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# EFFECT OF FEEDING DIFFERENT LEVELS OF DIETARY ENERGY ON NUTRIENT UTILISATION, DRAUGHT PERFORMANCE AND PHYSIOLOGICAL REACTIONS OF CAMELS

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## ABSTRACT

Nine draught camels aged 7 to 10 years and average body weight (566.33±37.81 kg) kept on sole roughage diet of dry groundnut straw (*Arachis hypogaea* L.) along with various level of energy in concentrate mixtures. The camels were randomly divided into 3 groups of 3 animals each and allotted 3 dietary treatments i.e., $T_1$: 65% TDN in concentrate mixture; $T_2$: 70% TDN in concentrate mixture and $T_3$: 75% TDN in concentrate mixture alongwith dry groundnut straw fed *ad libitum* as sole roughage. The concentrate mixture was fed as per requirements of draught camels. The camels were subject to payload of 2.8 kg/kg body weight (18%BW) on a 2 wheeled camel cart. The camels covered 25.5 km distance in 2.64±0.08 to 3.12±0.03 hr at an average speed of 1.73±0.01 m/sec in a continuous work during winter season. The DM CP and DCP intake were found non-significant among the treatments on metabolic body size basis while, significant differences were observed among the treatments irrespective of total digestible nutrient intake (TDNI). However, the total water intake (litres) was significantly ($P<0.05$) influenced by various dietary treatments with lower value in $T_3$ followed by $T_2$ and $T_1$. The respiratory frequency 79.9, 45.57 and 39.88%, pulse rate 37.91, 29.92 and 21.24, and body temperature was 2.54, 1.96 and 1.52% increased over the initial values.

The results indicated that the nutrient utilisation and draught performance was better in camels fed higher energy levels in concentrate and covered distance without any hurdle and also tolerate the work stress efficiently without any apparent ill effect on the health.

**Key words:** Camel, draught, groundnut straw, nutrient utilisation, physiological responses

The camel (*Camelus dromedarius*) is an important work animal of the arid and semi-arid ecosystem because of their unique bio-physiological characteristics. In the recent past, camel has become very popular as draught, race animal in some of the Arab world, Australia, Sudan and India. Camels have unique features of adaptability, survivability and draught performance under adverse climatic conditions (Khanna and Rai, 1989; Nagpal and Jabbar, 2005). The draught camel can be used for a variety of functions like cart pulling, drawing wheels, ploughing, carrying water, transport etc. No wonder, the camel is known as "Ship of the desert" traversing long distances on sandy stretches carrying men and materials and providing bio energy for agricultural operations.

The scientific knowledge on work potential of Indian camel is limited in respect of efficiency of this animal for optimum and economic use. The work performance of the camel is influenced by the body conformation, condition of the terrain, work type, environmental factors and feeding status (Rai and Khanna, 1994). Preliminary observations on utilisation of camel power in transport in Rajasthan were reported by Singh and Verma (1987). Though the camel is a multifunctional animal, but it is mainly reared for draught power. However, no systematic work has been done on feeding of different levels of energy on performance of draught camels. Thus, the present investigation was planned to study the effect of feeding different levels of energy along with groundnut straw on nutrient utilisation, draught performance and physiological responses in draught camels during winter season.

## Materials and Methods

The present study has been conducted at the National Research Centre on Camel (NRCC), Bikaner,

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Rajasthan during winter season. Nine draught camels of 7 to 10 years of age and body weight ranging from 528-602 kg were selected from the herd of NRC farm and randomly divided into 3 groups *viz.*, $T_1$, $T_2$ and $T_3$ containing 3 animals in each group on the basis of their age and body weight. The animals were offered *ad lib* quantities of groundnut (*Arachis hypogaea* L.) straw plus 65% TDN in concentrate mixture in $T_1$, groundnut straw plus 70% TDN in concentrate mixture in $T_2$ and groundnut straw plus 75% TDN in concentrate mixture in $T_3$ group (Table 1) as per requirement of draught camels (ICAR, 1985).

The camels were housed in well ventilated camel shed. 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 of camel. The groundnut straw was supplied to each animal as a sole in the diet between 5 to 6 pm. The daily allowance of concentrate mixture was offered to all camels @ 2.7 kg DM/camel at 8.30 am. 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 camels. The refusal of straw, if any, was also recorded to know the actual intake, and total faecal output in 24 hours was observed by harnessing faecal bags to individual animals. The representative samples of feeding and faeces were pooled and analysed for proximate principles (AOAC, 1995) *viz.*, crude protein (CP), crude fibre (CF), ether extract (EE), nitrogen free extract (NFE) and total ash (TA).

**Table 1.** Proximate composition (% DM basis) of concentrate mixture and groundnut straw.

| Ingredients | Concentrate mixture | | | Groundnut |
|---|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ | |
| | Ingredient proportion (%) | | | |
| Mustard cake | 6 | 15 | 8 | |
| Barley | 10 | 49 | 45 | |
| Wheat bran | 20 | - | 32 | |
| Deoiled rice polish | 54 | 35 | - | |
| Guar churi | 9 | - | - | |
| Moth churi | - | - | 14 | |
| Common salt | 1 | 1 | 1 | |
| | Chemical composition | | | |
| DM | 90.42 | 91.20 | 90.50 | 89.70 |
| OM | 88.15 | 87.95 | 87.04 | 92.75 |
| CP | 14.11 | 13.98 | 13.88 | 9.35 |
| CF | 13.25 | 11.56 | 12.85 | 29.20 |
| EE | 2.12 | 2.14 | 2.85 | 1.65 |
| NFE | 58.67 | 60.27 | 57.46 | 52.55 |
| TA | 11.85 | 12.05 | 12.96 | 7.25 |

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 that the experimental camels could exert an average draught power of 18% of their body weight. The draught power was recorded during the experiment and power was calculated using the standard formula:

$$P = \frac{dxs}{270}$$

Where,

*P*= Power developed, hp

d= Draught, kgf

s= Average speed, $kmh^{-1}$

The speed (km/hr) and draught power (kgf) was calculated for each 5.1 km span and cumulative 25.5 km distance. The cardinal physiological responses were recorded before and after carting covering each 25.5 km distance. The respiratory rate (flank movement), pulse rate (coccygeal palpation) and rectal temperature of the camels were recorded before and after the draught stress. The data obtained from the experiment was evaluated statistically to compare the mean values (Snedecor and Cochran, 1980).

## Results and Discussion

The groundnut straw contained 89.70, 92.75, 9.35, 29.20, 1.65, 52.55 and 7.25% DM, OM, CP, CF, EE, NFE and Ash on dry matter basis (Table 1). The values of CP, CF, EE and ash observed in the present investigation were lower than that reported by Ranjhan (1991). The draught camels used in carting worked for 4 to 6 hr/day and consumed 11.17, 11.53 and 11.83 kg/day (2.01% BW basis). The camels maintained their body weight during the draught period. The DMI of draught camels ranged from 1.98 to 2.03 kg/100 kg body weight. Similar results were obtained by Nagpal *et al* (1996) and Rai and Khanna (1990). Wilson (1989) reported the daily maintenance requirements for 500 kg adult camel as 300 g DCP and 54.0 MJ ME. Rai *et al* (1994) reported that the DMI, DCPI, TDNI (kg/d) and MEI (MJ/d) for 635 kg camels was 1.351, 0.607, 5.036 and 75.8,

respectively. The nutrient intake was higher than those recommended by Wilson (1989). Mokhtar *et al* (1989) observed that 0.91% DMI was not sufficient, hence the animals lost body weights. The camel has been reported to be more efficient in nitrogen recycling than the other ruminant species (Pathak and Kamra, 1989; Mokhtar *et al,* 1989).

The dry matter intake (DMI) on metabolic body size basis (g/kgW$^{0.75}$) was 101.93±12.28, 103.51±5.95 and 91.27±6.89, respectively in $T_1$, $T_2$ and $T_3$ treatments. There was non-significant difference between the treatments for DMI which was in close agreement with the findings of Khanna and Rai (1989) and Rai *et al* (1994). Similarly, there was non-significant difference for CPI and DCPI among the treatments. The values of total digestible nutrients (TDNI) were 65.72±0.82, 68.47±1.98 and 74.27±1.40 g/kgW$^{0.75}$, respectively in $T_1$, $T_2$ and $T_3$. The values of TDNI (g/kgW$^{0.75}$) were significantly (P<0.05) higher in $T_3$ (74.27±1.40) followed by $T_2$ (68.47±1.98) and $T_1$ (65.72±0.82). These results are in close agreement with the findings of Nagpal *et al* (2000) who reported 64.55 (g/kgW$^{0.75}$) daily TDNI in female camels during exercise. Khanna and Rai (2000) reported that the camel would require approximately 49.5 MJ ME daily during carting. They reported that a 500 kg camel expend 0.21 MJ gross energy per minute at 15 to 18 km/hr speed assuming an average metabolic efficiency of 60%. Racing camel would require approximately 18.9 MJ ME/hr which means that camels working for one hour would require approximately 49.6 MJ ME daily. The average requirement of energy needed for maintenance of draught animal weighing 450 kg is 3.3 kg TDN (Sen, 1966). Mathur (1976) reported that for camels weighing 350 to 450 kg, the ration should contain 0.34-0.59 kg DCP. The NRC (1976) recommendation in respect of immature cattle (100-400 kg body weight) gaining 0.5 to 1 kg/day is to feed 0.5 to 3.5 kg TDN over and above their maintenance requirements. The camel also gains between 0.5 to 1 kg/day during the period of growth, hence, their TDN requirements during this period may be similar to those of growing animals. But during draught period, the requirement of camels was increased as reported by ICAR (1985). Khanna and Rai (1989) reported that the requirement of Bikaneri camel on *ad lib* feeding on pulling a load of 1.8 to 2 tonnes for 4 hr/day is between 1.8 to 2.0% of body weight which confirms the findings of present study.

During initial training period draught animals need extra energy. The higher energy intake by the camels during draughtability might be due to higher energy needs of the camels for muscle tissue (Agarwal *et al,* 1991). The total water intake (TWI) was 36.63±1.42, 35.85±1.84 and 31.43±2.82 litres, respectively in $T_1$, $T_2$ and $T_3$ which was significantly (P<0.05) influenced by the treatments (Nagpal and Rai, 1993; Chaudhary *et al,* 2003). While, Mathur and Mathur (1979) who reported lesser water intake on feeding urea treated misa bhusa (*Phaseolus aconitifolius*) to Bikaneri male camels.

Normally, draught camels are introduced to work at the age of 4 to 5 years but should not be given full load upto 6 years (Khanna and Rai, 1989). The camels can be, however, broken for work at any time after 5 years of age depending upon nutritional status, physical development, climate and training of young camels for draught and management. Normally, the camel can be trained with in 3-4 months for carting purpose. The optimum load carrying capacity of Indian camels is about 2.8 kg/kg body weight (Rai and Khanna, 1990). Therefore, the camels were made to pull cart at pay load of 2.8 kg/body weight on 2 wheeled cart and covered 25.5 km in 4 to 5 hours. The average draught (kgf) was 103.43±1.90, 103.60±1.57 and 111.83±2.64, respectively in $T_1$, $T_2$ and $T_3$ (Table 2) which was significantly (P<0.05) higher in $T_3$ as compared to $T_2$ and $T_1$. The speed (km/hour) was significantly (P<0.05) higher in $T_3$ and $T_2$ than $T_1$. The values of power developed (hp) was significantly higher (P<0.05) in $T_3$ followed by $T_2$ and $T_1$ with their respective values of 1.28±0.04, 1.13±0.01 and 1.01±0.02. The results for draught performance in camels were within the range as reported by Rai and Khanna (1994) who observed the similar trend. 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. Camels weighing 520 kg could carry pack load up to 210 kg at a speed of 4 km/hr. The camels are capable for exerting equivalent to 1 hp of energy during ploughing covering 1 hectare in 11.25 hr and slightly more during oil milling (Khanna and Rai, 1989). Dong (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. Matharu (1966) 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) reported that by using properly harnessed cart, an

**Table 2.** Nutrient utilisation in draught camels under different treatments.

| sAttributes | Treatments | | |
|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ |
| **Body weight (BW)** | | | |
| Initial BW (kg) | 566.33±77.67 | 566.67±37.81 | 566.33±28.29 |
| Final BW (kg) | 573.33±75.22 | 576.00±33.29 | 588.00±15.87 |
| Total BW gain (kg) | $7.00^{b}$±2.00 | $9.33^{b}$±1.15 | $18.33^{a}$±2.89 |
| **Nutrient utilisation** | | | |
| DMI (kg/day) | 11.17±0.8 | 11.53±1.03 | 11.83±0.53 |
| DMI (g/kg $^{w\ 0.75}$) | 101.93±12.28 | 103.51±5.95 | 91.27±6.89 |
| CPI (kg/day) | 1.30±86.88 | 1.34±101.65 | 1.37±66.52 |
| CPI (g/kg $^{w\ 0.75}$) | 11.87±1.37 | 12.06±0.56 | 10.54±0.76 |
| DCPI (g/day) | 776.20±49.55 | 815.70±101.70 | 861.59±52.07 |
| DCPI (g/kg $^{w\ 0.75}$) | 7.07±0.68 | 7.32±0.77 | 6.65±0.53 |
| TDNI (kg/day) | $7.23^{b}$±0.27 | $7.62^{b}$±0.18 | $8.34^{a}$±0.16 |
| TDNI (g/kg $^{w\ 0.75}$) | $65.72^{c}$±0.82 | $68.47^{b}$±1.98 | $74.27^{a}$±1.40 |
| Total water intake (litres) | $36.63^{a}$±1.42 | $35.85^{a}$±1.84 | $31.43^{b}$±2.82 |
| DCP (%) | 7.07±0.59 | 7.06±0.34 | 7.29±0.39 |
| TDN (%) | $64.79^{c}$±0.95 | $66.09^{b}$±0.91 | $69.36^{a}$±2.55 |

Means with different superscripts differ significantly (P<0.05) from each other.

**Table 3.** Draught performance and physiological responses in draught camels.

| Attributes | Treatment | | |
|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ |
| **Draught performance** | | | |
| Draught (kgf) | $103.43^{b}$±1.90 | $103.6^{b}$±1.57 | $111.83^{a}$±2.64 |
| Average speed (km/h) | $2.64^{b}$±0.08 | $2.96^{a}$±0.06 | $3.12^{a}$±0.03 |
| Power developed (hp) | $1.01^{c}$±0.02 | $1.13^{b}$±0.01 | $1.28^{a}$±0.04 |
| Power developed (kW) | $0.75^{c}$±0.03 | $0.84^{b}$±0.02 | $0.96^{a}$±0.03 |
| **Physiological responses** | | | |
| **Body temperature (°C)** | | | |
| Before carting | 36.96±0.32 | 37.30±0.32 | 37.40±0.10 |
| After carting | 37.90±0.52 | 38.03±0.21 | 37.97±0.11 |
| % increase | 2.54 | 1.96 | 1.52 |
| **Pulse rate (beats/minute)** | | | |
| Before carting | 38.67±0.58 | 39.00±1.00 | 37.67±0.58 |
| After carting | $53.33^{a}$±0.58 | $50.67^{b}$±0.58 | $45.67^{c}$±0.58 |
| % increase | 37.91 | 29.92 | 21.24 |
| **Respiration rate (breaths/minute)** | | | |
| Before carting | 6.67±0.58 | 7.33±0.58 | 6.67±0.58 |
| After carting | $12.00^{a}$±1.00 | $10.67^{ab}$±0.58 | $9.33^{b}$±0.58 |
| % increase | 79.9 | 45.57 | 39.88 |

Means with different superscripts differ significantly (P<0.05) from each other.

Indian camel could pull 816 kg weight. According to draught capacity, Khanna and Rai (1989) reported that camel can pull 15-18 quintal load for 4 hr @ 5 km/hr on a kutchha (rough) road of desert area, the pulse and respiration rate and rectal temperature increased by 67-260%, 41-70% and 2.1-3.5°C, respectively in the Bikaneri breed of camel.

The values of body temperature, pulse rate and respiration rate are presented in table 3. There was non-significant effect on body temperature in all the treatments before and after carting of the animals. The pulse rate (beats/minute) after carting was significantly ($P<0.05$) low in $T_3$ followed by $T_2$ and $T_1$ which was in close agreement with the findings of Nagpal *et al* (1996). The values of respiration rate (breaths/minute) before and after carting was 6.67±0.58 and 12.00±1.00 in $T_1$, 7.33±0.58 and 10.67±0.58 in $T_2$ and 6.67±0.58 and 9.33±0.58 in $T_3$, respectively. There was significant ($P<0.05$) increase in respiration rate in $T_1$ and $T_2$ as compared to $T_3$ which confirms the reports of Khanna and Rai (2000) who reported increase in respiration rate after carting in draught camels. Similarly, Rai and Khanna (1994) reported an increase in body temperature, pulse rate and respiration rate over the initial values in Bikaneri camels which is similar to the observations reported in the present investigation. The increase in physiological responses might be due to higher heat stress and hard muscle exercise during carting and lower availability of energy in the body. Thus, the physical work puts muscles into action which needs more energy for their proper action.

The results concluded that the nutrient utilisation and draught performance was higher in camels fed on 75% TDN concentrate mixture as compared to 70 and 65% TDN concentrate mixture. Further, the higher energy consumed camels tolerate the work stress without any apparent ill effect on the health. Thus, it may be recommended that draught camels need extra energy for enhancing their working efficiency.

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