Article ID 240205032

Heat Stress and Its Managemental Advances (Ameliorative Measures) in Livestock

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Abstract

Heat stress is generally seen in cattle, buffalo, horses, poultry but sheep, goat are less prone to high temperature in livestock. Stress is a broad term and is described as the cumulative detrimental effect of a variety of factors on the health and performance of animals. Thermal stress is triggered when environmental conditions exceed the upper or lower critical temperature of domestic animals requiring an increase in basal metabolism to deal with the stress. Animals mount a response to a stress that involves behavioral, metabolic and physiological changes at multiple levels of vertebrate organization from subcellular to the whole animal. It depends on the surrounding air temperature. Therefore, high temperature has the most detrimental effect on livestock. It adversely affects the animal behavior, feeding pattern, reproductive changes, digestive upset, social gathering, immune system and livestock are more prone to bacterial, viral, TTBD, parasitic diseases, nutritional deficiencies. Lower values of milk fat content when the temperature–humidity index value was higher than 75 (3.46 g/100 g for temperature–humidity index < 75 vs. 3.17 g/100 g for temperature–humidity index > 75, respectively). A marked and significant decrease of milk fat during summer (3.20 g/100 g) compared with the values observed in winter (3.80 g/100 g) and in spring (3.61 g/100 g). Milk has higher casein content in winter (2.75 g/100 g) and spring (2.48 g/100 g) with respect to the summer season (2.27 g/100 g) . Due to high temperature effect silent heat is shown by buffaloes and Ram sterility is also seen in most. Although it is common in hot climatic condition but can be prevented by some managemental steps. Global warming has also detrimental effect on livestock heat stress because it increases the greenhouse gases in the atmosphere and as a result there is increase in the environmental temperature which causes thermal stress in animals. It severely acts on the reproductive performances of animals. The preventive and control management in this condition can brings out of the situation if performed at the right time and in a scheduled way. In severe condition some veterinary treatment can be helpful to save the life of patient.

Introduction

Stress is a broad term and is described as the cumulative detrimental effect of a variety of factors on the health and performance of animals or Stress is defined as an external event or condition which produces a "strain" in a biological system. Animals mount a response to a stress that involves behavioural, metabolic, and physiological changes at multiple levels of vertebrate organization from subcellular to the whole animal (Collier & Gebremedhin, 2015).

The strength of the negative correlation between thermal environment and feed intake increases as daily milk yield increases. Water intake requirements are increased in thermal stress to accommodate increased evaporative heat loss requirements. The local factors regulating reduced milk synthesis have not yet been elucidated (Wheelock *et al*., 2010).

Measures to ameliorate heat stress

Housing management

The best type of animal shelter is a one where the microenvironment temperature remains within 15 to 25 °C and humidity level around 10-12 mm Hg.

Orientation: Shed with its long axis running East - West provides a cooler environment than one with a North-South orientation (Kelly *et al*., 1950).

Shelter design: Open type of sheds has advantage over closed type shed. Mean temperature and minimum temperature in close shed was significantly higher than those of open type shed (Armstrong, D. V., 1994).

Height of shelter: Minimum roof height should be 10.0 feet to reduce heat load. The height of shelter in hot climate should be between 3.0 - 5.0 m. A height less than 3.0 m interferes with proper ventilation resulting into reduced convective heat loss from animal.

Shape and type of roof: The shape of the roof can be either flat, slopped or "A" shaped. "A" shaped roof is definitely better than a flat roof in hot climate.

Roofing material: it should be made up of tin or asbestos sheet and coated with black paint outside.

Shelter surroundings: it should be clean and have lot of trees.

Ventilation: There should be good ventilation inside of the barn.

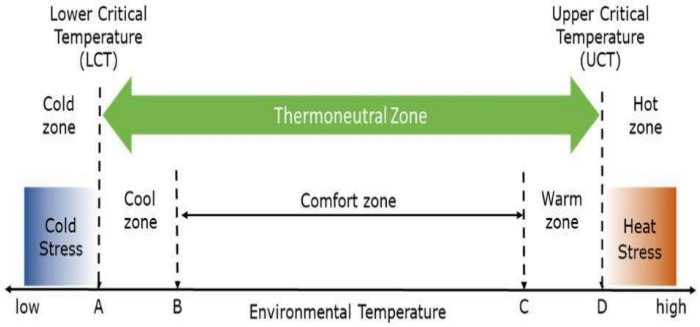
Colour of roof and walls: Roof colour must be black and inside wall must be white painted.

Microclimate modification: This can be done by the use of Fans.

Low pressure sprinklers or ordinary sprayers

Sprayers, Coolers

During summer, we can reduce heat load of animals artificially by spraying small quantity of water on their body at repeated interval of 15-30 minutes. (Blackshow, *et al*., 1994).



Heat stress occurs in animals when there is imbalance between heat production within the body and dissipation. Thermoregulation is the mean by which an animal maintains its body temperature.

Thermoregulation involves a balance between heat gain and heat loss. Under heat stress, a number of physiological and behavioural responses vary in intensity and duration in relation to the animal genetic make-up and environmental factors. Environmental factors such as ambient temperature, solar radiation and humidity have direct and indirect effects on animals (Collier *et al*., 1982)

Heat stress adverse effect in livestock

Milk production and quality

The daily milk yield is highly affected by climate change. The increment of temperature and humidity leads to a significant decrease in milk production (kilogram per day), and this reduction can be easily calculated using the formula;

Decline in milk production (kg / d) = 1.075 1.736 NL + 0.02474 × NL THI

where NL is the normal level of daily milk yield (kilogram per day), recorded in the temperature range of 10 to 18 °C, and THI is the daily mean temperature humidity index. (Berry *et al*.,1964)

Using this formula, it is clear that daily milk yield (kilogram per day) decreases with the increase of the temperature–humidity index (from 72 to 80), particularly in the more productive cows (from 15 to 40 kg/d).

When temperatures move out of the thermo-comfort zone, dairy cows begin to experience heat stress and start to reduce daily milk yield, not because of reduced intake. Cows subjected to heat stress reduced their ingestion and produced less milk when compared with cows raised in normal climate conditions (Cowley *et al*., 2015). When cows returned to the thermo-comfort zone, milk production increased to the physiological level.

Fat Content

Lower values of milk fat content when the temperature–humidity index value was higher than 75 (3.46 g/100 g for temperature–humidity index < 75 vs. 3.17 g/100 g for temperature–humidity index > 75, respectively). A marked and significant decrease of milk fat during summer (3.20 g/100 g) compared with the values observed in winter (3.80 g/100 g) and in spring (3.61 g/100 g) (Bernabucci *et al*., 2015)

Lactose

Milk lactose, the main component of milk after water, is not affected by heat stress of cows. Milk lactose content not significantly different between cows maintained at temperature–humidity index < 75 and cows maintained at temperature–humidity index > 75 (Abeni *et al*., 1993).

When cows are maintained in conditions of heat stress, both milk protein and casein content tend to decrease. A decrease of milk protein content when the temperature–humidity index value was higher than 75 (3.02 g/100 g for temperature–humidity index < 75 vs. 2.89 g/100 g for temperature–humidity index > 75, respectively) (Abeni *et al*.,1993). Milk protein content is mostly related to a direct effect of heat stress instead of a reduction of feed intake (Cowley *et al*., 2015). Milk has higher casein content in winter (2.75 g/100 g) and spring (2.48 g/100 g) with respect to the summer season (2.27 g/100 g) (Bernabucci *et al*., 2015).

Meat quality

High temperatures and warmer seasons increase the risks of heat stress, which induce the occurrence of pale, soft, and exudative (PSE) pork (Dalla *et al*., 2007). An elevated growing-finishing environmental temperature before slaughter was shown to decrease glycolytic potential and to alter biochemical and histochemical characteristics, leading to a darker meat colour of *Longissimus dorsi* muscle (Lefaucheur *et al*., 1991).

Wool: One early study indicated that an increase in subdermal temperature of 5°C resulted in increased wool growth, but if the temperature was further increased, wool growth declined and then cease.

Reproduction

Buffaloes are seasonal breeders and susceptible to thermal stress (Pandey & Roy, 1966). Presence of quiescent ovaries in most of the Buffaloes during summer months (Nanda *et al*., 2003). During summer, under nutrition coupled with high ambient temperature has been implicated with anoestrus condition in buffaloes.

Summer anestrous

This is popularly known as silent heat. It is of common occurrence and to a greater degree in buffaloes. The cow/buffaloes show normal cyclic ovarian activity but the behavioral signs are not exhibited (Beg *et al*., 1999). The condition is more common in hotter months. In buffalo it is a problem during breeding season. A number of nutritional deficiencies such as energy source, phosphorus, cobalt, copper and vitamin A are said to be causative factor of subestrous. Physiological factors such as calf suckling, high lactation and climatic variation results into suppressed gonadotrophic activity and thus weak heat. (Sane *et.al*., 1994).

Conclusion

Heat stress in livestock is mostly depends upon the air temperature of surrounding animal environment. It affects the behaviour, feeding pattern, reproductive performance and animals become more prone to viral, bacterial, parasitic disease and TTBD. Management is the core for the prevention and control of thermal stress in livestock and it includes natural and artificial methods. It includes good feeding, showering, sprinkling, shade, and housing etc. The veterinary medical treatment in severe condition can be a possible way to save the life. The use of managemental methods can reduce the heat stress in animals and save them from the detrimental effect of heat stress.

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