RESEARCH ARTICLE

Effect of Stress on Ovarian Follicular Activity in Postpartum Sahiwal Cows during Hot-Humid Season

Shobhit Ram[1], Manoj Kumar Awasthi[2]*, Javed R. Khan[3], Parveen Kaiser[4], Nishma Singh[5]

Abstract

Present investigation was carried out to study the effect of stress on ovarian follicular activity in postpartum acyclic Sahiwal cows during hot-humid months. Postpartum ovarian activity was monitored using trans-rectal ultrasound scanning on alternate days beginning between day 60 and 90 postpartum in Sahiwal cows (n=16) up to next 21 days. Daily maximum temperature and relative humidity was recorded and temperature-humidity index (THI) was calculated during study period. Six animals (37.5 %) showed presence of dominant follicle (≥10 mm, cyclic) and 10 animals (62.5 %) were classified as acyclic (ovarian follicle < 10 mm diameter). Present study demonstrated that as the value of THI reduced, the mean follicular diameter proportionately increased and vice versa. Based on the findings of present study, it may be concluded that development of ovarian follicle is highly affected by THI value during hot-humid season in Sahiwal cows and the reproductive performance of animal may be predicted using THI values.

Key words: Hot-humid season, Ovarian activity, Sahiwal cows, Stress, THI .

Ind J Vet Sci and Biotech (2023): 10.48165/ijvsbt.19.2.13

Introduction

Heat stress is the most traumatic abiotic stress that causes adverse effects on health, welfare and production of farm animals with huge economic losses to the livestock industry to the extent of about 60% of the dairy farms around the world (Behl *et al.,* 2010). In tropical countries like India, summer is the most stressful season for animals because of higher temperatures beyond 42°C (Kolli *et al.,* 2014). Heat stress is influenced by air temperature, humidity, air movement, solar radiation, and precipitation. Temperature-humidity index (THI) is a single value depicting the integrated effects of air temperature and relative humidity and is commonly used to quantify the degree of heat stress on dairy cattle. Negative relationships between THI and reproductive performances in dairy cows have been documented (Habeeb *et al.,* 2018).

The effect of heat stress on reproductive performance is multi-dimensional through several mechanisms either direct effect on reproductive system or via indirect metabolic and nutritional effects (De Rensis *et al*., 2017).Heat stress damages the developing follicles whenever the core body temperature exceeds 40°C (Roth *et al.,* 2000).Heat stress influences the follicular development by reducing steroid hormone secretion, which disrupts the oocyte growth, reduces the growth of dominant follicles and increases the growth of subordinate follicles compromising oocyte competence, and inhibiting embryonic development. The direct effect of heat stress on the cow with altered endocrine regulation is due to impairment of hypothalamic-pituitary-ovarian axis (Ozawa *et al*., 2005). Heat stress affects reproduction by inhibiting the synthesis of gonadotropin-releasing hormone and luteinizing hormone, which are essential for expression of estrus behaviour and ovulation (Temple *et al*., 2015). Heat stress also increases the production of $PGF_2\alpha$ in the endometrium, leading to the early regression of CL and consequently embryonic death. In the light of above

[1,2]Department of Veterinary Gynaecology and Obstetrics, College of Veterinary Science & Animal Husbandry, Anjora, Dau Shri Vasudev Chandrakar Kamdhenu Vishwavidyalaya, Durg, Chhattisgarh 491001, India

[3]Department of Veterinary Physiology and Biochemistry, College of Veterinary Science & Animal Husbandry, Anjora, Dau Shri Vasudev Chandrakar Kamdhenu Vishwavidyalaya, Durg, Chhattisgarh 491001, India

[4]Department of Animal Genetics & Breeding, College of Veterinary Science & Animal Husbandry, Anjora, Dau Shri Vasudev Chandrakar Kamdhenu Vishwavidyalaya, Durg, Chhattisgarh 491001, India

[5]Department of Livestock Production and Management, College of Veterinary Science & Animal Husbandry, Anjora, Dau Shri Vasudev Chandrakar Kamdhenu Vishwavidyalaya, Durg, Chhattisgarh 491001, India

Corresponding Author: Manoj Kumar Awasthi, College of Veterinary Science & Animal Husbandry, Anjora, Dau Shri Vasudev Chandrakar Kamdhenu Vishwavidyalaya, Durg, Chhattisgarh 491001, India, e-mail: awasthimk1963@rediffmail.com

How to cite this article: Ram, S., Awasthi, M.K., Khan, J.R., Kaisar, P., & Singh, N. (2023). Effect of Stress on Ovarian Follicular Activity in Postpartum Sahiwal Cows during Hot-humid Season. Ind J Vet Sci and Biotech. 19(2), 70-73.

Source of support: Nil

Conflict of interest: None

Submitted: 17/11/2022 **Accepted:** 30/12/2022 **Published:** 10/03/2023

perspective, the present investigation was conducted to study the effect of stress of hot-humid months on ovarian follicular activity in postpartum Sahiwal cows.

Materials and Methods

The present experiment was carried out on acyclic Sahiwal cows maintained at Bull Mother Experimental Farm, College of Veterinary Science and Animal Husbandry, Anjora, Durg (C.G., India) during June, July and August, 2021. Acyclic Sahiwal cows (n=16) between day 60 and 90 postpartum were randomly selected with no any genital abnormality. Ovarian activity was monitored through Ultrasound scanning (Prosound ALOKA) on alternate days beginning from any day between 60 and 90 postpartum up to next 21 days *i.e.* days 0, 2, 4, 6, 8, 10, 12, 14, 16, 18 and 21 using trans-rectal transducer of 5-7.5 MHz frequency to record the presence of dominant and/ or ovulatory follicle (≥ 10 mm in diameter). The number of small follicle (3-5 mm diameter), medium follicle (5-8 mm diameter) and dominant follicle (≥ 10 mm diameter) present on both ovaries were recorded. Based on findings of ultrasound scanning of ovaries, experimental animals were divided into two groups *viz.* cyclic and acyclic. The animals of cyclic group showed presence of dominant and/or ovulatory follicle (≥ 10 mm diameter) on any day of ultrasound scanning whereas; the animals of acyclic group did not reveal presence of dominant and/or ovulatory follicle during entire session of ultrasound scanning.

Meteorological data were obtained from Automatic Weather Station of Indian Meteorology Department installed at Krishi Vigyan Kendra, Anjora, Durg (CG). Information, consisting of daily maximum temperatures and relative humidity was used to calculate the temperature-humidity index (THI) for each day using equation described by Kim *et al.* (2012).

$$THI = (0.8 \times Temperature) + [(\% RH/100) \times (Temperature - 14.4)] + 46.4$$

Where, Temperature is the highest daily temperature in degree Celsius and RH denotes, the maximum relative humidity. The association between follicular diameter and THI values was determined in a linear regression model using SPSS computer Programme.

Results And Discussion

The ultrasound scanning of ovaries in postpartum Sahiwal cows revealed ovarian activity with respect to follicular growth right from the first day of examination any day between day 60 and 90 postpartum". The ovaries were characterized by growth and regression of several small, medium and large follicle until the detection of first postpartum dominant follicle (≥ 10 mm) during the study period.

Among the experimental animals, six animals (37.5 %) showed presence of dominant follicle (≥10 mm) between days 18 and 21 of the ultrasound scanning and these animals were classified as cyclic animals (Group-I, n=6). Among these, 3 cows expressed overt signs of estrus during experimental period. Remaining 10 animals (62.5 %) were classified as acyclic animals (Group-II) having medium to large ovarian follicles (5-9 mm) but did not show presence of dominant follicle. Mean diameter (mm) of the largest ovarian follicles between cyclic vs. acyclic animals were recorded on different days and are presented in Table 1. Highly significant difference ($p< 0.01$) was recorded in mean follicular diameter on days 14 to 18, which further increased on days 18 and 21 of examination between two groups. From the perusal of Table 1, it is evident that animals of cyclic group recorded significantly greater follicular diameter than that of acyclic group with the advancement of postpartum period. The size and number of ovarian follicles including dominant follicle can be successfully detected by ultrasound scanning during postpartum period in dairy cows (Mc Dougall *et al*., 1995).

Table 1: Mean follicular diameter (mm) in animals of cyclic and acyclic group of 60-90 days postpartum Sahiwal cows

Days of ultrasound examination	Mean follicular diameter (mm)		P value
	Cyclic (n=6)	Acyclic (n=10)	
0	3.9±0.48	3.4±0.38	0.11
2	3.9±0.49	4.1±0.44	0.47
4	4.6±0.48	4.7±0.45	0.40
6	5.6±0.53	5.1±0.69	0.25
8	5.8±0.45	5.3±0.48	0.07
10	6.2±0.42	5.6±0.53	0.21
12	7.1±0.32	5.8±0.45	0.01**
14	7.6±0.33	6.1±0.47	0.006**
16	8.3±0.25	6.4±0.37	0.001**
18	9.3±0.20	6.6±0.37	4.6E-06*
21	10.4±0.21	7.7±0.28	2.1E-06*

** P<0.01, E* = P<0.000001

The regression analysis for association between THI values and mean ovarian follicular diameter revealed that the effect of THI was significant on ovarian activity of postpartum Sahiwal cows during months of June, July and August. The mean follicular diameter was found to be the highest (10.4) mm in the month of August and the lowest (3.4 mm) during the month of July. The mean follicular size was continued to be larger on days with lower THI values and vice-versa.

The regression analysis between mean ovarian follicular diameter and THI values on different days of June (0.720), July (0.544) and August (0.009, P<0.01) revealed that there was inversely proportional relationship between these two traits. The mean follicular diameter was smaller when higher THI values were recorded. However, as the value of THI reduced the mean follicular diameter proportionately increased so much so that highly significant difference was recorded in the month of August than that of June and July with reduced THI value.

In the present study, interestingly all 6 cyclic animals were detected in the month of August with lower THI values, while acyclic animals were detected during the month of June and July with comparatively higher THI values. These findings indicate that cyclicity is influenced by heat stress in Sahiwal cows. Similar observation has been reported by Diaz *et al*. (2020) who concluded that the high level of THI have a negative effect on the resumption of ovarian activity and expression of reproductive behavior in *Bos indicus* cows. The present findings demonstrated that there was significant difference in the follicular diameter with changes in THI value. The overall association regression results of the dependency of follicular diameter with THI was found recognizable when it was observed that changes in 1 unit of THI resulted changes in 1.5 unit of follicular size.

When the environmental temperature moves upwards from the upper critical temperature, the detrimental effects of heat stress in terms of reduction of milk production, changes in milk composition and lower reproductive performances are observed in cattle. Armstrong (1994) categorized THI values into five different classes as no stress with THI value <72, mild stress (THI 72-78), moderate stress (THI 79-88), severe stress (THI 89-98) and dead cows with THI >98. In the present study, it was observed that animals showed presence of dominant follicle and behavioural signs of estrus when animals were under mild stress (THI 72-78) during the month of August. The acute exposure to extreme heat load is associated with disturbance to a physiological mechanism to the body like rapid respiration and excessive saliva production along with significant depression in reproductive performances in animals (Kadzere *et al*., 2002).

High temperature in summer months combined with a high level of RH has adverse effects on reproductive performance in cows. The location of present experiment generally has a dry tropical weather, which is moderate but on a warmer side in summer season. Although the cows of Sahiwal breed are well acclimatized to this climatic condition, but it appeared that they are also affected by increasing THI values as evident by findings of present study. All the animals exhibited presence of small and medium sized ovarian follicles unless THI values fell below 80 when they started to show presence of dominant follicle and three animals expressed overt signs of estrus. Like present findings, exposure of Gir cows to heat stress exerted a delayed deleterious effect on ovarian follicular dynamics and heat-stressed animals showed presence of small and medium sized ovarian follicles with absence of estrus signs (Torres Junior *et al*., 2007). Heat stress in dairy cows may adversely affect follicle development and that may cause impairment in subsequent follicular development and function of dominant follicle (Wolfenson *et al*., 1997). Heat stress appears to alter the efficiency of follicular selection and dominance and to have adverse effects on quality of ovarian follicles (Alves *et al*., 2014). A greater number (P< 0.01) of ovulation was reported in the cows during cool season compared to the cows in hot season and luteal phase was prolonged and ovulation were either delayed in cows during hot season or they failed to ovulate (Kornmatitsuk *et al*., 2008).

Shehab-El-Deen *et al*. (2010) documented that the mean diameter of the largest ovarian follicle during summer was lower than in winter season with ultrasound scanning at weekly interval beginning from second week to sixth week postpartum. Likewise, Alves *et al*. (2014) documented that the number and size of ovarian follicles are compromised by heat stress in cows. Similar to present observation, Masoumi and De Rensis (2013) reported that the heat stressed lactating cows present smaller follicular diameter compared with non-stressed cows. These authors also reported that most of the animals frequently presented smaller size follicle during the months of June and July and later, the size increased with lowering of THI during the month of August. Similar pattern of follicular development has been observed in present study.

Conclusion

From the results of present study, it may be concluded that development of ovarian follicle is highly affected by THI value during hot-humid season in Sahiwal cows and the reproductive performance of animal may be predicted using THI values.

Acknowledgement

Authors are grateful to the Dean of the Veterinary College, Anjora and authorities of Dau Shri Vasudev Chandrakar Kamdhenu Vishwavidyalaya, Durg, Chhattisgarh, India for providing facilities to conduct this experiment.

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