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Research Article

EFFECT OF SEASON ON PHYSIOLOGICAL PARAMETERS AND PRODUCTION PROFILE OF HARIANA AND SAHIWAL CATTLE

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ABSTRACT

The present work was designed to investigate seasonal factors affecting physiological parameters, milk yield and body condition score of Hariana and Sahiwal cows raised under sub-tropical Indian conditions. Physiological variables, milk yield, body condition score and plasma leptin were studied in six lactating cows each of Hariana and Sahiwal breeds for two seasons. Significantly ($p<0.05$) higher dry temperature, wet temperature, maximum temperature, minimum temperature, relative humidity and temperature humidity index were found during summer season, but relative humidity was not extremely high. Respiration rate, pulse rate, rectal temperature, milk yield and leptin also increased during summer season. No significant change in body condition score was observed over two seasons in both the breeds. Physiological parameters exhibited an increase during summer seasons, however, milk production and leptin were affected by ambient temperature and not by relative humidity or temperature humidity index in conditions where humidity does not reach levels that could compromise evaporative cooling.

Key words: Hariana cattle, milk production, physiological parameters, Sahiwal breed, season

Lactation performance in dairy cattle depends upon genetic and environmental factors. Genetic background, climate, breed, age, stage of lactation and parity influence production performance. Milk yield and duration of lactation have marked effects on dairy economy. Moreover, effects of lactation number, age and season on milk yield and lactation length are well known. The yields of farm animals are the result of the combined effects of genotype and environmental conditions. In order to increase the yield level, it is necessary to optimize the environmental conditions and to improve the genetic makeup of the animals. In order to enhance productivity, it is necessary to develop an understanding of the factors affecting milk production environmental factors can be classified as factors with measurable effects (age, year, season, milking frequency, etc.) and factors with immeasurable effects (infectious diseases, parasitic infestations etc.). The measurable effects can be determined and used in the management of the farm.

Environmental factors affecting variability in daily milk yield are widely documented in dairy cattle. Physiological responses like rectal temperature (RT), pulse rate (PR) and respiration rate (RR) reflect the degree of stress imposed on animals by climatic parameters (Ganaie *et al.*, 2013). However, effect of differing environmental temperature and relative humidity on milk production and body condition score has not been documented for Indian breeds. Hence, the present work was designed to investigate seasonal factors affecting physiological parameters, milk yield and body condition score of Hariana and Sahiwal breeds of cattle raised under sub-tropical Indian conditions.

MATERIALS AND METHODS

The experiment was conducted in north western semi-arid zone of India with latitude of 27.49 °N and longitude of 77.67 °E with an elevation of 177 m from mean sea level during the months of November to January (winter season) and May to July (summer season). Six apparently healthy, lactating cows (mid lactation stage) each of breeds, Hariana and Sahiwal, of similar age (range 5 to 6 years), weight (range 340 to 410 kg), parity (2nd or 3rd) maintained at the Instructional Livestock Farm Complex were selected for the study. Environmental parameters were recorded daily over the study period and averaged to obtain data points for the fortnight. Body condition score (BCS) of these animals was estimated every fortnight based on 0 to 5 system (Anitha *et al.*, 2011). Different microclimatic observations

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Table 1
Environmental parameters during two different seasons (Means± SE, n=6)

Season	Dry temp (°C)	Wet temp (°C)	Max temp (°C)	Min temp (°C)	Relative humidity (%)	THI
Summer	38.57^{b}±1.39	25.64^{b}±0.51	38.8^{b}±1.49	30.42^{b}±0.64	56.71^{b}±2.77	86.83^{b}±0.76
Winter	18.16^{a}±2.03	9.50^{a}±1.57	19.08^{a}±2.16	11.17^{a}±1.74	41.50^{a}±3.17	60.52^{a}±2.58

Means with different superscripts in a column differ significantly (p<0.05); THI=Temperature humidity index

viz. maximum and minimum temperature, dry and wet bulb temperature and temperature humidity index (THI) were recorded in the morning (0800 hrs) on daily basis during the experimental period. Maximum and minimum temperature was measured by using maximum minimum thermometer. Relative humidity (%) was calculated from the dry bulb and wet bulb readings (°C) on daily basis using the psychometric tables. THI values were calculated as per National Research Council (1971).

Physiological variables like PR, RR and RT of individual animals were recorded daily at 0800 hrs as per the standard protocol. The records of milk yield were collected from farm records while; blood samples were collected for each season from each animal in heparinized vials for harvesting plasma every fortnight during the study period. Plasma was harvested and preserved at -4°C and leptin was analyzed by ELISA Kit supplied by Cusabio Biotech Co. Ltd., Hubei, China. Data collected every fortnight was used for calculating Mean±SE over the season. Statistical analysis (Analysis of Variance, one way) of the data was done using Statistical Package for Social Science (SPSS® Version 20.0 for Windows®, SPSS Inc., Chicago, USA).

RESULTS AND DISCUSSION

Mean±SE of the environmental parameters recorded are presented in Table 1 and physiological parameters in Table 2. Environmental parameters exhibited wide variability during the two seasons while physiological responses exhibited significant (p<0.05) increase during summer season as compared to winter season. However, no significant difference could be observed between the breeds. The ability of an animal to withstand the rigors of climatic stress under warm conditions had been assessed physiologically by the means of changes in body temperature, respiration rate and pulse rate (Sethi *et al.* 1994). The animals panted in order to increase body cooling by respiratory evaporation. Increase in RR is the first reaction when the animals are exposed to environmental temperature above the thermoneutral zone (Maurya *et al.*, 2007). The changes in the RR are an adaptive response of the animal to maintain homoeothermic balance. In domestic animals, RR increases due to the activation of thermo-receptors in the skin when they are exposed to higher ambient temperature. Such activation of the receptors, in turn, sends neural signals to the hypothalamus that increases respiratory activity to accelerate heat loss from the body by respiratory evaporation (Haidary and Ahmed, 2004). The increase in PR causes an increase in the blood flow to the surface and thereby facilitates heat loss (Marai *et al.*, 2007). The RR, PR and RT observed in the present study are in accordance with the previous worker (Bhan *et al.*, 2012).

The best physiological parameter to objectively monitor animal welfare in hot environment is the RT (Silanikove, 2000; Keim *et al.*, 2002). Therefore, significantly higher physiological parameters observed in the present experiment during the summer season might be due to the high ambient temperature and the relative humidity which in turn increased THI and exceeded comfort zone of the animals, resulting in the imbalance in the heat energy produced and dissipated. In order to adjust the environmental temperature, all the physiological parameters might have been increased.

Milk yield increased significantly (p<0.05) during summer season while body condition score did not exhibit any significant change in either of the breeds (Table 3). No significant differences were observed between the two breeds in milk yield within season. Generally, high ambient temperatures depressively affect milk production (Shibata, 1983). Araki *et al.* (1984) reported that lactating cows were more sensitive to the effect of heat than were non-lactating cows, consistent with the greater metabolic heat production. The process associated with maintenance,

Table 2
Physiological parameters in two breeds of cattle during two different seasons (Means±SE, n=6)

Season	Rectal temperature (per minute)		Respiration rate (per minute)		Pulse rate (per minute)	
	Hariana	Sahiwal	Hariana	Sahiwal	Hariana	Sahiwal
Summer	102.19^{b}±0.03	102.28^{b}±0.04	28.71^{b}±0.68	27.50^{b}±1.00	69.04^{aa}±0.44	66.88^{ab}±0.88
Winter	100.17^{a}±0.03	100.27^{a}±0.04	18.00^{a}±0.73	20.52^{a}±1.05	62.22^{a}±0.48	60.86^{a}±1.20

Means with different subscripts in a row differ significantly within parameter (p<0.05)

Table 3

Production parameters and leptin profile in two breeds of cattle during two different seasons (Means± SE, n=6)

Season	Milk yield (L/day)		Body condition score		Leptin (ng/ml)	
	Hariana	Sahiwal	Hariana	Sahiwal	Hariana	Sahiwal
Summer	6.08^{b}±0.30	6.66^{b}±0.13	3.24±0.14	3.22±0.13	6.73^{b}±0.18	6.89^{b}±0.30
Winter	3.80^{a}±0.18	4.52^{a}±0.10	3.21±0.16	3.17±0.14	4.39^{aa}±0.17	5.06^{ab}±0.18

$p<0.05$, means with different superscripts in a column or row differ significantly ($p<0.05$)

digestion, activity, metabolism and production create a large amount of heat. High milk yield requires the intake of large quantities of nutrients and hence greater heat production. It has been well documented that temperature-humidity indices differ in their ability to detect heat stress. Indices with larger weights on humidity seem to be more suitable for humid climates. In climates where humidity does not reach levels that could compromise evaporative cooling, indices with the most emphasis on ambient temperature are preferable (Bohmanova *et al.*, 2007). In the present study, relative humidity remained moderate, at 56.71 % during summer season, even though THI has increased to 86.83, signifying that increase in THI is not affecting the milk yield during summers. Whereas, milk yield has reduced during winter season exhibiting that, reduction in ambient relative humidity and THI is not the critical factors affecting milk production but reduction in minimum temperature during winters is acting as the critical factor affecting milk productivity. This reduction in minimum temperature has led to partitioning of energy reserves towards temperature maintenance of the body diverting it away from requirements of milk production.

Leptin concentration increased significantly ($p<0.05$) during summer as compared to winter in both the breeds. Hariana cattle exhibited a significantly ($p<0.05$) lower leptin concentration than Sahiwal cattle during winter. Leptin is the key regulator of feed intake and energy homeostasis (Zhang *et al.*, 1994). Ronchi *et al.* (1999) reported that due to direct effect of heat stress, energy and lipid metabolism and liver enzymatic activities are enhanced in periparturient dairy cows which may be the reason for reduction in leptin concentration in winter season in this study. Our results are in concurrence with Bernabucci *et al.* (2006).

Conclusively, milk production and leptin are affected by ambient temperature and not relative humidity by or temperature humidity index in conditions where humidity does not reach levels that could compromise evaporative cooling.

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