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Effect of drinking water temperature on the haemoglobin, packed cell volume and body weight changes of crossbred dairy cattle at high altitude temperate region

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Mostly, the indigenous animals are adapted to the local climatic variables.The homeotherms can adjust body temperature mostly by regulating metabolic heat production, over a temperature range defined as zone of thermoneutrality, which is around 13–18°C (NRC 1981). However, the zone of comfort for Indian cows is 10–26.7°C (Prasad and Neeraj 2010). *Bos indicus* cattle differently performed from *Bos taurus* and their crossbred to environmental temperature (Scholtz *et al*. 2013). Therefore, the present study was conducted to the utility of different drinking water temperature as an important winter management practice in crossbred cows.

The experiment was carried out on 18 lactating crossbred cows divided into 3 groups of 6 each on the basis of milk yield and parity were allotted to ambient drinking water temperature at 10.25±0.28°C (T_1), 15–20°C (T_2) and 35–40°C (T_3). A measured quantity of water was provided to all the cows were in each groups two times a day just after milking and the left-over was recorded for individual animal. The cows were fed desired quantity of concentrate and roughage as per standard. Macroclimatic data were collected from weather station of Mukteshwar. Microclimatic data at animal level were recorded daily, throughout the experimental periods once in the morning at 08:00 hours and again in the afternoon at 15:00 hours. The temperature humidity index (THI) was calculated by using equation: THI = 0.72 (T_{db} +T_{wb}) + 40.6 (McDowell 1972), where T_{db} and T_{wb} are dry bulb and wet bulb temperature respectively in °C . The blood samples from the individual cows were collected, in early morning before feeding, from the jugular vein into a vial containing heparin once in week. The haemoglobin (Hb) was estimated with the help of Sahli method whereas packed cell volume (PCV) of whole blood estimated directly from the graduation micro hematocrit tube which was filled and centrifuged at 3,000 rpm for 25 min and until there was no further packing of cells expressed in percentage. The body weight was recorded on a digital weighing scale of capacity 1,000 kg having the least count of 100 g. Body weights were recorded at the start of the experiment and at the end of the experiment. Animals were weighed in the morning after milking but before offering water and feed in order to find the beneficial effect (if any) of warm drinking water. The various data collected were analyzed as completely randomized design (CRD) using statistical methods as per Snedecor and Cochran (1994).

The range of maximum temperature, minimum temperature, relative morning humidity (RH) and evening RH recorded was 9.0 to 21.0°C , 0 to 14°C , 73 to 89% and 54 to 91% respectively inside the animal shed. For all these variables, microclimatic changes inside the shed were higher than the outside environment. This was due to expired air of animals and evaporation of moisture inside the shed. However, optimum productivity of cattle occur at an air temperature of 13–18°C and RH of 60–70% (McDowell 1972) and lower critical value of THI was 64 (Igno *et al*. 1992).

The haemoglobin (Hb) values (g per cent) is presented in Table 1. There was no statistically (P>0.05) significant difference among the treatment groups in haemoglobin. The overall mean of the Hb value was 9.79±0.12, 9.51±0.14

Table 1. Effect of drinking water temperature on Hb percentage (mean±SEM)

Week	Ambient (T_1)	15–20°C (T_2)	35–40°C (T_3)
1[NS]	9.50±0.41	10.00±0.47	9.75±0.53
2[NS]	10.00±0.26	9.67±0.31	10.17±0.36
3[NS]	10.08±0.52	9.42±0.42	9.67±0.40
4[NS]	9.50±0.32	9.42±0.15	9.67±0.17
5[NS]	9.75±0.31	8.50±0.34	10.08±0.55
6[NS]	9.50±0.22	9.33±0.17	9.33±0.38
7[NS]	9.67±0.33	9.08±0.61	9.67±0.33
8[NS]	10.33±0.36	10.17±0.33	10.17±0.36
Overall[NS]	9.79±0.12	9.51±0.14	9.81±0.14

NS, Statistically nonsignificant.

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Table 2. Effect of drinking water temperature on packed cell volume percentage (mean±SEM)

Week	Ambient (T_1)	15–20°C (T_2)	35–40°C (T_3)
1[NS]	50.67±2.60	48.83±3.09	48.33±3.02
2[NS]	40.83±1.28	38.33±2.74	40.67±2.68
3[NS]	44.0±2.31	47.50±1.67	45.50±4.47
4[NS]	42.17±2.43	45.67±0.84	45.00±2.28
5[NS]	41.67±1.96	40.83±1.14	39.00±3.37
6[NS]	43.50±2.88	38.33±1.67	41.00±2.24
7[NS]	45.17±2.15	42.00±2.08	43.00±2.42
8[NS]	42.33±0.95	40.17±2.46	41.00±2.77
Overall[NS]	43.79±0.82	42.71±0.88	42.94±1.06

NS, Statistically nonsignificant.

Table 3. Body weight change of the animals under different treatments (kg)

Animal	Ambient T_1		15–20°C T_2		35–40°C T_3	
	Initial weight	Final weight	Initial weight	Final weight	Initial weight	Final weight
1	321.5	326.0	373.0	404.0	328.0	360.5
2	353.0	359.5	281.0	278.0	324.0	339.0
3	257.0	275.0	321.5	315.0	352.0	363.5
4	384.0	404.0	280.0	303.5	415.0	437.0
5	407.0	371.0	290.0	342.0	352.0	346.0
6	314.0	345.0	225.5	243.0	280.0	296.0
Mean[NS]	339.42^a±21.98	346.75^A±17.90	295.17^a±20.05	314.25^A±22.61	341.83^a±18.16	357.00^A±18.82
Body wt. change[NS]	7.33^a±6.91		19.08^a±7.51		15.16^a±2.45	

Means having similar small/capital superscript do not differ significantly. NS, Statistically nonsignificant.

and 9.81±0.14 g %, respectively for the cows in the T_1, T_2 and T_3. The observation indicated that at low ambient temperature (mean daily temperature of 11.64±0.40°C and range of 0 to 14°C), adult crossbred cow maintained normal physiological Hb value and providing warm drinking water did not influence the haemoglobin content. The finding corroborated well with the report of Rowland's *et al.* (1979) and Rajora and Pachauri (1992).

Packed cell volume (PCV) percentage is presented in Table 2. There was no statistically (P>0.05) significant difference among the treatment groups in PCV values. The overall mean of the PCV value was 43.79±0.82, 42.71±0.88 and 42.94±1.06%, respectively for the cows in the T_1, T_2 and T_3. The observation indicated that at low ambient temperature (mean daily temperature of 11.64±0.40°C and range of 0 to 14°C) adult crossbred cow maintained normal physiological PCV value and providing warm drinking water did not influence the PCV content. The finding corroborated well with the report of Rowland's *et al.* (1979) and Rajora and Pachauri (1992).

The body weight of cows under experiment is shown in Table 3. The average initial body weight was 339.42±21.98, 295.17±20.05 and 341.83±18.16 kg for cows under T_1, T_2 and T_3, respectively. The corresponding final weight was 346.75±17.90, 314.25±22.61 and 357.00±18.82 kg, respectively. The lower body weight gain in T_1 group might be due to requirement of relatively more energy to maintain the normal body temperature. These results were consistent with the Demircan *et al.* (2007) who reported that cattle raised in cold season had lower average daily gain (ADG) than those in warm season (P<0.05). Feed efficiency of cattle raised in warm and hot season was better than those raised in winter (P<0.05). Cold stress (below the thermoneutral zone) increased maintenance requirements of livestock (Hidiroglou and Lessard 1970). At ambient temperature below the lower limit of thermoneutral zone sheep convert more energy to heat (Graham *et al.* 1959) and digest their feed less efficiently (NRC 1989). A decrease of 10°C in the mean monthly temperature resulted in decrease of 0.14 kg gain/day, an increase of 0.7 kg feed/gain and an increase of 1.1 Mcal/kg gain (Milligan and Christison 1974).

SUMMARY

The study was conducted to explore the utility of different drinking water temperature during winter season at IVRI, Mukteshwar campus on 18 lactating crossbred diary cattle. The results of the experiment revealed that providing warm drinking water (35–40°C) to crossbred lactating dairy cows during winter season at high altitude temperate Himalayan hills, no statistically significant difference among the treatment groups in haemoglobin and packed cell volume of crossbred cattle adapted to the local climatic variables was observed. However, cows in warm drinking water groups showed relatively more gain in body weight compared to cows provided with ambient cool drinking water.

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