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EFFECT OF DRAUGHT ON SPEED, POWER OUTPUT AND PHYSIOLOGICAL RESPONSES OF CAMELS (*Camelus dromedarius*)

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ABSTRACT

An experiment was conducted by using three Bikaneri camels (608.33 kg body weight; 7-9 years age) to study the effect of draught on speed, power output and physiological responses. The draught was varied by varying pay load on the four wheeled cart and hydraulic dynamometer was used for measuring the draught. The maximum and minimum speed (km/h) was observed at 8 and 22 per cent draughts, respectively. There was decrease in speed with increase in draught but the average speed was noted at 16 per cent draught. The power output increased linearly with increase in draught and maximum power output was observed at 22 per cent draught which differed significantly from other levels of draught. The values of pulse rate, respiration rate and rectal temperature were found to increase with increase in draught and duration of work. The maximum variation in physiological responses was noted at 22 per cent draught. However, increase in rectal temperature did not show any remarkable effect at higher draughts. The fatigue symptoms were observed after 3-4 hours of work on draughts beyond 16 per cent of body weight of camels. It can be concluded that the speed of camels decreased with increase in duration of time and draught. The best values of speed and power output were observed at 16 per cent draught level. Further, the physiological responses increased with duration of work and draught.

Key words: Camels, draught, physiological responses, power output, speed

Draught animals are the major source of farm power for marginal and small farmers. They are used for a variety of operations such as tillage, transportation, water lifting, oil extraction and threshing. Camel is one of the most economically important species in the desert ecosystem and is highly suitable for arid regions because of its unique ability to withstand draught conditions. The survival of camel in desert depends on physiological reactions to environmental stresses for thermoregulatory mechanism, metabolic behaviour and regulatory responses to extreme scarcity of feed and water. The camel has unique ability to utilise low quality feed resources which other species of animals are unable to consume. It is only source of power for goods and material transport in hot arid sandy regions which are inaccessible to motorised transport. The work performance of all draught animals is judged by the power output which is related to their body weight. A lot of information is available about the work performance of bullocks, buffaloes, horses and donkeys but very little literature is available about the draught capacity and physiological responses in camels at various combinations of draught and speed which became the objective of present investigation.

Materials and Methods

An experiment was conducted by using three adult male camels of Bikaneri breed having average weight 608.33 kg (7-9 years age). A four wheeled cart with sliding beam arrangement was used as a loading device. A hydraulic dynamometer of 500 kg capacity was placed between the body of the cart and the beam for measuring the draught. The draught was varied by varying pay load on the cart, which was in the form of gunny bags filled with concrete. The observations were recorded on tarmacadam test track at draughts of 8 to 22 per cent of the body weight (BW) of the camels. The speed of operation was measured by recording the time taken by the camels to travel 100 meters distance on the test track.

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The power out put was calculated by using speed and draught with the help of standard formula:

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

Where,

P= Power developed, hp

D= Draught, kgf

S= Average speed, kmh^{-1}

The physiological responses were recorded after every hour while the camels were on the work. The pulse rate was measured from coccygeal artery. The respiration rate and rectal temperature were also measured. The various physical distress signals such as leg in-coordination, eyes movement, crying, refusal to move forward, tear from eyes, turning of neck abruptly and water from the nostrils were also observed to assess the state of fatigue of camel. The data obtained from the experiment were analysed statistically (Snedecor and Cochran, 1967).

Results and Discussion

The results of this experiment have been presented under the following sub-heads:

Effect of draught on speed: The average speed of the camels on test track was found to vary between 2.54 to 3.49 km/h with variation in draught from 48.80 to 134.20 kgf (Table 1). There was marginal decrease in speed with the increase on draught, but the difference was statistically (P<0.05) non-significant among different levels of draughts for speed of travel by the camels. Rai and Khanna (1994) observed a speed of 4.75 km/h for camels, which was higher than the present investigation.

Table 1. Variation in speed and power output of camels at different levels of draught.

Draught, %BW	Draught*, kgf	Speed, km/h	Power*, hp
8	48.80±3.39	3.49±0.78	0.63±0.09
10	61.00±4.24	3.38±0.65	0.76±0.08
12	73.20±5.09	3.28±0.57	0.88±0.09
14	85.40±5.93	3.15±0.49	0.99±0.08
16	97.60±6.78	3.00±0.67	1.07±0.16
18	109.80±7.63	2.80±0.43	1.14±0.09
20	122.00±8.48	2.74±0.36	1.22±0.09
22	134.20±9.33	2.54±0.22	1.26±0.02

* Significant at 0.05 level (P<0.05)

However, Geo and McDowell (1980) reported a speed of 3.5 km/h for camel weighing 600 kg body weight which was similar to the results noted in the present investigation. It is clear from the table that the speed reduced with increase in draught and a linear relationship between speed and draught was observed in the following form.

$$S=4.0618-0.0111D$$

Where S=speed, km/h and D= Draught, kgf

Effect of draught on power output: The power output (hp) at 8 per cent draught was significantly (P<0.05) lower than all other levels of draught. The values of power output at 10 per cent draught did not differ significantly from 8 and 12 per cent draughts but was statistically (P<0.05) higher than other levels of draught. Likewise, at draught level of 22 per cent, the power output (hp) was significantly (P<0.05) higher as compared to all other draught levels.

It is evident that power output increased linearly with draught. The maximum power output was 1.26 hp at draught of 134.20 kgf (22 per cent of

Table 2. Effect of duration of work on pulse rate of camels at different draughts (Normal-35 to 49 beats/minute).

Duration of work, h	Draught as per cent body weight of camels							
	8%	10%	12%	14%	16%	18%	20%	22%
	Starting pulse rate, beats/minutes							
	40	41	39	40	39	42	41	42
	Per cent variation in pulse rate							
1	4.10	3.85	5.10	9.90	7.15	7.50	10.50	10.05
2	8.00	10.25	9.40	11.35	12.05	8.80	12.50	15.90
3	11.75	11.45	10.95	12.65	14.40	12.0	16.90	18.20
4	14.25	12.75	12.25	15.45	15.60	14.65	20.65	27.10
5 (Rest)	6.40	6.45	5.10	8.05	7.15	8.95	15.20	19.30
6	13.20	9.00	9.00	18.15	12.75	14.10	25.70	21.50
7	15.90	11.60	12.00	20.95	14.10	16.10	27.75	28.00
8	15.90	14.90	17.55	22.4	18.35	20.30	30.10	33.35

body weight) with the speed of 2.54 km/h which confirms the findings of Wilson (1978) and Khanna and Rai (2000) who reported the similar values for power output in camels. Geo and McDowell (1980) estimated that the light and heavy camels (dromedary) weighing 373 and 600 kg, respectively, produced 0.6 and 1.1 hp power at low speed and 0.5 and 0.9 hp power at high speed, respectively.

A linear relationship between power output and draught was observed in the following form:

$$P=0.0436\ D^{0.6944}$$

Where, P=Power, hp and D= Draught, kgf.

It was concluded that the speed reduced with increase in draught and the maximum power output of camel with four wheeled cart on tar road was 1.26 hp.

Effect of draught and duration of work on physiological responses

It was evident from the observations that the pulse rate increased at faster rate in the beginning but the rate of increment was lower after three hours (Table 2). When the initial pulse rate was low the increment was more in comparison to start with high pulse rate. The maximum variation in pulse rate was 33.35 per cent of its initial value at 22 per cent draught. The results confirms the findings of Rana *et al* (1978) who observed that there is an increased demand of oxygen during exercise which is met by enhanced oxygen carriage of blood aided by an increased circulation rate and hence leads to an increase in pulse rate of the animals.

The fatigue symptoms such as unwillingness to move forward, tail up, tears from eyes, appearance of belly artery and leg in-coordination were observed after 3-4 hours of work on draughts beyond 16 per cent of body weight of camels. Khanna and Rai (2000) also observed reluctance to move further on completion of third hour, and tendency to sit during fourth hour and beyond in camels. The in-coordination of movements and muscular tremors appears on completion of fourth hour.

The respiration rate increased with duration of work and the rate of increase was dependent on draught and the initial respiration rate at rest (Table 3). The maximum variation in respiration rate was 98.56 per cent at draught level of 22 per cent. However, Roy *et al* (1992) reported 142 per cent increase in respiration rate after the appearance of fatigue in draught camels. The maximum and minimum respiration rate recorded during the study was between 6 to 13 breaths per minute. Thompson (1973) reported that the physiological responses change vary rapidly during work and greatly affect the draught performance. The increase in rates of 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 effect of draught and duration of work on rectal temperature. The data revealed that the normal rectal temperature for camels ranges from 36 to 38°C at rest and the rectal temperature increases with duration of work (Table 4). But the increase in rectal temperature did not show any remarkable effect at higher draughts and the maximum variation in rectal temperature was 4.98 per cent. Gupta *et al* (2010) reported 5.27 per cent increase in rectal temperature before and after work which is in close agreement with the results noted in the present investigation.

Table 3. Effect of duration of work on respiration rate of camels at different draughts (Normal-8 to 10 breaths/minute).

Duration of work, h	Draught as per cent body weight of camels							
	8%	10%	12%	14%	16%	18%	20%	22%
	Starting pulse rate, beats/minutes							
	7	7	8	8	7	8	8	7
	Per cent variation in pulse rate							
1	14.28	12.50	12.25	20.83	14.41	25.00	12.50	14.28
2	28.57	36.42	25.00	25.00	20.83	40.28	54.42	58.33
3	37.50	42.85	50.52	62.50	61.67	66.67	66.67	69.37
4	56.42	65.71	61.90	62.32	72.50	79.90	88.66	98.56
5 (Rest)	12.50	14.35	12.55	0	12.50	12.50	16.66	13.68
6	28.02	18.50	45.80	20.83	27.12	50.28	58.33	62.50
7	42.85	48.90	61.78	58.33	62.50	70.50	72.69	91.33
8	50.90	72.14	66.25	72.50	70.00	75.00	95.07	95.68

Table 4. Effect of duration of work on rectal temperature of camels at different draughts (Normal-36 to 38°C).

Duration of work, h	Draught as per cent body weight of camels							
	8%	10%	12%	14%	16%	18%	20%	22%
	Starting pulse rate, beats/minutes							
	7.0	36.8	36.9	37.0	36.5	36.8	37.0	36.5
	Per cent variation in pulse rate							
1	0.41	0.94	0.94	0.68	1.62	1.23	1.35	1.61
2	1.49	1.75	1.34	1.22	2.70	2.19	2.17	2.55
3	2.16	3.10	1.61	1.49	3.10	3.43	3.39	3.35
4	2.57	2.83	2.15	2.31	3.91	3.84	4.34	3.89
5 (Rest)	1.30	1.10	1.34	2.44	2.37	2.30	2.99	2.22
6	2.64	3.19	2.69	3.39	3.51	4.53	4.61	3.36
7	2.70	2.67	3.09	4.88	3.64	4.58	4.75	3.62
8	2.75	3.85	3.12	5.02	4.05	4.79	4.98	4.30

Khanna and Rai (2000) observed an increase in rectal temperature by 6.8 per cent over the initial value of 38.4°C and a gradual increase with increasing hours of work. Likewise, Rai and Khanna (1990) confirmed the results that significant increase in rectal temperature occurs after work performance in camels.

It was concluded that the speed of camels decreased with increase in duration of time and draught. The maximum power output was noted at 22 per cent of body weight (draught, kgf) but there was decrease in speed of travel. However, the best values of speed and power output were observed at 16 per cent draught. Further, the physiological responses increased with duration of work and draught. The fatigue symptoms were observed after 3 to 4 hours of work on draughts beyond 16 per cent of body weight of the camels.

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