



Effect of feeding management practices on water intake in Tharparkar and Rath cattle of Indian hot arid zone

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Water is becoming a scarce natural resource in the world and competition for drinking water has increased in many locations across the world (Parker and Brown 2003). The possible shortage of water also affects livestock productivity by affecting metabolic processes (Looper and Waldner 2007) and through dry matter production. The livestock sector uses more than 8% of the global water used, with the major portion going to irrigate feed crops for livestock (7% of the global usage) (Schlink *et al.* 2010). For cattle, peak demands are likely to occur during the summer months, but drinking water intake by animals reared outdoors is affected by the dry matter content of their food supply as well as by weather conditions and, in the case of dairy cows, by milk yields.

Overall, water used for product processing, drinking and servicing livestock is insignificant at global levels (less than 1% of global water), but it may be important in dry areas, in terms of the proportion of water used (Steinfeld *et al.* 2006). Therefore all procedures involving water use in animal production must be reviewed in order to increase its capture and use with positive effects for the productive systems (Araújo *et al.* 2010). Very few studies have been conducted so far to measure nutritional requirements of water intake for indigenous cattle breeds (Mathur *et al.* 2016, 2018). Considering a paucity of information on the daily water intake of Tharparkar and Rath cattle in different season maintained at their respective home tract, i.e. Jodhpur and Bikaner, the present study was undertaken to assess the daily water intake of arid cattle breeds, and the effect of different management, i.e. stall fed and grazing on water requirement of two important native breeds in different seasons under existing climatic conditions at the experimental stations.

The study was conducted in the native tracts of indigenous cattle breeds from 2013 to 2016 during summer, rainy and winter season of the year at Tharparkar research-

cum-demonstration unit, CAZRI, Jodhpur and for Rath cattle at Regional Research Station, CAZRI, Bikaner. Ten lactating cattle and 10 heifers of Tharparkar breed at Jodhpur and 10 lactating cattle and 8 heifers of Rath breed at Bikaner were enrolled for the study. Lactating cattle and heifers were divided into two groups of equal numbers, forming grazing and stall-fed group at both locations. The average body weight of stall fed and grazing Tharparkar cattle were 349.00 ± 3.17 kg and 328.80 ± 1.94 kg and for Rath cattle it was 249.15 ± 0.35 kg and 257.30 ± 1.32 kg, respectively. The corresponding body weight of stall fed and grazing heifers were 224.25 ± 4.64 and 218.25 ± 4.19 kg for Tharparkar and 167.19 ± 0.31 and 170.38 ± 2.04 kg for Rath breed. Metabolic live weight was calculated by multiplying the body weight of animal to the power of 3 and product is square root twice and expressed as $W^{0.75}$.

All the animals were maintained under similar management conditions of loose housing system. Observations were recorded for water intake, dry matter intake and milk yield in the morning and afternoon regularly, twice weekly for six weeks. The daily water intake of animals over the weeks of respective season was averaged to get daily response. Animals were provided dry fodder as roughages *ad lib.* and left over fodder weighed. The roughage source included pearl millet stover, wheat straw and dried *Cenchrus ciliaris* grass. Balanced concentrate was provided to animals as per production stage of lactating and heifers. No green fodder was available to stall fed animals. The data were analyzed by using t-test as per Snedecor and Cochran (1994).

On the basis of the geographical locations of the experimental stations [experiment stations lie at $26^{\circ}15'N$ (Jodhpur) and $28^{\circ}03'N$ (Bikaner) latitude], it can be inferred that the climate was tropical, with hot and dry weather for most of the year. The yearly temperature ranges from a minimum of $4^{\circ}C$ to a maximum of $49.2^{\circ}C$. The average annual rainfall of Jodhpur were 370 mm, and of Bikaner 260 mm.

Average daily water intake (DWI) values of experimental animals during different seasons are given in Table 1. This intake was higher during summer season than in the other

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Table 1. Daily water intake (liters) of experimental animals during different seasons at Jodhpur and Bikaner

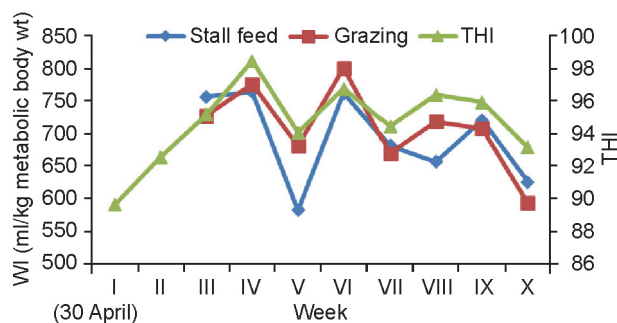
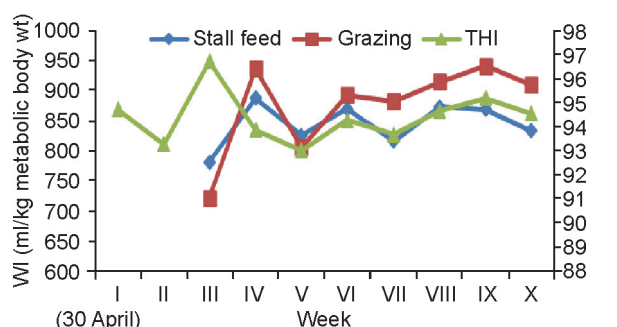
Season	Milching cattle				Heifers			
	Stall fed		Grazing		Stall fed		Grazing	
	Tharparkar	Rathi	Tharparkar	Rathi	Tharparkar	Rathi	Tharparkar	Rathi
Rainy	45.49±3.25	47.73±2.09	52.75±2.28	50.96±1.42	14.48±1.62	17.50±0.34	12.26±0.88	18.35±0.73
Winter	45.88±3.31	41.29±0.71	46.25±1.33	44.93±0.59	18.94±2.73	12.00±0.35	16.69±1.38	13.39±0.49
Summer	58.62±2.59	55.64±1.44	57.56±2.49	56.39±1.99	22.34±1.59	18.52±0.74	19.90±1.78	19.18±0.64

seasons in the animals of both the breeds. This might be due to higher demand of water to maintain physiology of animal during thermal stress conditions. During winter and summer season, Rathi cows had higher DWI/kg $W^{0.75}$ than Tharparkar cows in both stall-fed and grazing systems. However, Sirohi *et al.* (2018) reported average 32.84 L DWI in indigenous cattle in semi-arid zone of the country. Water intake and requirements are influenced by physiological state, breeds, rate of milk yield and dry matter intake and environmental factors (Payne 1966).

It was observed that water intake (ml/kg $W^{0.75}$) was least in experimental animals during winter season than in the other seasons. Water intake in lactating cows and heifers of both the breeds followed the pattern of THI during summer season (Figs 1 and 2). The water requirement of animals increase with increasing temperature and it is also shown that water losses tend to increase under such conditions (Lardy *et al.* 2008). The nutrient needs of these animals probably differ from those prescribed in the feeding standards of temperate countries (NRC 1989, AFRC 1990) because of differences in genetic makeup, mature body size and growth rate, quality of feeds, climatic conditions and differences in efficiency of nutrient utilization.

Table 2 and 3 depict average water and dry matter intake and milk yield of lactating Tharparkar and Rathi cows and heifers, respectively. Rathi cows had higher water intake/kg $W^{0.75}$ than Tharparkar cows, however, Tharparkar heifers had higher water intake/kg $W^{0.75}$ than Rathi heifers. Grazing Rathi cows had significantly higher ($P<0.05$) water intake than stall-fed cows. Dry matter content of the diet is an important factor affecting total water consumption (Dahlborn *et al.* 1998).

With respect to water conversion efficiency, the

Fig. 1. Water intake (ml/kg $W^{0.75}$) of Tharparkar cattle and THI during summer season 2016 at JodhpurFig. 2. Water intake (ml/kg $W^{0.75}$) of Rathi Cattle during summer season 2016 at Bikaner.

corresponding metabolic water intake by Tharparkar cattle (ml/kg $W^{0.75}$) is 709.23 and milk yield (ml/l of water intake) was 125.95, while in Rathi cattle (ml/kg $W^{0.75}$) was 874.56 and milk yield (ml/l of water intake) was 95.36. Rathi cows, whether stall-fed or grazing, had higher water intake (ml/kg $W^{0.75}$) than Tharparkar cows. Murphy *et al.* (1983) found that lactating cows required at least 900 ml water to produce

Table 2. Water and dry matter intake and milk yield of lactating Tharparkar and Rathi cattle during summer

Group	Body weight (kg)	Metabolic body weight (kg $W^{0.75}$)	Dry matter intake (kg/head/day)	Water intake (litre/head/day)	Water intake (ml/kg $W^{0.75}$)	Milk yield (litre/head/day)	Milk yield (ml/l of water intake)
<i>Tharparkar</i>							
Stall fed	349.00±3.17	80.74±0.55	10.49±0.14	56.0±1.96	693.55±19.14	6.29±0.11	112.26
Grazing	328.80±1.94	77.21±0.34	8.18±0.09	54.76±1.75	709.23±17.36	6.90±0.08	125.95
<i>Rathi</i>							
Stall fed	249.15±0.35	62.71±0.07	7.56±0.17	52.89±0.81	843.35±11.60 ^a	5.47±0.05	103.36
Grazing	257.30±1.32	64.24±0.25	5.92±0.16	56.18±1.71	874.56±20.16 ^b	5.36±0.08	95.36

Figures with different superscripts differ significantly ($P<0.05$).

Table 3. Water and dry matter intake of Tharparkar and Rathhi heifers during summer

Group	Body weight (kg)	Metabolic body weight (kgW ^{0.75})	Dry matter intake (kg/head/day)	Water intake (litre/head/day)	Water intake (ml/kgW ^{0.75})
<i>Tharparkar</i>					
Stall fed	224.25±4.64	57.94±0.90	5.45±0.14	27.43±1.79	473.47
Grazing	218.25±4.19	56.78±0.81	3.20±0.05	26.48±1.83	466.46
<i>Rathi</i>					
Stall fed	167.19±0.31	46.49±0.07	3.63±0.08	17.61±0.83	378.74
Grazing	170.38±2.04	47.16±0.42	2.66±0.11	20.28±1.25	430.09

1 litre of milk.

The findings of the study revealed that water intake increases with rise of THI, however, arid cattle breeds' milk production were not adversely affected. Grazing Rathhi cows had significantly higher water intake than stall-fed cows. Tharparkar cows had lesser water intake/kg W^{0.75} and per kg milk yield basis, however, Rathhi heifers had lesser water intake/kg W^{0.75} basis under stall fed and grazing system of management in their native tract.

SUMMARY

The present study was conducted to assess the effects of grazing and stall feeding on water intake in Tharparkar and Rathhi cattle in their native tract of hot arid zone. Lactating cattle (Tharparkar 10; Rathhi 10) and heifers (Tharparkar 10; Rathhi 10) of each breed were divided into two groups, forming grazing and stall-fed group at Jodhpur and Bikaner districts of Rajasthan. Observations were recorded for water intake, dry matter intake and milk yield in the morning and afternoon regularly, twice weekly for six weeks during each season (summer, winter and rainy) continuously for two years. Water intake in lactating cows and heifers of both the breeds followed the pattern of THI during summer season. Rathhi cows had higher water intake/kg W^{0.75} than Tharparkar cows, however, Tharparkar heifers had higher water intake/kg W^{0.75} than Rathhi heifers. Grazing Rathhi cows had significantly higher water intake than stall-fed cows. Study revealed that Tharparkar cows had lesser water intake per kg W^{0.75} and per kg milk yield basis; however, Rathhi heifers had lesser water intake per kg W^{0.75} basis in their native tract.

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