lost 29.7 kg body weight. Lactating camels in 6th month of lactation given complete feed blocks (CFB group) were observed to have significantly higher daily gain (1117 g/d) than the 227 g/d in lactating camels given sole dry moth fodder (MF group) and daily DM intake was 16.9 kg and 11.4 kg /d in CFB and MF groups, respectively (Nagpal and Jabbar, 2005). Nutrient intakes of DCP and ME were 102.7 and 71.7% higher in CFB lactating camels as compared to MF camels, respectively. Milk yield was observed to be 10.4 kg/d in CFB group and it was economical and significantly higher than 7.2 litres/d in MF group indicating that lactating camels should be properly fed to get their optimum milk production.

Table 3. Feed intake, digestibility and nutrient intakes of camel calves.

Particular	G 1	G 2	G 3
Body wt. Kg	569.00±14.98	597.00±13.22	579.25± 27.29
DMI kg/d	9.77± 0.07	9.84 ±0.12	11.57 ±0.81
DMI kg/100 kg B.Wt**.	1.72 a±0.03	1.65 a±0.04	1.99 b± 0.08
Nutrient Digestibility %			
DM**	51.68a±0.38	52.51a±2.28	59.12 b ±1.72
OM**	56.10 a ±0.26	59.13 b ±2.21	66.05 c±1.32
CP**	51.20 a±0.81	52.73 a±2.22	57.81 b ±1.53
EE**	50.49 a ±5.12	53.62 a±2.50	66.96 b±1.24
CF*	47.36 a±0.73	44.96 a±4.41	55.55 b±1.29
NFE**	62.80 a±0.94	67.61b ±1.40	72.33 c±1.42
Nutritive value			
CP %	11.8	12.39	12.15
DCP %	6.04	6.54	6.97
TDN %	51.46	54.24	61.79
ME MJ /kg	7.75	8.17	9.31
Plane of Nutrition			
DMI kg/d	9.77±0.07	9.84±0.12	11.57±0.81
CPI g/d	1.15±0.01	1.22±0.01	1.39±0.09
DCPI g/d	0.59±0.01	0.64±0.02	0.80 ± 1.53
TDNI kg/d	5.03±0.04	5.33±0.13	7.12 ±0.35
MEI MJ/d	75.75±0.63	80.35± 1.99	107.21±5.30
DMI** g/kg W 0.75	83.94 a±1.08	81.54 a±1.46	97.84 b±4.41
DCPI** g/kg W 0.75	5.07 a±0.07	5.32 a ±0.13	6.79 b ±0.02
TDNI** g/kg W 0.75	43.19 a±0.53	44.19 a±1.12	60.32 b ±1.90
MEI** MJ / kg W 0.75	0.65 a±0.01	0.67 a±0.02	0.91 b±0.03

Means bearing different superscripts in a row differ significantly * P<0.05, ** P<0.01

Comparing present observations with those recommended by ICAR (1985) for lactating camels, the daily intake of DM, and ME are lower but of DCP are closer to the recommendations made by the ICAR (1985). Looking at Table 4, our values of DM, DCP and ME are closer to those of Wardeh (1997) but milk production is higher (about 8.0 litre/d) in the present study than 5 litres milk/d of Wardeh (1997) which means recommendations of Wardeh (1997) are higher than our values. The lactating camels must be provided with sufficient quantity of energy, protein and minerals to cope up with the continuous drain of nutrients from its body in the form of milk. The animal efficiently converts feed protein into milk protein. About 1.25 times the quantity secreted in the milk will satisfy its requirements, exclusive of the maintenance allowance. Although animals have the ability to convert carbohydrates into milk fat, it is easier for the animals to convert fat of their feed. Hence, it is advisable that the concentrate ration of the camels should contain at least 4% fat. Maintenance requirement of 400 kg breeding female has been estimated to be 45 MJ ME and 260 g DCP and 5MJ ME and 50 g DCP is required for one litre milk production (Wilson, 1989 and Wardeh, 1997). An extra 20% and 10% ME and protein of the maintenance requirement should be given to growing lactating

Table 4. Comparison of nutrient intakes with various feeding standards.

Group	BW kg	DM kg	CP g	DCP g	TDN kg	ME MJ
G1	569.00	9.77	1.15	0.59	5.03	75.75
G2	597.00	9.84	1.22	0.64	5.33	80.35
G3	579.25	11.57	1.39	0.80	7.12	107.21
Average	581.75	10.39	1.25	0.68	5.83	87.77
ICAR (1985)	550.00	16.25	-	0.66	7.25	-
ICAR (1985)	600.00	17.5	-	0.69	8.13	-
Wilson (1989)	400.00	-	-	0.73		93.50
Wardeh (1997)	600	9.15	-	0.60	-	84.31

females during first and second lactation for growth (Wardeh, 1997). Energy and protein requirements for maintenance increased by 25-40% respectively when camels are sent for grazing. Wilson (1989) stated that the demands for milk production are high in terms of energy. The requirement for one litre of milk is equivalent to almost 10 per cent of the maintenance requirement. In terms of protein, milk is even more demanding of nutrients and one litre requires about 20 per cent of the maintenance requirement of a 400 kg. lactating camel. According to recommendations of Wilson (1984) the nutrient requirements of 400 kg lactating camels, the requirements for maintenance, 8.0 litres milk/d and extra 10% allowance of 400 kg lactating camels are 45MJ ME+ 5MJ ME/litret milk x 8 litres milk/d+8.5 MJ ME= 93.5 MJ ME/d and 260 g + 50g DCP/litre milk x 8 litres milk /d + 66 g DCP= 726 g DCP. Both energy and protein requirements are higher than those observed in the present study and these values are likely to go up taking into consideration the higher body weights of lactating camels. The reason may be extrapolation of nutrient requirements from cattle to camel by Wilson (1984) and not based on actual experiments. Hence, it is suggested to conduct trials on Indian camels and develop our own feeding standards.

It was concluded that lactating camels of group G3 given complete feed block containing 6.97% DCP and 107.21 ME MJ performed better in terms of milk yield, body weight maintenance and nutrient utilization.

References

Agrawal R P, Beniwal R, Sharma S, Kochar D K, Tuteja F C, Ghorui S K and Sahani M S. (2005). Effect of raw milk in type 1 diabetic patients; 1 year randomise study. Journal of Camel Practice and Research 12:27-31

AOAC (1995). Official Methods of Analysis. 16th Edn. Association of Official Analytical Chemists, Virginia, USA.

Basmaeil S (1989). The nutrition of Arabian camels under controlled management. Proceedings of the International Symposium on the constraints and possibilities of Ruminant Production in the Dry Sub-tropics. Cairo, Egypt. 5-7 Nov.1988. pp 259-261.

ICAR. (1985). Nutrient Requirements of Livestock and Poultry. Indian Council of Agricultural Research, New Delhi.

Jakhmola RC (1990-91). Annual Report. NRC on Camel, Bikaner.

Nagpal AK, Sahani MS, Roy AK and Mal G (1998). Voluntary feed intake and utilisation of macro-and micro-nutrients in dry and lactating Bikaneri camels. International Journal of Animal Science 13:19-24.

Nagpal AK, Manju Arora and Singh GP (2003). Utilisation of mixed and complete rations by lactating camels. Indian Journal of Animal Nutrition 20(2):178-184.

Nagpal AK and Jabbar A (2005). Productivity of lactating camels on complete feed blocks. Indian Journal of Animal Nutrition 22(2):102-106.

Shareha AM (1987). Effect of the presence of calf and early weaning on milk secretion and growth rate of the young dromedarious camels. Proceedings of the International Conference on Animal Production in Arid Zones. Damascus, Syria, 7-12 September, 1985. pp 511-14.ACSAD, Syria.

Stahl T, Sallmann HP, Duehlmeier R and Wernery R (2006). Selected vitamins and fatty acid patterns in dromedary milk and colostrums. Jounal of Camel Practice and Research 13:53-57.

Snedecor GW and Cochran WG. (1994). Statistical Methods. 8th Edn. Oxford and IBH Publishing Company, Kolkata.

Wardeh MF (1997). The Nutrient Requirements of the Dromedary Camels. The Arab Centre for the Studies of Arid Zones and Dry Lands. Damascus, Syria.

Wernery U (2006). Camel milk, the white gold of the desert. Journal of Camel Practice and Research 13:15-26.

Wilson RT (1984). The Camel. Longman. London and New York.

Yagil R (1982). Camels and camel milk. FAO Animal Production and Health Paper No. 26. FAO, Rome.

Zia-Ur-Rahman and Haq IU (1994). Milk production potential of camels in Punjab (Pakistan). Chameaux Et Dromadairies Animaux Laitiers.24-26 Octobre 1994. Nouakachott Mauritanie.