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Study the Effect of Feed Additives on Physiological Performance of Sahiwal Growing Female Calves During Summer Season in Arid Region of Rajasthan

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ABSTRACT

The objective of this study was to evaluate the effects of probiotics and encapsulated niacin supplementation on physiological parameters of growing Sahiwal female calves during summer season in arid region of Rajasthan. The present investigation was conducted at the Livestock Research Station, Kodamdesar, College of Veterinary and Animal Sciences, Rajasthan University of Veterinary and Animal Sciences for a period of 90 days during the months of June to August, 2019. Eighteen Sahiwal growing female calves having ages between 6-15 months were procured, such that the calves were the best representation of the population. Calves were housed in a well-ventilated and protected shed and were allocated to three different groups, each group consisting of six calves. The selected female calves were divided into three groups viz., group 1 (G-1), group 2 (G-2) and group 3 (G-3). Group 1 (G-1) calves received basal diet and the calves of group 2 (G-2) and group 3 (G-3) were fed the basal diet additionally supplemented with feed additives. Results revealed that the temperature humidity index (THI), which was used to express the effect of environmental parameters, gradually decreased as the season changed from summer to autumn. The values of physiological parameters, respiration rate (RR), and pulse rate (PR) were beyond the normal range which indicates that the animals were in the state of heat stress. Calves receiving supplementations along with the basal diet showed a reduction in summer heat stress was indicated by a significant decrease in the various stress indicators viz. respiration rate, and pulse rate

HIGHLIGHTS

- Studied on effect feed additives on physiological parameters.
- It can be effectively used as feed additives for alleviating heat stress in Sahiwal calves under the arid conditions of Western Rajasthan

Keywords: Sahiwal, feed additives, respiration rate, and pulse rate

The mean temperature of the earth is continuously rising due to the effect of global warming. In a study conducted by IPCC (Pachauri, 2014), the earth temperature has been elevated by 0.85°C (0.65-1.06) during the period from 1880 to 2012. It is also predicted that the earth temperature will be further increased due to the continuous emission of greenhouse gases. The climatic parameters will be also changed with further increase of temperature, which will impact the growth and production of domestic livestock. Heat stress (HS) occurs when the body temperature of the livestock increases and they cannot dissipate body heat adequately to maintain thermal equilibrium, which is due to an elevated ambient temperature above TNZ along with high humidity and slow air movement (Bernabucci *et al*., 2010). This heat accumulation would result in compromised performance and reproduction and increased mortality of livestock. The major strategies for reducing heat stress such as high insulated roof housing, sprinklers, fans, and

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air conditioner require a high financial investment and may not be applicable for small and medium-size dairy farms. Thus, there is a need of applying other management practices to reduce thermal stress, such as incorporation of feed additives that could improve productivity of the animals. Feed additive is an ingredient or combination of ingredients added to the feed-in appropriate quantities for the purpose of promoting growth lower feed consumption, improving feed efficiency, protecting against the all sorts of harmful environmental stress and it also prevents and controls diseases and makes end product more homogenous and of better quality and finally lowers the cost of production. These additives include products such as probiotics, enzymes, microflora enhancers, herbal products, prebiotics, vitamins, and minerals or a combination of these products.

Probiotics are whole food-based supplement of live microorganisms, which benefits the host animal by improving its intestinal microbial balance. The multi-strain probiotics have a broad-spectrum effect from the different strains against infections and could increase their beneficial effects of probiotics due to their synergistic adhesion effect. Niacin is a well-known subcutaneous vasodilator in many species and could be effective for reducing body temperature. Unprotected niacin may be degraded in the rumen. Niacin helps to alleviate heat stress both by increasing evaporative heat loss from the body and also by reducing the effects of heat at the cell level. Niacin plays a significant role in abatement of heat stress by increasing peripheral circulation and sweating (Maclejewski-Lenoir *et al.,* 2006). Das *et al*. (2014) also demonstrated that dietary supplementation with yeast, niacin, and mustard oil along with some other management practices resulted in alleviating summer stress in Nili Ravi buffaloes. Purwar, *et al.* (2017) also found reduction in heat stress in KF heifer by supplementation of protected fat (2.5% of DMI), yeast (10 g/animal/day), niacin (6 g/animal/day), zinc (40 mg/kg DMI), and chromium (1.5 mg/kg DMI). Similarly Patel *et al.* (2017) also found reduce heat stress by supplementation of 80 and 120 ppm zinc to KF cows.

Therefore, the present study was carried out with the following objectives, to evaluate the potential of a mixture of feed additives to mitigate heat stress effects and enhance growth in Sahiwal growing calves in terms of the level of climatic protection and performance and behavior of the animal in the arid region of Rajasthan.

MATERIALS AND METHODS

The present investigation was conducted at the Livestock Research Station, Kodamdesar, College of Veterinary and Animal Sciences, Rajasthan University of Veterinary and Animal Sciences, which is situated about 32 km away from the city of Bikaner in Rajasthan. All the facilities required for carrying out the research work were available at the College of Veterinary and Animal Sciences, Bikaner and Livestock Research Station, Kodamdesar. All the cattle in the experimental groups were reared under similar climatic conditions. Eighteen Sahiwal growing female calves having ages between 6-15 months were procured from the Livestock Research Station, Kodamdesar. The animals were received in a staggered manner and were allocated to three different groups, each group consisting of six calves. The grouping was done on the basis of treatments given and the calves which were selected represented the cattle population as much as possible.

The study was conducted during the months of June to August. The investigation lasted for a period of 90 days. During this period, observations on various parameters were taken and the data was recorded. All cows were free from physiological, anatomical and infectious diseases. Calves were housed in a well-ventilated and protected shed and allowed to acclimatize for a period of seven days prior to experimental feeding.

To study the effect of feed additives on the performance of Sahiwal growing female calves during the summer season, the selected female calves were divided into three groups viz., group 1 (G-1), group 2 (G-2) and group 3 (G-3). Group 1 (G-1) calves received a basal diet and the calves of group 2 (G-2) and group 3 (G-3) were fed the basal diet additionally supplemented with feed additives.

The calves were fed two times a day in the morning at 9.00 a.m and in the evening at 3.00 p.m. For conduction of the experiment, the animals were individually fed, with available green fodder *Jower (Sorghum vulgare*) and dry *Wheat straw (Triticum aestivum)* fodder *ad* libitum along with required quantity of concentrate is in form of Saras Cattle feed pellets (Basal diet). The treatment group was also supplemented with probiotics (10 g/animal/day)

and encapsulated niacin (6 g/animal/day) The probiotic containing *Saccharomyces cerevisiae* and bacteria, *Saccharomyces boulardii and Lactobacillus acidophilus* was used for feeding the experimental female calves. Both the feed additives probiotics, and encapsulated niacin was mixed with concentrate mixture.

The effect of weather parameters, such as temperature and humidity, on the growing calves was expressed in terms of temperature humidity index (THI). Temperature humidity index (THI) was calculated as per the formula described by McDowell (1972). The formula for the estimation of the temperature-humidity index (THI) is given below:

Temperature humidity index,

THI = 0.72 (Wet bulb temperature + Dry bulb temperature) + 40.6

Physiological parameters such as respiration rate and pulse rate of calves were recorded at fortnightly intervals for 2 consecutive days at 9.00 AM and 2.00 PM.

Respiration rate (RR) has long been used as an indicator of heat stress in cattle. Respiration rates (RR) were recorded by manual observation (using a stopwatch and counting uninterrupted flank movements.

Respiratory rate was counted from a distance by observing flank movements and recorded as counts per minute fortnightly. RR observations were made in conjunction with panting observations e.g. rapid open mouth or deep phase open mouth.

The pulse rate was measured by observing the pulsation of the middle coccygeal artery at the base of the tail with the help of a finger. The pulse rate was recorded beats per minute (beats minute^{-1}).

RESULTS AND DISCUSSION

The present study was undertaken to explore the possibility of using probiotic cultures (*Saccharomyces cerevisiae* SC-47, *Saccharomyces boulardii, Lactobacillus acidophilus, Propionibacterium freudenreichii* and seaweed powder), encapsulated niacin or a combination of both as feed additives to reduce the heat stress.

Environmental parameters (micro-climate)

Temperature humidity index (THI) was used to express the effect of environmental parameters like temperature and humidity on the growing Sahiwal female calves. The effect of environmental parameters viz. temperature and humidity have been expressed in terms of temperature-humidity index (THI). Temperature humidity index (THI) values recorded in the forenoon and afternoon have been presented in Table 1 & 2 and Fig. 1. Temperature humidity index (THI) in the forenoon range from 79.54±0.82 to 74.18±0.21 and the afternoon observations vary from 84.83±0.55 to 80.10±0.27 during the course of the experiment. There was a gradual decline in the THI values as the season gradually changed from summer to autumn. Also, it was observed that the THI values were greater in the afternoon than in the morning. Thatcher *et al.* (2010) reported that dairy cows were exposed to heat stress when THI exceed above 72 and when it exceed 88, then animals is exposed to severe heat stress condition.

Table 1: Average values of environmental parameters (micro-climate) during the experimental period

Environmental parameters	Morning (AM)	Afternoon (PM)
Temperature humidity index (THI)	76.76±0.42	81.62±0.61

Table 2: Temperature humidity index values (THI) for Morning (AM) and Afternoon (PM) during the experimental period

Fortnight	Morning (AM)	Afternoon (PM)
1	79.54±0.82	84.83±0.55
2	78.23±0.64	82.58±1.29
3	74.81±0.28	80.33±0.68
4	76.97±0.05	82.83±0.55
5	76.82±0.53	79.09±0.37
6	74.18±0.21	80.10±0.27

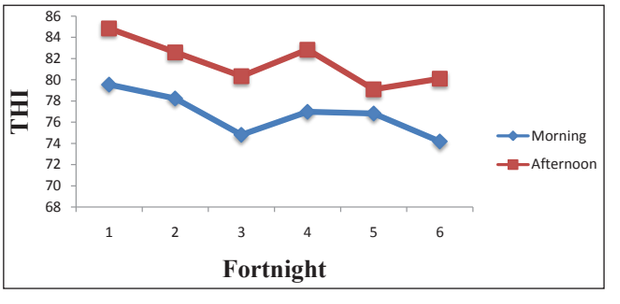

Fig. 1: Temperature humidity index (THI) values in the Morning and Afternoon

Physiological parameters

Respiration rate (RR)

The mean values of respiration rate for G-1, G-2, G-3 calves recorded at 9.00 AM in the morning and 2.00 PM in the afternoon fortnightly have been presented in Table 3 & 4.

Table 3: Fortnightly morning (AM) respiration rate in female Sahiwal calves

Fortnight	G1	G2	G3
0	29.34±1.20	29.17±1.17	29±1.16
1	29.17±0.75	29±0.52	29.17±0.98
2	29±0.82	28.5±0.43	28.17±0.75
3	29.84±0.87	28.17±0.60	28±0.73
4	29.67±1.05	27.84±0.87	27.5±1.03
5	29.17±0.79	27.5±0.96	27±0.97
6	29.5±0.92	26.84±0.79	26.34±0.8
Overall Mean	29.39±0.63^{b}	28.15±0.34^{a}	27.89±0.46^{a}

Mean having different superscript in a row differ significantly (P<0.05).

Table 4: Fortnightly afternoon (PM) respiration rate in female Sahiwal calves

Fortnight	G1	G2	G3
0	32.17±0.79	32±0.86	32±1.13
1	32±0.82	31.34±0.62	31.17±1.01
2	31.67±0.67	31±0.37	30.84±0.65
3	32.5±0.67	30.5±0.22	30.17±0.54
4	31.67±1.20	30±0.78	29.5±0.92
5	31.5±0.85	29.5±0.96	29±0.97
6	32.34±1.02	28.84±0.60	28.17±0.70
Overall Mean	31.98±0.65^{b}	30.46±0.34^{a}	30.12±0.40^{a}

Mean having different superscript in a row differ significantly (P<0.05).

The mean values of respiration rates in the morning varied from 29±0.82 to 29.84±0.87 breaths/min for control calves (G-1) and 26.84±0.79 to 29.17±1.17 breaths/min for treatment animals (G-2) and 26.34±0.8 to 29.17±0.75 breaths/min for (G-3). The overall mean of the respiration rate in the morning was 29.39±0.63 breaths/min, 28.15±0.34 breaths/min and 27.89±0.46 breaths/min for G-1, G-2, and G-3 animals respectively. In the afternoon, mean values of respiration rates varied from 31.5±0.85 to 32.34±1.02 breaths/min for control calves (G-1) and 28.84±0.60 to 32±0.86 breaths/min for treatment animals (G-2) and 28.7±0.70 to 32±1.13 breaths/min for (G-3). The overall mean of the respiration rate in the afternoon was 31.98±0.65 breaths/min, 30.46±0.34 breaths/min and 30.12±0.40 breaths/min for G-1, G-2, and G-3 animals respectively. The result showed that the respiration rate was significantly higher (P<0.05) in G-1 as compared to G-2 but there was no significant variation between group G-2 and G-3 in morning and afternoon respectively. The difference might be due to feed additives.

Gyanendra *et al*. (2009) showed a significant reduction (P<0.05) in the respiration rate in buffalo calves by supplementation of zinc sulphate @ 500 mg/animal/day. Wrinkle *et al*. (2012) also found a reduction in morning respiration rate by supplementation of rumen protected niacin@19 g/day. Broadway *et al.* (2016) Yeast probiotic supplementation mitigate some of the negative effects of heat stress in feedlot heifers also found a decrease in vaginal temperature (p<0.01) and RR (p=0.09) in live yeast (1.5 g/animal/d) supplemented beef heifers, during summer months.

Pulse rate (PR)

The mean values of pulse rate for the three groups of experimental animals were recorded at 9.00 AM in the morning and 2.00 PM in the afternoon at fortnightly intervals and have been presented in Tables 5 & 6. From the tables, it can be concluded that the low values of pulse rates were observed in the morning and the values were comparatively higher in the afternoon. The overall mean of the pulse rate in the morning was 80.29±1.22 beats/min for G-1, 78.96±1.53 beats/min for G-2, and 75.96±0.88 beats/min for G-3 calves. In the afternoon, the overall mean of the pulse rate was 85.43±1.23 beats/min, 83.43±1.73 beats/min, and 80.29±0.82 beats/min for G-1, G-2, and G-3 calves. The result showed that the pulse rate was significantly higher (P<0.05) in G-1 as compared to G-3 but there was no significant variation between group G-2 and G-3 in morning and afternoon respectively.

The difference can be attributed to the use of probiotics and encapsulated niacin as feed additives. The studies

conducted by various researchers support the above findings. Das *et al*. (2014) supplemented niacin (6 g/ buffalo/day), yeast (10 g/buffalo/day), and mustard oil (150 g/buffalo/day) during summer month in Nilli-Ravi buffalo and found a significant decrease in pulse rate in the treatment groups.

Table 5: Fortnightly morning (AM) pulse rate in female Sahiwal calves

Fortnight	G1	G2	G3
0	81±3.31	81.5±3.23	82.34±2.64
1	80.17±2.81	80.34±2.04	79.17±2.07
2	82.67±1.28	79.17±4	77.67±1.69
3	81.67±1.50	78.5±2.83	76.67±1.26
4	80.5±1.82	79.34±1.75	73.5±1.96
5	78±1.81	79±0.90	71.67±1.28
6	78±1.71	74.84±1.72	70.67±0.84
Overall Mean	80.29±1.22^{b}	78.96±1.53^{ab}	75.96±0.88^{a}

Mean having different superscript in a row differ significantly (P<0.05).

Table 6: Fortnightly afternoon (PM) pulse rate in female Sahiwal calves

Fortnight	G1	G2	G3
0	85.67±3.19	86.84±3.66	87±2.86
1	85.67±2.93	84.17±2.36	83.67±1.82
2	87.84±1.20	84±4	82±1.73
3	86.84±1.49	83±2.73	81.5±0.99
4	86.17±2.01	84.5±1.46	77.5±2.08
5	83.84±1.85	82.34±1.17	75.67±0.99
6	82±1.77	79.17±1.6	74.67±0.84
Overall Mean	85.43±1.23^{b}	83.43±1.73^{ab}	80.29±0.82^{a}

Mean having different superscript in a row differ significantly (P<0.05).

Thus Results Revealed That The temperature-humidity index (THI),which was used to express the effect of environmental parameters, gradually decreased as the season changed from summer to autumn. The mean temperature-humidity index (THI) values were greater in the afternoon than in the morning.

The values of physiological parameters respiration rate (RR), and pulse rate (PR) were beyond the normal range which indicates that the animals were in the state of heat stress. The mean value of RR, and PR was lower during morning hours due to the higher heat dissipation rates during night hours. The mean value of the physiological parameters differed significantly in the morning.

Higher rates of respiration were observed in calves of the control group (calves fed basal diet) than the treatment group animals both in the morning and afternoon. Both morning and afternoon pulse rates were lower in animals receiving the diet containing both probiotics and encapsulated niacin.

The reduction in summer heat stress was indicated by a significant decrease in the various stress indicators viz. respiration rate, and pulse rate in the calves receiving supplementations along with the basal diet.

CONCLUSION

The results of the present study suggest that the supplementation with probiotics (*Saccharomyces cerevisiae* SC-47, *Saccharomyces boulardii, Lactobacillus acidophilus*, *Propionibacterium freudenreichii* and seaweed powder) and encapsulated niacin in the ration of growing female Sahiwal calves during summer stress period can ameliorate the effect of summer stress and minimize fiscal losses of the farmer.

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