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Supplemental effect of different levels of energy and protein along with groundnut straw (*Arachis hypogaea* L.) based ration on nutrient utilization in dromedary camels

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ABSTRACT

The present investigation was carried out to study the effect of feeding different levels of energy and protein supplementation along with groundnut haulms (*Arachis hypogaea* L.) on nutrient utilization in dromedary camels. Three concentrates mixtures were formulated, viz. high protein and low energy (T_1); high energy and low protein (T_2); and medium protein and energy (T_3). The digestibility coefficients for dry matter and organic matter were higher in T_3 as compared to T_2 and T_1 but there was nonsignificant difference between T_1 and T_2 on one hand, and between T_1 and T_3 on the other hand. There was nonsignificant difference between the groups for NDF, ADF and hemicellulose digestibility. The digestible crude protein (DCP) content was significantly higher in T_1 followed by T_3 and T_2 but there was reverse trend for total digestible nutrient (TDN) content. The nitrogen balance was significantly lower in group fed on high energy and low protein content through the concentrate mixture. The results of the study concluded that the nutrient utilization was higher in T_3 treatment as compared to either high protein or high energy supplementation.

Key words: Camels, Energy, Nutrient utilization, Protein

In the arid and semi-arid areas of the world, camels are important livestock species, which contribute significantly to the livelihood of the pastoralists and agro-pastoralists living in a fragile environment. The camel is a triple-purpose animal producing milk, meat and transport. It also provides hair and hides in some areas. The one humped camel (*Camelus dromedarius*) has the capacity of being a better provider of food in the desert areas of the world than the cow which can be severely affected by heat and scarcity of feed and water (Nazik *et al.* 2015). The camel is primarily a browsing animal enabling it to make use of fodder often not relished by other domestic animals. Adaptations of the camel to the desert environment encompass anatomical, behavioural and physiological changes. There are many factors which influence the work performance of the camels such as condition of terrain, body conformation, environmental factors, type of work and feeding status (Rai and Khanna 1994). Thus, the present investigation was planned to study the supplemental effect of different levels of energy and protein along with groundnut straw (*Arachis hypogaea* L.) based ration on nutrient utilization in dromedary camels (*Camelus dromedaries*).

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MATERIALS AND METHODS

Experimental animals and treatments: The experiment was conducted in completely randomized block design using nine Bikaneri male camels at around 8–9 years of age with an average body weight of 590 to 640 kg. Three concentrates mixtures were formulated, viz. high protein and low energy (T_1); high energy and low protein (T_2) and medium protein and energy (T_3). The groundnut haulms (*Arachis hypogaea* L.) was offered free of choice to all the camels as basal roughage. Concentrate mixtures were formulated on the farm by using wheat bran (*Triticum aestivum*), groundnut cake (*Arachis hypogaea*), barley (*Hordeum vulgare*), moth meal (*Vigna aconitifolia*), salt and mineral mixture (Table 1). The amount of concentrate fed was calculated on the basis of estimated requirement of camels as per Indian Council for Agricultural Research (1985). Before the start of the experiment, the animals were vaccinated, wormed and adapted to the feeds. The camels were weighed fortnightly after 16 h fasting to reduce the gut-fill, thereby minimizing the weight fluctuations.

Metabolic trial and chemical analysis: A metabolic trial was conducted at the end of 50 days period for 10 days including a 3 days acclimatization followed by 7 days collection period. The animals were kept in individual pens

with feeding and watering arrangements during the metabolic trial. During the collection period, the daily feed consumption through roughage and concentrate, leftover as well as faeces and urine voided during preceding 24 hours were recorded at 9:00 h. Representative samples of each feed and fodder offered and residues were collected and pooled over 7 days for analysis. The ground subsamples were then analyzed for crude protein (CP), ether extract (EE), crude fiber (CF), total ash (TA), neutral detergent fiber (NDF), acid detergent fiber (ADF), hemi-cellulose (HC) and phosphorus as per AOAC (2000). Nitrogen determination was carried out in duplicate using fresh feed and faeces subsamples with Macro Kjeldahl apparatus and 2% boric acid mixed indicator solution to absorb the distillate (Bremner 1960). The calcium in feed and faeces was analyzed by complexometric titration methods (USSLS 1968).

Statistical analysis: The experiment was conducted in completely randomized design and statistical analysis of the data was carried out by one-way ANOVA as suggested by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Chemical composition: The chemical and nutritional composition of feeds and fodder offered to dromedary camels during experimental period are reported in Table 2. The overall crude protein (CP) and total digestible nutrient (TDN) content of concentrate mixtures offered were 23.27 and 65.65, 13.13 and 74.89, 16.49 and 70.71, respectively in T_1, T_2 and T_3. The groundnut haulms offered as basal roughage contained 9.01% CP, 1.78% EE, 24.73% CF, 14.82% TA, 41.51% NDF, 29.39% ADF and 12.12% hemicelluloses. The crude protein content was higher in the present investigation as compared to the reports of Nagpal *et al.* (2011) and Gupta *et al.* (2012) but lower than that reported by Chaudhary *et al.* (2008) for groundnut straw and Bui (1998) for peanut haulms.

Nutrient digestibility and nutritive value: The digestibility coefficients for DM and OM were higher in T_3 as compared to T_2 and T_1 but there was non-significant difference between T_1 and T_2 on one hand, and between T_1 and T_3 on other hand (Table 3). The CP and CF digestibility was significantly ($P<0.05$) higher in T_3 but there was nonsignificant difference between T_1 and T_2. The difference between treatments for EE digestibility was nonsignificant. The NFE digestibility was significantly ($P<0.05$) higher in camel fed on medium levels of energy and protein as compared to other treatment groups. However, the diets did not show any significant effect on NDF, ADF and hemi-cellulose digestibility coefficients in the dromedary camels. Significantly ($P<0.05$) higher digestibility of dry matter and organic matter was reported by Saini *et al.* (2007) in camel calves fed on higher levels of nitrogen source in the ration. Nagpal *et al.* (2010) reported significantly higher dry matter digestibility as compared to the present investigation in breeding camels fed on different energy rations. The crude protein digestibility was significantly ($P<0.05$) higher in T_3 as compared to T_1 and T_2. Gupta *et al.* (2012) revealed that feeding of high value feeds will significantly improve the digestibility of dry matter, organic matter, crude protein and crude fibre. The DCP content was significantly ($P<0.05$) higher in T_1 followed by T_3 and T_2 but there was reverse trend for TDN content which was significantly higher in T_3 (63.58) as compared to T_2 (60.29) and T_1 (57.06). Likewise, feeding of different levels of energy and protein significantly affect the DE and ME (Mcal/day) digestibility among the treatment groups. The digestible and metabolic energy (Mcal per day) was also affected by the treatment groups which might be due to their higher digestibility in T_3 as compared to T_2 and T_1 (Gupta *et al.* 2010).

Nutrient and water intake: Feeding of different levels of energy and protein did not significantly affect the dry matter intake in the dromedary camels (Table 4). The digestible crude protein (in grams per day) was significantly

Table 1. Proportion of ingredients in concentrate mixtures (%)

Feed	Treatments		
	T_1	T_2	T_3
Triticum aestivum bran	33.33	13.89	28.57
Arachis hypogaea cake	33.33	8.33	14.28
Hordeum vulgare	16.67	69.44	42.86
Vigna aconitifolia meal	16.67	8.34	14.29

T_1, high protein and low energy through concentrate; T_2, high energy and low protein through concentrate; T_3, medium protein and medium energy through concentrate.

Table 2. Proximate composition of experimental feeds and fodder offered to dromedary camels (% DM basis)

Parameter	*Triticum aestivum* bran	*Arachis hypogaea* cake	*Hordeum vulgare*	*Vigna aconitifolia* meal	*Arachis hypogaea* haulms
Dry matter	91.25	95.05	94.45	95.05	94.23
Organic matter	95.20	92.80	95.50	89.80	85.18
Crude protein	12.25	43.20	9.50	19.25	9.01
Ether extract	2.96	8.79	2.15	5.97	1.78
Crude fibre	8.89	9.20	6.68	10.67	24.73
Total ash	4.80	7.20	4.50	10.20	14.82
Nitrogen free extract	71.10	31.61	77.17	53.91	49.66
Neutral detergent fibre	29.32	23.30	20.00	25.00	41.51
Acid detergent fibre	14.50	18.20	7.00	20.00	29.39
Hemi-cellulose	14.82	5.10	13.00	5.00	12.12
Calcium	0.17	0.18	0.05	0.73	1.37
Phosphorus	0.93	0.60	0.38	0.62	0.69

Table 3. Supplemental effect of different levels of energy and protein on nutrient digestibility and nutritive value in dromedary camels (*Camelus dromedaries*)

Attribute	Treatments			SEM
	T_1	T_2	T_3	
Nutrient digestibility (%)				
Dry matter	62.64^{ab}	60.61^{b}	64.28^{a}	1.36
Organic matter	66.20^{ab}	64.65^{b}	69.29^{a}	1.13
Crude protein	64.66^{b}	62.81^{b}	67.75^{a}	0.97
Crude fibre	62.30^{b}	64.28^{b}	67.31^{a}	1.22
Ether extract	59.41	61.53	62.25	1.20
Nitrogen free extract	63.21^{b}	65.34^{ab}	68.42^{a}	1.76
Neutral detergent fibre	50.73	51.26	51.08	0.95
Acid detergent fibre	43.35	45.16	44.74	1.11
Hemicellulose	58.01	57.53	58.20	1.15
Nutritive value				
Digestible crude protein (%)	8.11^{a}	6.36^{c}	7.19^{b}	0.15
Total digestible nutrients (%)	57.06^{c}	60.29^{b}	63.58^{a}	0.99
Digestible energy (Mcal/kg)	2.51^{b}	2.66^{b}	2.80^{a}	0.04
Metabolizable energy (Mcal/kg)	2.03^{c}	2.15^{b}	2.26^{a}	0.03

^{a,b,c}Mean values in the same row that have different superscripts are significantly different from each other (P<0.05).

higher in T_1 and T_3 as compared to T_2. The TDNI (in kilogram per day) was significantly (P<0.05) higher in T_3 followed by T_2 and T_1. Likewise, the voluntary water intake (in litres per day) by the camels was significantly (P<0.05) higher in T_3 (38.57) as compared to T_1 (33.19) and T_2 (36.09) (Table 4). These results are also supported by Gupta *et al.* (2012). The digestible crude protein (DCP) intake was 5.17 and 21.82% higher in T_1 as compared to T_3 and T_2 which might be due to feeding of camels with higher levels of protein in T_1. These results were supported by Nagpal *et al.* (2011) who reported significantly higher DCP intake in camel calves fed on higher levels of protein. The total digestible nutrient (TDN) intake on metabolic body size basis was significantly (P<0.05) higher in T_3 (58.96) as compared to T_2 (51.78) and T_1 (48.85) which was in accordance with the findings of Gupta *et al.* (2008). The findings on total water intake by the camels were comparable with the reports of Chaudhary and Tiwari (2010), Gupta *et al.* (2011) and Gupta *et al.* (2012).

Nitrogen and mineral balance: The nitrogen intake (in grams per day) was higher in T_1 as compared to T_2 and T_3 but the difference between T_1 and T_3 was nonsignificant (Table 5). All the camels during the experimental period were in positive nitrogen balance which was higher in T_3 followed by T_1 and T_2. The Ca and P balance was not affected on feeing different levels of energy and protein to dromedary camels. The results were in accordance with the

Table 4. Supplemental effect of different levels of energy and protein on nutrient and water intake in dromedary camels (*Camelus dromedaries*)

Attribute	Treatments			SEM
	T_1	T_2	T_3	
Dry matter and Nutrient intake				
Dry matter intake (kg/day)	10.95	10.89	11.69	0.55
Dry matter intake (% BW)	1.70	1.71	1.85	0.54
Dry matter intake (g/kgW$^{0.75}$)	85.62	85.90	92.72	3.33
Digestible crude protein intake (g/day)	886.62^{a}	693.08^{b}	840.73^{a}	33.94
Digestible crude protein intake (% BW)	1.37^{a}	1.08^{b}	1.33^{a}	0.05
Digestible crude protein intake (g/kgW$^{0.75}$)	6.93^{a}	5.46^{b}	6.66^{a}	0.21
Total digestible nutrient intake (kg/day)	6.24^{c}	6.86^{b}	7.43^{a}	0.22
Total digestible nutrient intake (% BW)	0.97^{b}	1.03^{b}	1.18^{a}	0.05
Total digestible nutrient intake (g/kgW$^{0.75}$)	48.85^{b}	51.78^{b}	58.96^{a}	2.23
Water intake				
Voluntary water intake (litres)	33.19^{c}	36.09^{b}	38.57^{a}	0.59
Water intake through feeds (litres)	0.76	0.75	0.81	0.03
Total water intake (litres)	33.95^{c}	36.84^{b}	39.38^{a}	0.60

^{a,b,c}Mean values in the same row that have different superscripts are significantly different from each other (P<0.05).

findings of Nagpal *et al.* (1996) and Gupta *et al.* (2012). The per cent nitrogen retention against total intake ranged from 12.76 to 23.30 which were higher in T_3 but the difference between T_1 and T_3 was nonsignificant. The camels were in positive calcium and phosphorus balance (Table 5). These results for nitrogen, calcium and phosphorus balance were supported by Nagpal *et al.* (1996) and Gupta *et al.* (2012) which indicated that the mineral balance was adequate for maintenance of body weight of the camels.

The results concluded that the draught camels may be fed on ration containing 16.49% CP and 70.71% TDN (both

Table 5. Supplemental effect of different levels of energy and protein on nitrogen and mineral balance in dromedary camels (*Camelus dromedaries*)

Attributes	Treatments			SEM
	T_1	T_2	T_3	
Nitrogen Balance, g/day				
N intake	141.86^{ab}	110.89^{c}	134.52^{b}	10.34
N excretion through				
Faeces	50.133	41.24	43.38	5.34
Urine	61.14	55.50	59.79	6.0
N Balance	30.607^{ab}	14.15^{c}	31.35^{a}	4.3
Ca balance, g/d				
Ca intake	0.267	0.1427	0.2314	0.50
Ca excretion through				
Faeces	0.130	0.071	0.114	0.32
Urine	0.025	0.012	0.019	0.11
Ca Balance	0.112	0.059	0.098	0.13
P balance, g/d				
P intake	0.054	0.053	0.070	0.29
P excretion through				
Faeces	0.027	0.029	0.039	0.23
Urine	0.005	0.009	0.008	0.17
P Balance	0.022	0.015	0.023	0.19

^{a,b,c} Mean values in the same row that have different superscripts are significantly different from each other ($P<0.05$).

protein and energy) in concentrate mixture along with leguminous based roughages for improved nutrient intake and digestibility.

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