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EFFECT OF PLANE OF NUTRITION ON DRAUGHT PERFORMANCE AND PHYSIOLOGICAL RESPONSES OF BIKANERI CAMELS

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ABSTRACT

Nine draught camels (578.00-582.33 kg BW) were randomly divided into 3 groups of 3 camels each to evaluate the effect of plane of nutrition on draught performance and physiological responses of Bikaneri camels. The camels were offered 3 different levels of energy concentrate mixture *viz*. T_1: 65% TDN; T_2: 70% TDN and T_3: 75% TDN, respectively along with gram straw (*Cicer arietinum*) as a sole diet of camels. There was significant difference between the treatments for DCP and TDN contents which were significantly ($P<0.05$) higher in animals fed on high energy levels. The DMI was 10.60, 12.23 and 13.4 (kg/day) in T_1, T_2 and T_3, respectively and the difference was statistically significant among the treatments but there was non significant difference between T_2 and T_3. Likewise, DDMI and DOMI (kg/d) was significantly higher ($P<0.05$) in T_3 as compared to T_2 and T_1. The average draught (kgf) was 105.78, 107.58 and 108.81, in T_1, T_2 and T_3, respectively which did not differ significantly. There was significant difference ($P<0.05$) between the treatment groups for speed of camels. The values of power developed (kw) was significantly higher ($P<0.05$) in T_3 followed by T_2 and T_1 with their respective values of 0.74, 0.84 and 0.93 in T_1, T_2 and T_3. There was increase in physiological responses in all the treatments after carting over the initial values. The camels fed with 75% TDN concentrate mixture exhibited less physiological stress as compared to camels fed with 70 and 65% TDN concentrate mixtures. It can be concluded that by increasing the level of energy in the diet of draught camels, there was improvement in the nutrient utilisation and draught performance by the camels with out any apparent ill effect on the health.

Key words: Camels, draught, energy levels, gram straw, nutrient utilisation, physiological responses

Camels are associated with nomadic or semi-nomadic production systems with few exceptions. However, these systems are undergoing rapid adaptive changes and transformations to cope with emerging demographic and economic factors (Hashi, 1991). Many herders are becoming more and more attached to quasi-permanent settlements. The resulting short-range management system differs considerably from the traditional long-range mobility patterns which used to balance the feed budgets of the herds. A related trend within formerly purely pastoral systems is the increasing commercialisation of milk and various forms of less mobile camel dairying are expanding. In some cases, producer-traders may keep lactating animals (taken from the main mobile herd) near settlements where they can regularly market the milk. On occasions, the milking herd has access to range enclosures or reserves around the settlements. At the extreme end of these trends, camels may be raised, on a permanent basis, in ranches or in agricultural areas with access to fallow lands, stubble grazing and crop residues and in and around urban centres where they are provided purchased feedstuffs.

Gram straw (*Cicer arietinum*) is one of the agricultural by-products used in livestock feeding. Gram straw is a dry residue of gram plants after the removal of grains by threshing and winnowing. It is a rabi crop by-product in gram growing areas and it may be valuable, especially during the period between May-July when grasses and other fodder are not readily available. The purpose of this paper is to provide a scientific assessment of gram straw as a sole diet along with different levels of energy on nutrient utilisation, draught performance and physiological responses in Bikaneri camels.

Materials and Methods

Nine draught camels (8 to 10 years of age and 578.00-582.33 kg BW) were randomly selected and fed on 3 dietary treatments. The animals were offered *ad*

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lib. gram straw supplemented with either low energy (65% TDN) concentrate (T_1); medium energy (70% TDN) concentrate (T_2) or high energy (75% TDN) concentrate (T_3). The concentrate mixture was fed as per requirement of draught camels (ICAR, 1985). The animals were housed in a well ventilated shed having sandy floor, asbestos roofing and provision for manger for individual feeding. All animals were offered fresh water once at 4 pm daily and refusal of water, if any, was also recorded to know the actual voluntary water consumption. The quantity of water received by the animals through feed and fodder were also calculated to know the total water intake by the camel. The gram straw (*Cicer arietinum*) was fed to each animal as a sole diet between 5 to 6 pm. The daily allowance of concentrate mixture was offered to all camels @ 2.7 kg DM/camel. All other management practices were kept the same for all the groups. After a preliminary feeding of 54 days, a 6 day digestibility trial was conducted on all the draught camel. The refusal of straw, if any, was also recorded to know the actual intake of feed and total faecal output in 24 hr was collected by harnessing faecal bags to individual animals. The representative samples of feeding and faeces were pooled and analysed for proximate principles (AOAC, 1995).

A 2 wheeled camel cart was used as a loading device for applying the load cells (Dynometer of 500 kg Ecl, UK) between the body of the cart and the beam for measuring the draught. The cart was pulled on a sandy track to cover a distance of 25.5 km with 18% pay load in 4 to 5 hr. The camels were allowed to pull payload including the weight of the cart and the driver in such a way the experimental camels could exert an average draught of 18% of their body weight. The data obtained was analysed by using simple ANOVA (Snedecor and Cochran, 1967).

Results and Discussion

Chemical Composition: The gram straw contained 89.80% DM, 91.50% OM, 5.99% CP, 45.00% CF, 0.98% EE and 39.53% NFE on dry matter basis which is in close confirmation with the results of Gupta and Murdia (2002). However, Nagpal *et al* (2005) reported high percentage of CP, EE, NFE and TA in gram straw as compared to present investigation. The concentrate mixture fed to the camels had 15.20, 15.68 and 15.32% CP, in T_1, T_2 and T_3 respectively. The DCP and TDN contents were 4.99 and 6.11 in T_1, 5.50 and 63.82 in T_2 and 5.81 and 66.05 in T_3, respectively which were significantly ($P<0.05$) different from each other. However, Chaudhary *et al* (2008) found significantly higher DCP and TDN contents in groundnut straw fed to draught camels as compared to present study.

Nutrient intake and efficiency: The total dry matter intake (kg/d) was 10.60, 12.23 and 13.40 in T_1, T_2 and T_3, respectively. The DMI through roughage was lower in T_1 followed by T_2 and T_3 but there was non-significant difference between T_2 and T_3. The DMI (g/kgw$^{0.75}$) was higher in T_3 as compared to T_2 and T_1 but the difference between T_2 and T_3 was non-significant which was in close agreement with the findings of Khanna and Rai (1989) and Rai *et al* (1994). The CPI (g/kgw$^{0.75}$) was significantly higher ($P<0.05$) in T_3 followed by T_2 and T_1 with their respective values of 7.40, 8.20 and 8.79, in T_1, T_2 and T_3. The values of DCPI and TDNI (g/kgw$^{0.75}$) were 4.43 and

Table 1. Proximate composition (% DM basis) of concentrate mixture and gram straw offered to draught camels.

Attributes	Gram straw (%)	Concentrate mixture		
		T_1	T_2	T_3
DM	89.80	89.90	90.10	90.05
OM	91.50	88.74	88.40	87.22
CP	5.99	15.20	15.68	15.32
CF	45.00	11.83	10.03	10.92
EE	0.98	2.20	2.29	2.68
NFE	39.53	59.51	60.40	58.30
TA	8.50	11.26	11.60	12.78

Table 2. Nutrient intake and feed efficiency in draught camels fed on gram straw supplemented with different levels of energy.

Attributes	Treatments			S.Em
	T_1	T_2	T_3	
Nutrients Intake				
Total DMI, kg/day	10.60^b	12.23^a	13.4^a	0.634
DMI roughage, kg/d	7.90^b	9.53^a	10.70^a	0.252
DMI concentrate, kg/d	2.70	2.70	2.70	–
DMI, g/kgw$^{0.75}$	88.79^b	102.35^a	112.06^a	4.532
CPI g/kgw $^{0.75}$	7.40^c	8.20^b	8.79^a	0.097
DCPI, g/kgw$^{0.75}$	4.43^c	5.62^b	6.50^a	0.223
TDNI, g/kgw$^{0.75}$	54.40^c	65.21^b	73.90^a	1.678
DDMI, kg/d	6.35^c	7.60^b	9.31^a	0.499
DOMI, kg/d	6.67^c	7.70^b	8.69^a	0.356
Feed efficiency				
DMI/kg BWG, kg	66.34^b	44.55^a	36.53^a	5.450
CPI/kg BWG, g	5531.29^b	3572.72^a	2865.28^a	417.289
DCPI/kg BWG, g	3290.46^b	2455.78^a	2124.80^a	261.373
TDNI/kg BWG, kg	40.63^b	28.41^a	24.11^a	3.476

Figures with different superscripts in a row differ significantly, $P<0.05$

54.40, 5.62 and 65.21 and 6.50 and 73.90, respectively in T_1, T_2 and T_3. There was significant (P<0.05) difference between the treatment groups for DCPI and TDNI on metabolic body size basis in draught camels. Likewise, DDMI and DOMI (kg/d) was significantly (P<0.05) higher in T_3 as compared to T_2 and T_1. Likewise, Nagpal *et al* (1993) confirmed the present results and reported DMI, DCPI and TDNI of 74.17±3.61, 7.92±0.39 and 63.14±3.07, respectively on metabolic body size basis in growing camel males. However, Nagpal *et al* (1996) noted daily intake of nutrients ($g/kgw^{0.75}$) as 3.41±0.26 DCP and 39.13±2.49 TDN on feeding *Phaseolus acontifolius* straw to pack safari camels.

The total water intake (l/d) was 34.69, 37.70 and 39.82, respectively in T_1, T_2 and T_3. The total water intake differs significantly among the treatments which are in close agreement with the results of Nagpal and Rai (1993) and Chaudhary *et al* (2008). However, Mathur and Mathur (1979) reported less water intake as compared to the present investigation on feeding urea treated (vernacular name-missa bhusa) gram straw to Bikaneri male camels.

The values of DMI/kg body weight gain were 66.34, 44.55 and 36.53, respectively in T_1, T_2 and T_3 which were significantly higher (P<0.05) in T_1 than T_2 and T_3 but there was non-significant difference between T_2 and T_3. The TDNI per kg body weight was 40.63, 28.41 and 24.11, respectively in T_1, T_2 and T_3. The camels fed 75% TDN through concentrate required less quantity of DCP and TDN per kg body weight gain as compared to other treatment groups. However, Nagpal *et al* (1993) reported 21.30 and 32.40 DMI per kg BW gain in camel calves on daily and weekly watering schedule which is lower than that noted in the present investigation.

Body weight and draught performance: There was non-significant difference between the treatments for final body weight of the camels but the difference between the treatment for total body weight change (kg) was statistically significant (P<0.05). The average daily gain (g/d) was 161.11, 277.78 and 369.44, respectively in T_1, T_2 and T_3 which was significantly higher (P<0.05) in T_3 as compared to T_2 and T_1 and confirms the findings of Chaudhary *et al* (2003) who reported the average daily gain between 77.08 to 387.25 (g/d). However, Nagpal and Jabbar (2005) reported average daily gain of 227.3 (g/d) in camels on feeding dry gram fodder.

The draught camels are introduced to work at the age of 4-5 years but should not be given full load upto 6 years (Khanna and Rai, 1989). The camel can be broken down for work at any time after 5 years of age depending upon nutritional status, physical development, climate and training of young camels for draught. The camels were made to pull cart at pay load of 2.8 kg/body weight on 2 wheeled camel cart and covered 25.5 km in 4 to 5 hours. The average draught (kgf) was 105.78, 107.58 and 108.81 (Table 3), respectively in T_1, T_2 and T_3 but there was non-significant difference between the treatments which might be due to non-significant difference between the treatments for body weight of camels at the time of draughtability studies. The results for draught performance in camels were within the range as reported by Rai and Khanna (1994) who reported the similar trend as compared to the present investigation. Dong Wei (1979) reported that the bactrian camel can pull 1 tonne load which is equivalent to the capacity of 2 chinese ponies or 2 oxens. Phillips *et al* (1975) reported that bactrian camels could carry 275 kg load and cover 1150 km in 30 days. Mathur (1976) reported that the Indian camel could produce draught power equal to 2 ponies and could pull cart with 1 tonne load. Yasin and Wahid (1957) reported that Pakistani camel could carry load up to 2050 lb for short distance and 800 to 960 lb at slow speed for long distances. Singh (1963) also reported that by using properly harnessed cart, an Indian camel could pull 816 kg weight. Khanna and Rai (1989) reported that Bikaneri camels could haul a load of 1.8 to 2 tonnes for 4 hours covering a distance about 20 km without any apparent sign of discomfort. In Niger, the camels on endurance test while pulling a sledge for a maximum period of 3 hours produced work of 6.09 MJ at a force of 438 N. The power output

Table 3. Body weight and draught performance in camels fed gram straw supplemented with different levels of energy.

Attributes	Treatments			S.Em
	T_1	T_2	T_3	
Body weight (BW)				
Initial BW, kg	578.00	581.00	582.33	18.722
Final BW, kg	587.67	597.66	604.50	19.092
Total BW change, kg	9.67^c	16.67^b	22.17^a	1.471
Mid BW, kg	582.83	589.33	593.41	18.894
ADG, g/d	161.11^c	277.78^b	369.44^a	24.533
Draught performance				
Draught (kgf)	105.78	107.58	108.81	3.436
Speed (m/sec.)	0.71^c	0.79^b	0.85^a	0.021
Power (kw)	0.74^c	0.84^b	0.93^a	0.031

Figures with different superscripts in a row differ significantly, P<0.05

of camels of different body sizes ranged from 425 to 1338 Nm/sec at force ranging from 332 to 883 N, where heavier camels (520 kg) showed lower work and lower output on unit live weight basis (Slingerland, 1989).

The speed of operation (m/sec.) was significantly higher ($P<0.05$) in T_3 followed by T_2 and T_1 with their respective values of 0.71, 0.79 and 0.85 in T_1, T_2 and T_3. The power output (kw) was 0.74, 0.84 and 0.93 in T_1, T_2 and T_3, respectively which differed significantly ($P<0.05$) from each other. Geo and Mc Dowell (1980) estimated that the light and heavy camels (dromedary) weighing 373 and 600 kg, respectively produced 0.6 and 1.1 hp at low speed and 0.5 and 0.9 hp at high speed, respectively. According to Singh and Verma (1987) camels could pull a maximum of 1800 kg for 1.5 hour at the speed of 3.5 km/h on tarmacadam road and produces 80 kgf.

Physiological responses: The rectal temperature, pulse rate and respiration rate of camel maintained under different treatments groups are presented in table 4. There was non-significant difference between treatments for rectal temperature before carting. The rectal temperature after carting was significantly higher ($P<0.05$) in T_1 as compared to T_2 and T_3 which confirms the results of Rai and Khanna (1990) who reported significant increase in rectal temperature after work performance.

The values of pulse rate before and after carting were 37.66 and 62.67 in T_1, 37.00 and 57.66 in T_2 and 36.00 and 55.00 in T_3, respectively and the difference was statistically significant. The per cent increase in pulse rate after carting was 66.40, 55.83 and 52.77, respectively in T_1, T_2 and T_3. Nagpal *et al* (1996) reported similar trend for increase in pulse rate after exercise which is in close agreement with the findings of present research work. Rana *et al* (1978) reported that there is an increased demand of oxygen during exercise which will be met by enhanced oxygen carriage of blood aided by an increased circulation rate and hence leads to increase impulse rate of the animals.

Table 4. Physiological responses in camels fed gram straw supplemented with different levels of energy.

Attributes	Treatments			S.Em
	T_1	T_2	T_3	
Rectal Temperature				
Before carting	37.33	37.16	37.13	0.244
After carting	39.30^b	38.50^a	38.00^a	0.371
% Increase	5.27	3.60	2.34	-
Pulse rate				
Before carting	37.66	37.00	36.00	0.981
After carting	62.67^a	57.66^a	55.00^b	3.042
% Increase	66.40	55.83	52.77	-
Respiration rate				
Before carting	7.67	7.33	7.00	0.769
After carting	17.66^a	15.00^b	13.00^c	0.720
% Increase	130.24	104.63	85.71	-

Figures with different superscripts in a row differ significantly, $P<0.05$

The respiration rate after carting differed significantly ($P<0.05$) among the treatments with their respective values of 17.66, 15.00 and 13.00 in T_1, T_2 and T_3. The per cent increase in respiration rate before and after carting was 130.24% in T_1, 104.63% in T_2 and 85.71% in T_3. Similarly, Rai and Khanna (1994) found an increase in body temperature, pulse rate and respiration rate over the initial values in Bikaneri camels which is similar to the observations noted in the present investigation. The increase in rates of pulse and respiration after work might be associated with a greater increase in their metabolic rate to provide more energy to the muscles and dissipate the extra body heat load.

The above findings indicated that the Bikaneri camels utilised the gram straw fed along with 75% TDN better as compared to other treatment groups. Further, the draught performance was higher in camels fed on 75% TDN concentrate mixture and tolerates the work stress without any apparent ill effect on health. Thus, feeding of gram straw with high energy levels not only maintained the body weight of the camels but also improved the nutrient utilisation and power output with enhanced work performance of the camels.

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