The Indian Journal of Animal Reproduction; 27 (2): 65-68; Dec. 2006

Research Article

Reproduction behaviour and stress hormones level in Holstein-Friesian (HF) crossbred cows under various thermolytic measures*

UDAY NARAYAN[1], D.V. SINGH[2], A.H. AHMAD[3] AND M. PATEL[4]

Department of Livestock Production and Management, College of Veterinary and Animal Sciences, G.B. Pant University of Agric. & Technology, Pantnagar - 263 145 (Uttarakhand)

Received : July 26, 2005
Accepted : January 3, 2006

ABSTRACT

The study, carried out during April – August, 2004, was aimed to find out the effect of summer stress ameliorating measures on reproductive traits and stress hormone levels of HF crossbred cows. Water showering of cows during peak hot hours improved their service period ($P< 0.05$). Other traits, like intensity of estrus signs, number of estrus expressed during service period, number of AI per conception, days to attain first post-parturient estrus and length of estrus cycle were found improved numerically but statistically non-significant. The stress hormones, like epinephrine and nor-epinephrine were significantly ($P< 0.01$) lowered as compared to non-showered cows. The study showed that the region experiences marked stressful conditions and these can be ameliorated by adopting suitable management measures.

Key words: HF crossbred, reproduction behaviour, stress hormones, thermolytic measures

Indian tropics inhabit variety of livestock species. Among these crossbred cattle are 9.8% of total cattle (226.1 million) population (Narang, 2004). Livestock, depending on the species and production level, have an optimal comfort zone and they must be maintained within this for optimal growth, production and reproductive functions. However, extreme weather conditions can dramatically press up on nutritional requirements, feed intake and weight gain. The negative effect of heat stress on dairy cows performance is well known. High temperature and humidity can result in behavioral and physical changes in cattle and affect behaviour and reproductive performance. The impact on such performances depends upon the severity (magnitude and duration) of heat stress.

MATERIALS AND METHODS

The study was undertaken at Instructional Dairy Farm, G.B. Pant University of Agric. & Technology, Pantnagar from April to August 2004. This place is located between 28° 53' 24" to 30° 27' 50" N and 77° 34' 27" to 81° 02' 22" E at 243.84 m MSL in Tarai region of Uttarakhand state. Thirty four normally calved, lactating Holstein Friesian (HF) x Sahiwal cows of first to fourth parity, 64.21 ± 0.03 % exotic inheritance, 6.35 ± 0.14 years age and 273.8 ± 0.7 kg body weights were available for study. These cows were divided in four groups of 8-9 each and were housed loose under partly covered asbestos sheeting of 5.25 ± 1.0 m height on cement concrete floor. Animals were offered chaffed green and dry fodders at 8.00 am and 4.00 pm; concentrate feed @ 2.5 kg/ cow at 8.00 am and during milking (@ 3.0 kg/ cow at 3.00 am and at 2.30 pm) and *ad lib* clean drinking water through common water troughs. Animals were washed daily at 9-10 am. Sheds were cleaned and washed with hose water twice daily.

Group I cows were provided with water showers during peak hot hours (10.00 – 16.00 hrs) of the day. II group cows were fed sodium bicarbonate salt (Win-field® Baking Powder from WINCO, INDIA)

*Part of M.V.Sc. thesis of first author, [2]Assoc. Prof. (LPM), [3]Prof. & Head (Pharmacology), & [4]SMS (LPM).

@ 1.2 % of the concentrate feed, mixed with it at the time of evening milking daily. While III group cows were assigned both treatments same as group I and II; and the group IV cows acted as control.

Temperature humidity index (THI) was calculated as per Esmay and Dixon (1986). Estrus was detected daily by using teaser bull. Cows in heat were bred by Artificial insemination using frozen semen. Recorded reproduction parameters included service period (SP) in days, intensity of estrus symptoms (in 1-5 grades, in order of increasing intensity), number of estrus during SP (no.), days to attain first post-parturient estrus (days), number of AI/ conception (no.) and length of estrus cycle (days).

Blood samples were collected at fortnightly intervals from left jugular vein, serum separated and stored at -20°C. It was used to estimate stress hormones, like epinephrine (µg/ ml) and nor epinephrine (µg/ ml) by their respective standard curve drawn from various known concentration of pure chemicals through High Performance Liquid Chromatography (Semerdjian-Roiquier, *et al.*, 1981) method.

RESULTS AND DISCUSSION

Climatic parameters

Average values for minimum and maximum ambient temperature and RH during the study period were 23.2 ± 2.8°C and 34.2 ± 2.8°C, 58.5 ± 13.4 % and 78.9 ± 11.1 %, respectively. The averages for wind speed and sun shine hours were 5.7 ± 1.6 km/ hr and 7.4 ± 2.1 hrs. Where as, THI ranged from 78.1 ± 2.9 to 86.1 ± 3.1. These observations indicated stressful climatic conditions for crossbred cattle (Ravagnolo *et al.*, 2000). Environmental temperatures greater than 30°C may alter hormone secretion pattern which may be affect conception rates.

Reproduction traits

Service period (SP) of the cows of water showered group I and III (94.38 ± 13.68 and 94.22 ± 12.90 days) was significantly ($P< 0.05$) lower as compared to the non water showered cows of group II and IV (134.44 ± 12.90 and 148.13 ± 13.68 days). Present results indicated that water showering during summer months was beneficial in improving service period in HF crossbred cows. The favorable effects of water showering on SP were also noticed in HF cows (Pongpiachan *et al.*, 2000). Other workers have observed significant (Akhtar *et al.*, 2003) as well as non significant (Kothekar, 2004) effect of season of calving on service period in HF crossbred cows. Sodium bicarbonate feeding did not show any significant effect on SP, contrary to the findings of Shpil'man and Obukhov (1986) in high yielding dairy cows.

Intensity grades of estrus for I to IV group cows were 3.38 ± 0.28, 2.56 ± 0.26, 3.17 ± 0.26 and 2.59 ± 0.28, respectively. Although, it varied non-significantly among the different treatment groups, but numerically it was improved (30.5% and 22.4 %) in water showered cows of I and III groups than control. Summer stress affects reproductive performance in HF heifers and lactating dairy cows as a consequence to reduced intensity and duration of behavioral estrus (Shukla, 2004).

The number of estrus expressed during SP by the cows of group I to IV were 5.63 ± 0.83, 5.00 ± 0.78, 6.56 ± 0.78 and 4.75 ± 0.83, respectively. The water showered cows of I and III group had more (18.5% and 38.1%) number of estrus than group II and control cows. Water showering had shown improving effect, though non-significant, on this traits.

Days to attain first post-parturient estrus among these four groups were 26.63 ± 3.65, 26.22 ± 3.44, 24.77 ± 3.44 and 24.88 ± 3.65 days, respectively. In Tarai region during hot-humid months the post-partum estrus intervals were significantly ($P< 0.01$) high (71.80 ± 6.53 days) in crossbred cows (Gupta *et al.*, 2004). The effect of water showering and sodium bicarbonate feeding on this trait was non-significant. Pongpiachan *et al.* (2000) observed effect of water showering on days to attain first post parturient estrus during summer in lactating HF cows and in HF crosses as non significant and favorable, respectively.

Number of AI per conception were 1.88 ± 0.59, 4.00 ± 0.56, 2.89 ± 0.56 and 3.25 ± 0.59, respectively. Water showered cows required numerically lesser number of AI (72.9%) than that of the control cows.

Table 1: Least-squares means and SE of reproduction traits and stress hormones level in HF crossbred cows.

Group	SP (day)	Intensity of estrus (1-5)	No. of estrus during SP	Days to attain first post parturient estrus	No. of AI/ conception	Length of estrus cycle (day)	Epinephrine Concentration (µg/ ml)	Nor-epinephrine concentration (µg/ ml)
I	94.38 [a]	3.38	5.63	26.63	1.88	23.36	0.170 [A]	0.990 [A]
	± 13.68	± 0.28	± 0.83	± 3.65	± 0.59	± 3.91	± 0.012	± 0.045
II	134.44 [b]	2.56	5	26.22	4	25.14	0.276 [B]	1.365 [B]
	± 12.90	± 0.26	± 0.78	± 3.44	± 0.56	± 3.69	± 0.011	± 0.043
III	94.22 [a]	3.17	6.56	24.77	2.89	23.23	0.906 [A]	0.906 [A]
	± 12.90	± 0.26	± 0.78	± 3.44	± 0.56	± 3.69	± 0.043	± 0.043
IV	148.13 [b]	2.59	4.75	24.88	3.25	26.2	0.287 [B]	1.357 [B]
	± 13.68	± 0.28	± 0.83	± 3.65	± 0.59	± 3.91	± 0.012	± 0.045

Least-squares means followed by same or no superscripts do not differ significantly (P< 0.05; P< 0.01).

The statistically measurable difference could not be observed in this trait probably due to the less number of observations in the study. Her *et al.* (1988) observed improved fertility by water spraying during the first 10 days after insemination in HF cows during summer. THI were significantly correlated with the number of services per conception in HF cows (Ray *et al.*, 1992).

Length of estrus cycle of water showered cows of group I (23.36 ± 3.91days) and III (23.23 ± 3.69 days) was lesser (12.2 and 12.8 %) than that of the group II and control (26.20 ± 3.91 days) ones. Water showering showed a trend in bringing down length of estrus cycle towards normal range. Feeding of sodium bicarbonate did not affect the trait. Trout *et al.* (1998) found lengthening of estrus cycles by more than 24 days in 33.3 % lactating HF cows, kept at 20.8 to 25.6°C.

Stress hormones

The level of circulating epinephrine and nor-epinephrine hormones get elevated in stressful conditions. Nor-epinephrine is more stable in physiological solutions as compared to epinephrine (Crooks *et al.*, 1978).

Level of epinephrine and nor epinephrine was significantly (P< 0.01) lower in water showered cows (0.170 ± 0.012 µg/ ml vs 0.287 ± 0.012 µg/ ml and 0.990 ± 0.045 µg/ ml vs 1.357 ± 0.045 µg/ ml) as compared to group II and control cows. The findings indicated respite from heat stress trough water showering. Alvarez and Johnson (1973) observed elevated level of epinephrine nor-epinephrine during acute and chronic heat stress in cattle by maintaining them for 24 days at 35°C. Sodium bicarbonate fed group was indifferent with the control cows.

ACKNOWLEDGEMENT

Authors are thankful to the Joint/ Assistant Director, IDF, Nagla, Dean, C.V.A.Sc. and Director Experiment Station, Pantnagar for their help in carrying out the study.

REFERENCES

Akhtar, F., Ray, R.C. and Das, B. (2003). Studies on some production and reproductive traits in Holstein-Friesian cattle. Indian Vet. J., **80**: 453-454.

Alvarez, M.B. and Johnson, H.D. (1973). Environmental heat exposure on cattle plasma chatecholamine and glucocorticoids. J. Dairy Sci., **56**: 189-193.

Crooks, P.A., Xandra, O.B. and Coward, J.K. (1978). Catecholamine metabolism and drug effects in cultured mammalian cells: Analysis by HPLC. Fourth International Catecholamine Symposium, 210-211.

Esmay and Dixon (1986). R.E. McDowell (ED.), Improvement of livestock production in warm climate. W.H. Freeman and company, Sanfrancisco pp 51.

Gupta, H.P., Singh, B., Mishra, A.K. and Shukla, M.K. (2004). Effect of season of calving, sex of new born and parity of dam on post partum estrus interval in crossbred cows maintained in Tarai region of Uttarakhand. Proceedings of National symposium on "Advanced re-

productive technologies for management of fertility in livestock." Dec 14 - 16, 2004, Anjora, Durg pp 58.

Her, E., Wolfenson, D., Flamenbaum, I., Folman, Y., Kaim, M. and Berman, A. (1988). Thermal, productive and reproductive responses of high yielding cows exposed to short- term cooling in summer. J. Dairy Sci., **71**: 1085-1092.

Kothekar, M.D. (2004). Effect of environmental factors on performance of Holstein Friesian cattle. Indian Vet. J., **81**: 283-285.

Narang, I.K. (2004). Important schemes of the Department of Animal Husbandry and Dairying aimed at milk production enhancement and development of dairy industry. Souvenir, XXXIII Dairy Industry Conference, September 26 - 28, 2004, New Delhi: 15-23.

Pongpiachan, P., Rodtian, P. and Ota, K. (2000). Reproduction in cross and pure bred dairy cows and effects of tropical climate on them. Asian-Aus. J. Anim. Sci., **13**: 549.

Ravagnolo, O., Misztal, I. and Hoogenboom, G. (2000). Genetic component of heat stress cattle development of heat index function. J. Dairy Sci., **83**: 2120-2125.

Ray, D.E., Halbach, T.J. and Armstrong, D.V. (1992). Season and lactation number effects on milk production and reproduction of dairy cattle in Arizona. J. Dairy Sci., **75**: 2976-2983.

Semerdjian-Roiquier, Bossi, L. and Scatton, B. (1981). Determination of 5-HT, Serotonin and Hydroxy-indoleac acid in rat and human brain and biological fluids by reversed phase High Performance Liquid Chromatography with electrochemical detection. J. Chromatography, **218**: 663-670.

Shpil'man, I.D. and Obukhov, L.M. (1986). Control of rational feeding of high yielding cows and of utilization of supplements. Shovershenstvoranie tekhnologii kormleniya sel'skokhozyaist-vennykh zhivotnykh, 15-18 (CAB Abstract 1987-1989).

Shukla, S.P. (2004). Early embryonic mortality in bovines. Proceedings of National symposium on "Advanced reproductive technologies for management of fertility in livestock." Dec 14-16, 2004, Anjora, Durg pp 23-35.

Trout, Jennifer P., McDowell, Lee R. and Hansen, Peter J. (1998). Characteristics of the estrous cycle and antioxidant status of lactating Holstein cows exposed to heat stress. J. Dairy Sci., **81**: 1244-1247.