Journal of Animal Research: v.7 n.1, p. 133-137. February 2017
DOI: 10.5958/2277-940X.2017.00019.5

Draftability of Kutchi Camel under Agro Climatic Condition of Middle Gujarat

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Received: 20 Aug., 2016 **Revised:** 31 Jan., 2017 **Accepted:** 02 Feb., 2017

ABSTRACT

Present study was conducted on five clinically healthy adult Kutchi camels (B.wt. 450-550kg) with the objective to assess the effect of different payloads (L_1-1500kg, L_2-2000kg and L_3-2500kg), under different seasons (S_1- hot dry, S_2-hot humid and S_3-winter) and work rest cycles (WR_1: 2h (W) - 1h (R) - 2h (W) - 1h (R) + 2h (W) and WR_2: 1h (W) - 15 min (R) - 1h (W) - 15 min (R) - 1h (W) - 1h (R) - 1h (W) - 15 min (R) - 1h (W) - 15 min (R) - 1h (W). The Kgf, Hp, power output (W), stride (no/100m), time (sec/100m), stride length (m) and duration of stride/sec were recorded significantly ($p<0.05$) higher under L_2 and L_3 as compared to L_1 under different work rest cycles, whereas speed (m/sec) declined significantly ($p<0.05$) under L_2 and L_3 as compared to L_1. The no of strides/sec did not differ under any pay loads under different work rest cycles. The Hp, power output (W), speed (m/sec) and number of stride/sec increased significantly ($p<0.05$) under S_2 and S_3 as compared to S_1 whereas time (sec)/100 m and duration of stride/sec declined significantly ($p<0.05$) under season S_2 and S_3 as compared to S_1. The stride length (m) recorded significantly ($p<0.05$) high in S_2 an compared to S_1 and S_3. The Kgf did not alter in any season.

Keywords: Draftability, season, payload, work rest cycle, Kutchi camel

Camels have unique features of adaptability, survivability and very versatile work animal suitable for draft, riding, load carrying in the desert ecosystem under adverse climatic conditions (ICAR, 1985; Khanna and Rai, 2000). The work-rest schedule practiced by the farmers is based on experience and convenience of operators. It needs to be developed on scientific lines to ensure minimum fatigue to the animal and operator. Enhancing power availability from draught animals through draughtability studies and scheduling proper work rest-cycles is future research priorities (Singh, 1996). The Kutchi breed of camels is medium sized animal mainly utilized for draught purpose. The home tract of this animal is Kutch district of Gujarat state. The scientific knowledge on work potential of Indian camel is limited in respect of efficiency of this animal for optimum economic use. The draught animal power is being supplemented by mechanical power, especially for tillage, irrigation and threshing (Shrimali, 1995; Singh, 1999) but little information available on their draftability parameter at various combinations of pay loads, work rest cycles and duration of work in different agroclimatic condition. Hence, the present study was conducted on healthy adult Kutchi camels.

MATERIALS AND METHODS

Five adult clinically healthy Kutchi camels (450-550 kg; 6-7 years) selected for thirty days study in each season. The experiment was conducted in three seasons namely S_1 - hot dry (15th May -30th June), S_2 - hot humid (1st Sept – 15th Oct) and S_3 - winter (1st Dec – 15th Jan). The camels worked for 8 hrs daily from 08.00 to 16.00 hrs in two work rest cycles viz. WR_1: 2h (W) - 1h (R) - 2h (W) - 1h (R) - 2h (W) (Singh, 1996) and WR_2: 1h (W) - 15 min (R) - 1h (W) - 15 min (R) - 1h (W) - 1h (R) - 1h (W) - 15 min (R) - 1h (W) - 15 min (R) - 1h (W) (Traditional) on straight tar road of about 5.2 km/round. Three loads (L_1 – 1500 kg, L_2 – 2000 kg and L_3 – 2500 kg) were placed on the camel cart. The total load was the sum of payload + weight of cart + weight of driver. The bags filled with gravels and concentrate mixture were used to fix the pay loads on the cart. The camel worked with three pay loads in two work rest cycles for six days (two days for each pay load in two work cycles) in one season. A four-wheel camel cart with platform size of 2.9 × 1.7 meters with a payload capacity of 3500 kg was used. The traditional wooden pull beam of camel cart was modified in to telescopic pull beam by using 2" and 1.5" MS pipe. The slit was made in the 2"and 1.5" MS Pipes and cross bar of 1.5" M S pipe was fitted to establish free telescopic movement in the pull beam. The load cell dynamometer measured draft (kgf) generated by the camel during work was fixed between the cart and the crossbar. The speed was measured by sensor fitted below the cart. The entire diameter of the wheel was divided in to three parts by using the protector and fixing the iron bar on these three points facing the speed measuring sensor. The data generated on draft (kgf) and speed (m/sec) transferred in to a memory storage microchip fixed in the chargeable battery operated display unit through attached cables which transferred in the computer for further analysis. Horse power generated by the camel was calculated using the formula (Chaudhary *et al.,* 2008).

$$P = \frac{d \times s}{270}$$

Where, P = Power developed (hp), d = Draft (kgf) and s = Average speed (kmh^{-1})

The power exerted by the camel to pull the load was calculated by using the following expression (Rai and Khanna, 1994).

Power (W) = 9.8 x Draft (Kgf) × Speed (m/Sec)

The no of strides and its duration (sec) was measured manually by counting the No. of steps per 100 meter and time required (sec) to cover 100 m distance by using the stop watch and subsequently the stride length, no of stride/km, duration of stride/sec and stride/sec was calculated as follow.

- Stride length (m) =100m/stride no
- No of stride per km = No. of steps per 100 meter × 10
- Duration of stride/sec = Time (sec) to cover 100 m distance/stride no
- Stride/sec = Stride no/stride length (m)

All means and SE were estimated as per the procedure outlined in SPSS® 11.00 statistical packages. The significance between means and their combined interaction effect of different treatment effect individually season (S), Payload (L), Session of work (Se), and Work Rest Cycle (WR) were assessed using the multi-factorial completely randomized design (CRD) procedures (Snedecor and Cochran, 1980).

RESULTS AND DISCUSSION

The effect of seasons and pay loads during different work rest cycles on different draftability parameters viz., Kgf, Hp, Power output (W), Speed (m/sec.), Stride no per 100m, Time (sec)/100m, Stride Length (m), Duration of stride/sec and Number of stride/sec are expressed in Table -1 and 2, respectively.

Kgf

The Kgf generated during different seasons and work rest cycles did not differ significantly indicated Kutchi camel produces equal kgf in all seasons in both the work rest cycles of the experiment. However, the camels generated significantly ($p < 0.05$) different kgf under different payloads. The generation of kgf increased with the increment in the payloads. Camel generated 24.27 and 24.6% and 22.75 and 21.89% more kgf under L_2 and L_3 compared to L_1 in WR_1 and WR_2, respectively. The interaction effects of seasons, work rest cycles and pay loads did not affect the kgf produced during the experiment. The Kgf value generated by the camels during experiment are in accordance with the values reported by Khanna and Rai (1989) who reported that 110-115 Kgf produced by Indian camel at 20% draught force, whereas the lowest value for Kgf reported by Tiwari *et al.* (2003) when camel put to work with 1.8 tons (80 Kgf) and under different tillage implements like MB plough (83.1 Kgf), cultivator (84.88 Kgf) and Bund former (17.9 Kgf) and Shrimali (1995) has reported highest Kgf at 1600 kg payload under Bikaneri cart (111.92) and Alwar cart (98.23).

Hp and power generated

The Kutchi camel generated significantly ($p < 0.05$) higher Hp during S_2 (0.63±0.09 and 0.62±0.106) followed by S_3 (0.60±0.09 and 0.59±0.09) and S_1 (0.55±0.09 and 0.55±0.13) in WR_1 and WR_2, respectively. The Kutchi camel generated significantly ($p < 0.05$) higher power during S_2 (1688.2±48.13 and 1654.2±51.53) followed by S_3 (1588.26±42.61 and 1578.1±45.54) and S_1 (1459.6±43.31 and 1480.9±63.89) in WR_1 and WR_2, respectively. The Hp and power output indicated that S_2 was more stressful for Kutchi camel compared to S_1 and S_3. The high Hp and power generation during S_3 as compared to S_1 may be due to climatic change at Anand station. The environmental temperature was more than 30°C as compared to reported value (29.17 °C) by Dhangar (1993) but there was very low wind speed (km/h) during entire experiment during S_3 as compared to S_1. The Kutchi camel generated significantly ($p < 0.05$) higher Hp under L_3 (0.670±0.02 and 0.705±0.02) followed by L_2 (0.599±0.01 and 0.579±0.01) and L_1 (0.521±0.01 and 0.498±0.01) in WR_1 and WR_2, respectively. Simultaneously, camels generated significantly ($p < 0.05$) higher Power under L_3 (1770.7±46.20 and 1863.9±51.86) followed by L_2 (1585.4±32.34 and 1531.0±25.79) and L_1 (1380.0±33.16 and 1318.3±27.63) in WR_1 and WR_2, respectively indicated increase in payload results in increment in Hp and Power output. The power generation increased significantly ($p < 0.05$) progressively as the payloads increased from L_1 to L_3 in both the workrest cycles. The reported values of power output during experiment was more than the value reported by Shrimali (1995) due to more generation of kgf and more speed of Kutchi camel on tar road.

Table 1: Effect of season and work rest cycle on draftability parameters

Parameter	WR1			WR2		
	Hot dry	Hot humid	Winter	Hot dry	Hot humid	Winter
Kgf	125.1±3.99	125.5±3.96	126±3.98	125.4±3.97	125.5±3.97	125.7±3.98
Hp	0.55^{a}±0.09	0.64^{c}±0.09	0.60^{b} ±0.09	0.56^{a}±0.13	0.63^{c}±0.11	0.60^{b}±0.09
Power output(W)	1459.6^{a}±43.31	1688.2^{c}±48.13	1588.26^{b}±42.61	1480.9^{a}±63.89	1654.2^{c}±51.53	1578.1^{b}±45.54
Speed (m/sec.)	1.21^{a}±0.01	1.38^{c}±0.01	1.30^{b}±0.011	1.20^{a}±0.01	1.35^{c}±0.009	1.28^{b}±0.007
Stride no per 100m	50.35^{ab}± 0.28	49.29^{a}±0.24	50.99^{b}±0.20	51.47^{b}±0.25	49.62^{a}± 0.241	51.66^{b}±0.15
Time (sec)/100m	84.20^{b}± 0.62	73.24^{a}±0.50	75.91^{a}± 0.47	86.47^{b}± 0.56	74.73^{a}±0.460	75.25^{a}±0.392
Stride Length (m)	1.98^{ab}± 0.01	2.02^{b}±0.01	1.96^{a}±0.01	1.95^{ab}±0.01	2.07^{b}± 0.01	1.93^{a}±0.01
Duration of stride/sec	1.66^{b}±0.01	1.47^{a}±0.01	1.48^{a}±0.01	1.67^{b}±0.01	1.49^{a}±0.01	1.49^{a}±0.01
Number of stride/sec	0.60^{a}± 0.01	0.66^{b}±0.01	0.66^{b}±0.01	0.59^{a}± 0.01	0.63^{b}±0.00	0.65^{b}± 0.00

Means with dissimilar superscripts (a, b and c) in a row differ significantly ($p < 0.05$) in respective work rest cycles

Table 2: Effect of load and work rest cycle on draftability parameter

Parameter	WR1			WR2		
	L1	L2	L3	L1	L2	L3
Kgf	100.10^{a}±0.49	124.40^{b}±0.57	152.10^{c}±0.51	100.00^{a}±0.42	124.70^{b}±0.60	152.00^{c}±0.51
Hp	0.52^{a}±0.01	0.60^{b}±0.01	0.67^{c} ±0.02	0.50^{a}±0.01	0.58^{b}±0.01	0.71^{c}±0.02
Power output (W)	1380.0^{a}±33.16	1585.4^{b}±32.34	1770.7^{c}±46.20	1318.3^{a}±27.63	1531.0^{b}±25.79	1863.9^{c}±51.86
Speed (m/sec)	1.40^{c}±0.01	1.29^{b}±0.01	1.18^{a}±0.01	1.34^{b}±0.01	1.25^{a}±0.01	1.25^{a}±0.01
Stride (no/100m)	47.82^{a}±0.22	50.29^{b}±0.21	52.53^{c}± 0.24	49.27^{a}±0.21	51.06^{b}±0.18	52.42^{c}±0.38
Time (sec/100m)	72.53^{a}±0.58	77.72^{b}±0.50	83.10^{c}±0.55	75.55^{a}±0.50	77.41^{a}±0.47	83.50^{b}±0.57
Stride Length (m)	2.08^{c}±0.01	1.99^{b}±0.01	1.89^{a}±0.01	2.03^{b}±0.01	1.95^{a}±0.01	1.91^{a}±0.01
Duration of stride/sec	1.50^{a}±0.01	1.53^{ab}±0.01	1.57^{b}±0.01	1.52^{a}±0.01	1.55^{ab}±0.01	1.58^{b}±0.01
Number of stride/sec	0.66±0.01	0.64±0.03	0.63±0.04	0.64±0.00	0.61±0.00	0.62±0.00

Means with dissimilar superscripts (a, b and c) in a row differ significantly ($p < 0.05$) in respective work rest cycles

Speed

The effect of payloads on speed of Kutchi camel was significant ($p < 0.05$) in both the work rest cycles. During S_2 and S_3, the speed of camel under L_3 declined significantly ($p < 0.05$) progressively as work progresses. The present value of speed are in the accordance with the values reported by the Rai *et al.* (1992) where as Rai and Khanna (1994) observed more speed (1.53 ± 0.04 m/sec) in Bikaneri camel than the values reported in the present experiment. The speed of camel reduced to the tune of 7.85 and 6.72 % and 15.71 and 6.72 % when camels worked under L_2 and L_3, respectively as compared to camels worked under L_1 in WR_1 and WR_2, respectively indicated that the camels worked comfortably with higher speed under L_1 in WR_1 where as camel worked with the same speed under L_2 and L_3 pay loads in WR_2. The percentage decline in the speed was in accordance with the values reported by Paniraja and Panchasra (2009) who reported that Jaisalmeri camel was speedy than Kutchi camel in trot and gallop gaits.

Interaction effect on speed

The interaction effect of work rest cycles and payloads affected the speed (m/sec) produced during the experiment (Table 3) indicated Kutchi camel can walk with same speed under L_1 and L_2 but it declined significantly ($p < 0.05$) under L_3 in WR_1. The speed of camel remained at par under all three loads in WR_2. When both the work rest cycles compared in different loads respectively indicated that the speed of camel remained at par under L_1 and L_2 but under L_3 the speed of camel declined in WR_1 significantly ($p < 0.05$) as compared to WR_2.

Time (sec) and stride no. per 100 m distance

The camels required significantly ($P < 0.05$) less time (sec) to cover 100m distance during S_2 (73.24±0.499) and S_3 (75.91±0.470) as compared to S_1 (85.20±0.62). The camels took significantly ($p < 0.05$) lesser time when put to work under L_1 (12.71%) and L_2 (6.47%) payload as compared to L_3 payload under WR_1. However, in WR_2 the camels took same time either under L_1 or L_2 payload which was significantly lesser ($p < 0.05$) than under L_3 payload. The stride numbers required by Kutchi camels to cover 100 meter distance was significantly less ($P < 0.05$) during S_2 compared to S_3 but it did not differed from S_1 in WR_1 and WR_2. The effect of pay loads on number of stride was significant ($P < 0.05$) in both the work rest cycles. The camel required 5.16 and 3.5% and 9.84 and 6.39 %.more strides /100 meter under L_2 and L_3, respectively as compared to L_1 in WR_1 and WR_2, respectively. Wilson (1989) reported that camel increased the speed mainly by increasing the speed of limb movement and not by lengthening its stride.

Stride length (m)

The stride length (m) of Kutchi camels were significantly ($p < 0.05$) less during S_1 and S_3 compared to S_2 in both the work rest cycles. Similarly, camel walked with significantly ($p < 0.05$) lesser stride length (m) when they worked under L_3 (1.90) as compared to L_2 (1.97) and L_1 (2.06). The stride length of Kutchi camel reduced by 5.29 and 10.05% when worked under L_2 and L_3, respectively in WR_1 where as the camels walked with similar stride length under L_2 and L_3 but walked with significantly ($p < 0.05$) more strides length under L_1 in WR_2. The average length of stride was more in Bikaneri camel (2.25m) as compared to Kutchi camel (2.12m) reported by Rai and Khanna (1992).

Duration of stride per sec

The duration of stride during S_2 and S_3 was at par but significantly lower ($p < 0.05$) than S_1 in both the work rest cycles. The duration of stride was significantly ($p < 0.05$) lower under L_1 as compared to L_3 in both the work rest cycles. The duration of stride was higher in Bikaneri camel (1.58) followed by Jaisalmeri (1.55) and Kutchi camel (1.46) as reported by Rai and Khanna (1992) are in accordance with the present findings. This indicated that the duration of stride was less in Kutchi camel as compared to Jaisalmeri and Bikaneri because Kutchi camel used is light in weight than Bikaneri and Jaisalmeri.

Table 3: Interaction effects of W x L on speed of Kutchi camel.

	L_1	L_2	L_3
W_1	$1.40^a \pm 0.01$	$1.29^a \pm 0.01$	$1.18^b \pm 0.01$
W_2	$1.34^a \pm 0.01$	$1.25^a \pm 0.01$	$1.25^a \pm 0.01$

Means with dissimilar superscripts (a, b and c) in a column differ significantly ($p<0.05$)

No. of stride per sec

The number of stride/sec during S_2 and S_3 was at par but significantly higher ($p < 0.05$) than S_1 season in both the Work Rest cycles which is in accordance with the findings of Rai and Khanna (1992). He also reported that number of strides/sec during trot and gallop for Jaisalmeri, Kutchi and Bikaneri camels were in descending order. However, during walk Kutchi camel (0.68) had higher stride/sec than Jaisalmeri (0.65) and Bikaneri camel (0.64).

CONCLUSION

The Kutchi camel generated significantly ($p<0.05$) more power and Hp but speed of work and stride length declined significantly ($p<0.05$) as pay loads increased from L_1 to L_3. Similarly it can also be concluded that the Kutchi camels can work more comfortably under WR_1 as compared to WR_2.

REFERENCES

Chaudhary, J. L., Tiwari, G. S. and Gupta, L. 2008. Effect of feeding different levels of dietary energy on nutrient utilization, draught performance and physiological reactions of Camels. *J. Camel Prac. Res.,* **15(2):** 195-200.

Dhangar, M.R. 1993. Investigation on draft performance and certain related aspects in Kankrej and crossbred bullocks. Ph.D. Thesis submitted to Gujarat Agricultural University, Gujarat, India.

ICAR. 1985. Nutrient requirements of Livestock and Poultry. 1st Ed. Indian Council of Agricultural Research, New Delhi., Pp-8.

Khanna, N.D. and Rai, A.K. 1989. A description of work performance of camel. *Indian J. Anim. Sci.,* **59:** 1172-77.

Khanna, N.D. and Rai, A.K. 2000. Investigation on work potential of Indian camel. Camel News Letter No. 17. Sept., pp. 15-22.

Paniraja, K.L. and Panchasra, H.H. 2009. Indian draught animals power. *Vet. World*., **2(10):** 404-407.

Rai, A.K. and Khanna, N.D. 1994. Draught performance of Indian camels of Bikaneri breeds. *Indian J. Anim. Sci.,* **64(10):** 1092-1096.

Rai, A.K., Roy, A.K. and Khanna, N.D. 1992. Speed and stride of different breeds of Camel. *J. Anim. Sci.,* **62(1):** 91-92.

Shrimali, H. 1995. Performance evaluation of two wheeled camel carts of Rajasthan. In: Compendium of Seminar on Status and utilization of draught animal power held at College of Technology & Agricultural Engineering, Udaipur, pp. 98-113.

Singh, G. 1996. Agricultural machinery for sustainable economy. R. N. Tagore Memorial Lecture, Xth National Convention of Agricultural Engineers, the Institution of Engineers (India), held at Central Institute of Agricultural Engineering, Bhopal, February, 10-11.

Singh, G. 1999. Empowering farmers through animal traction in India. In: Proceedings of an ATNESA workshop held in South Africa during September 22-24, 1999, pp. 315-322.

Snedecor, G. W. and Cochran, W. G. 1980. Statistical methods. 7th Ed. The Iowa state University Press, Ames, Iowa, USA.

SPSS. 2001. SPSS® User's Guide: Release 11.00 Ed. SPSS Inc., USA.

Tiwari, G.S., Verma, R.N., Laddha, V., Bhatt, Y.C. and Shrimali, H. 2003. Effect of tillage implements on physiological responses of Camel. *Ann. Arid Zone.,* **42(2):** 185-189.

Wilson, R.T. 1989. Eco-physiology of the camelidae and desert ruminants. Springer-Verlag, Berlin, Heidelberg, New York, London, Paris, Tokyo, Hongkong, pp. 6.