

Popular Article

Physiological and behavioral effects of heat stress in dairy cattle from arid tract of Rajasthan

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Abstract

Heat stress is failure of heat dissipation of body when too much heat is produced. Summer season is the most detrimental for production in animals especially arid regions i.e., Bikaner district of Rajasthan. Exotic dairy cows are more prone to environmental stress as they have more heat of metabolism. Moreover, high producer animals are more susceptible to heat stress. Heat Stress has harmful impact on production, reproduction, metabolism and immune status of animal. Semen quality of exotic cattle is also affected by heat stress. Similarly, fertility decreases during highly warm months due to heat stress. In managemental perspective, cooling systems (Fans and mist) along with shades and grazing at night are involved in environmental modification. Due to heat stress, intake of dry matter decreases but requirement of energy increases along with the bypass protein. So, there is need of nutrition-based management of animals in proper way.

Keywords: Heat stress, Dairy cows, Management.

Introduction

Heat stress in animals is associated the imbalance in heat production and dissipation in the body of the animals; more heat is produced or absorbed but less heat is dissipated from body. Dairy animals are warm-blooded animals and have ability to maintain their temperature on a specific degree. When more heat is produced or absorbed by the body but less is dispersed, animals suffer from heat stress (Vasanth et al., 2016). This condition harmfully affects the performance of animals. Animals reduce their production and reproduction performance (West, 2003; Nardone et al., 2006, 2010).

Animals experience heat stress when the body temperature is above the optimum range defined for normal activity because the total heat produced is greater than the heat dissipation capability. Temperature and humidity can be combined in the form of a single entity through temperature-humidity index. Maximum HLI obtained in present study during extreme ambiances corroborated the earlier recordings from the Bikaner

In arid tracts, animal population encounter intensive environmental temperatures and they need greater degree of contentment. It can be proposed that environmental thermal standards to placate native breeds from arid tracts can be bolstered by analyzing environmental elements of a particular area for a long time. Although according to previous workers, Higher THI than 72 can be crucial for cow as far as decrease in milk production and feed intake is concerned, but in native breeds it may touch to 80-85 even in harsh environmental conditions. Seasonal variations alters the kidney functions and acid-base balance so influence the plasma anion status in goat (Arora *et.al.* 2021).

In warm environments heat stress reduces the milk production, fertility rate, conception rate and health and immunity of the animals. Warm environment has negative effect on overall performance of the animals (Jordan, 2003; Bernabucci *et al.*, 2010). Animals suffer from heat stress when temperature exceeds 25° C due to which animal cells are affected, body temperature rises, and production performance is reduced. High-producing dairy cattle have increased sensitivity to heat stress, compared with lower-producing Genetic selection for milk production traits contributes to cows producing an increased amount of metabolic heat. Cows with greater milk production potential have greater feed intake, and thus higher metabolic heat production through processes such as body tissue synthesis and milk secretion, than their counterparts of lower genetic caliber. A series of severe changes occur in the biological functions of animals due to heat stress. These changes lead to decrease in feed efficiency, utilization, feed intake, protein, energy, mineral imbalances, disturbances in water, enzymatic activities, blood metabolites, hormonal secretions and ending to damage the productive and reproductive performance as well as lowers natural immunity and animals becomes more susceptible to disease.

Effect of heat stress

Effect of heat stress on feed intake: As the environmental temperature increases the temperature of the animal's body also increases due to which dry matter intake decrease (West, 2003; Allen *et al.*, 2015). Heat stress cause reduction in feed intake and a failure in nutrient availability due to which body weight decreases and ultimately the animals go into physiological negative energy balance escorted by a reduction in the cow's BCS (Collard *et al.*, 2000; Rhoads *et al.*, 2011).

Effect on the quantity and quality of the milk: High yielding cows are more sensitive to heat stress as compared with dry cows (Purwanto *et al.*, 1990; Spiers *et al.*, 2004). Dry matter

intake is reduced when a cow becomes heat-stressed resulting in the lower availability of nutrients used for milk synthesis (West, 2003; Rhoads *et al.*, 2009). In Addition, mild to severe heat stress can increase metabolic maintenance requirements by 7 to 25% further decreasing the nutrients supply for production.

Effect on female reproduction: During summer, season conception rate of cows is decreased ranging between 20 and 30%, with marked seasonal patterns of estrus exposure. A warm environment harmfully affects the cow's ability to show estrus behavior, due to which both the intensity and duration of estrous expression are reduced (Orihuela, 2000). When dry matter intake reduces, the intensity and duration of estrous expression also reduce due to effects on the production of the hormones. In beef cattle, estrous behavior and frequency decrease during the summer as compared to winter months (Westwood *et al.*, 2002).

Effects on cow's service period: Cow's service period is defined as the time-period between date of calving and date of conception of a cow. The service period is longer for cows which calve in summer as comparatively to those who calves in winter.

Effects on conception rate in cows: Heat stress has adverse effects on cow's conception rate. If THI is more than 72 at the time of insemination, the chance of conception is reduced. It has been seen that if heat stress continues for 3-5 days before insemination and almost 5-7 days after insemination, conception rate is minimized in cows

Effects on pregnancy rate in cows

It is reported that pregnancy rate decreases when temperature and relatively humidity goes up from 25°C and 50% respectively. Month of insemination has also significant effect on pregnancy rate.

Heat stress management

These strategies can reduce the negative impact of hot and humid climate on dairy cows and enhance the quality and efficiency of milk production in the dairy industry.

Water

Neat and clean water is important for milk production and thermal homeostasis. It is observed that heat-stressed cows must remain well hydrate for optimum production. If water is abundant and clean, their consumption rate will increase. To keep animal cool water tank should be clear from feed debris and algae

Glucose

During heat-stress, grains feeding causes more ruminal heat increment, so to increase propionate production, propylene glycol can be add in animals feed which is a glucose precursor for the production.

Protein

In summer season, protein should not be increased in animal diet because it generates a lot of heat. The addition of dietary crude protein is not helpful during heat stress. It is not well defined how heat stress affects the requirement of dietary protein.

Mineral and vitamin supplements

Total oxidant activity in blood plasma is reduced due to heat stress and it can cause depression in survival of embryo. So, at the time of breeding and in lactating cows, administration of antioxidants like b-carotene, vitamin E and selenium is necessary during heat stress period. Acidosis, due to heat stress, could be solved by use of sodium bicarbonate that acts as buffer. Some other feed additives that stabilize rumen health and improve fibre digestion include niacin and chromium.

Cooling system

To control heat stress in dairy cows, cooling systems are being used in large dairy farm. The principle of cooling system is depending on evaporation, which make possible with the use of fans, mist and force ventilation

Shade

To protect animals from solar radiations, shade is basic protecting method. The tree and other plants are most effective source of shade for animals to protect from sun radiations. Evaporation occurs in summer from leaves of plant, which create a cooling effect on animals body. When we use metallic or concrete shade for the animal's production from sun radiation, roof isolation with suitable materials and painting with white color reduces heat stress or solar radiation

Conclusions

Summer season is the most detrimental for production in animals. Exotic dairy cows are more prone to environmental stress as they have more heat of metabolism. In arid region, production of the animals can be maintained through nutritional management during heat stress. These strategies include supplementation of monensin, propylene glycol, niacin, yeast, bypass fat as well as sodium bicarbonate.

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