Bio Vet Innovator Magazine
(Fueling The Future of Science…)
Volume 3 (Issue 3) MARCH 2026
OPEN ACCESS World Tuberculosis Day – 24th March Popular Article

Combating Heat Stress in Broilers: Practical Approaches to Improve Productivity and Welfare

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DOI: https://doi.org/10.5281/zenodo.19420507

Received: March 27, 2026
Published: March 31, 2026

Abstract:

One of the most significant environmental problems that affect broiler chickens is heat stress. This is a critical problem in tropical and subtropical areas where the temperature is usually high. Generally, heat stress is a condition that occurs when chickens are not able to evaporate sweat to cool their bodies. This leads to a series of changes that affect the chickens. Broiler chickens are more likely to experience heat stress due to their growth rate, metabolic heat production, and inability to sweat. This leads to a decline in their growth performance, feed efficiency, and death rate, causing economic losses for farmers. Additionally, heat stress is a critical issue from the perspective of animal welfare because of the discomfort that chickens experience at extreme temperatures. This article presents strategies to alleviate heat stress in broilers in an integrated manner. Changes in the environment, including better housing and ventilation facilities equipped with cooling systems, are very important in maintaining a good microenvironment in broiler farms. Nutrition strategies, including the timing of feeding in relation to cooler times of the day, changing the nutritional value of the feed, and adding vitamins, minerals, and electrolytes, can be useful in maintaining a balance in the physiology of the broilers and in reducing stress. Effective management practices, including reducing the handling of broilers when the temperature is high, can be useful in reducing heat stress in broilers. Genetic selection and precision farming can also be useful in reducing heat stress in broilers. In conclusion, it is important to note that an integrated approach is needed in order to increase productivity in a situation in which the environment is becoming increasingly hot.

Keywords: Heat stress, Broilers, Poultry production, Thermal stress management, Nutrition

Introduction:

Broiler poultry farming has been identified as one of the fastest-growing areas in the livestock

sector, which offers an affordable and high-quality animal protein to meet the nutritional requirements of the growing human population. In countries like India, the climatic conditions are quite pronounced, with high temperatures and humidity. The poultry farmers in these countries are facing a challenge in maintaining the environmental conditions. Among the many environmental issues, heat stress has been identified as one of the most detrimental environmental issues in broiler poultry farming, which affects the performance, health, and welfare of the birds. "Heat stress occurs when the ambient temperature exceeds the thermoneutral zone, which is between 18 and 25 C, impairing the bird's ability to maintain thermal balance." Unlike mammals, chickens lack sweat glands. The only means of reducing heat is through panting. With the rise in global warming, the occurrence of heat stress is expected to increase, which can be detrimental to poultry farming.

Physiological Basis and Impact of Heat Stress:

Broiler chickens are more susceptible to heat stress because of their inherited nature of increased growth rate and efficiency of feed consumption. The increase in the growth rate of broiler chickens is associated with an increase in their metabolic rate, which in turn generates a lot of internal heat. Broiler chickens are not able to reduce the heat produced by the metabolism when the ambient temperature is high; therefore, their internal temperature is raised. The fact that they have feathers does not enable them to lose heat, making them more vulnerable to heat stress.

When subjected to heat stress, broiler chickens undergo physiological changes to enable them to return to homeostasis. The first physiological change observed when broiler chickens are subjected to heat stress is panting, which enables them to increase their breathing rate in order to lose more heat by the process of evaporation. The increased respiration rate causes a loss of carbon dioxide, thus leading to respiratory alkalosis. Heat stress also causes oxidative stress, which comes with the production of free radicals that damage cellular components. Heat stress also causes an imbalance of hormones, a decrease in feed consumption, and a decrease in the digestion and absorption of nutrients.

The cumulative effect of all these physiological alterations results in decreased growth performance, feed conversion efficiency, meat quality, and an increased susceptibility to various diseases. Under severe heat stress conditions, there may be high mortality rates, especially in birds that are old or heavier. From an animal welfare point of view, heat stress results in considerable discomfort, dehydration, and stress. Therefore, it becomes essential to adopt various strategies to alleviate heat stress.

Environmental and Housing Interventions:

Another important component that is crucial in the mitigation of heat stress in broiler production is environmental management. Housing of poultry is critical in ensuring that there is a microclimate that is comfortable for the birds. This is a critical aspect that impacts broiler production. Ventilation is critical in ensuring that there is the removal of heat, moisture, and gases such as ammonia and carbon dioxide.

Modern poultry housing has adopted the use of tunnel ventilation systems, where there is the movement of air along the length of the poultry house. This ensures efficient heat dissipation. The air speed is critical in this process. The speed ranges between 2-3 meters/second during hot weather.

The use of cooling pads, foggers, and misters has been shown to be effective in lowering the ambient temperature within the poultry house. These systems work on the principle of evaporative cooling, which involves lowering the air temperature as water evaporates. Roof sprinklers are used to reduce heat load by sprinkling water on the roofs.

Design changes in housing also contribute to the management of heat stress. The poultry house can be oriented in an east–west direction, which reduces exposure to solar radiation. The use of reflective or insulated roofs also reduces heat absorption. The height of the roof and spacing between houses also help in the circulation of air, thus reducing the accumulation of heat. Also, reducing stock density under hot weather conditions can help in the circulation of air between the birds, thus reducing the heat in the house.

Nutritional Strategies:

Nutritional management is of critical importance in mitigating the harmful impacts of heat stress. During hot weather, birds decrease their feed intake as a method of reducing metabolic heat production. Therefore, it is recommended that the birds should be fed at cooler times of the day, such as early morning or late evening.

Dietary changes are of critical importance in reducing heat increment and improving the utilization of nutrients. Increasing the fat content of the feed is recommended because fat has a low heat increment compared to carbohydrates and proteins. However, it is critical to maintain the optimal amounts of amino acids in the feed. There is a need to slightly decrease the protein content of the feed to reduce heat increment from protein metabolism. Additionally, using highly digestible ingredients will help to promote nutrient utilization.

Another strategy that can be used to enhance thermotolerance in broilers is the supplementation of vitamins and minerals. Vitamins such as vitamins A, C, and E, which have antioxidant properties, play an important role in mitigating oxidative stress, hence maintaining cell integrity. Minerals such as zinc and selenium, which have antioxidant properties, play an important role in enhancing the immune system and metabolism. The supplementation of electrolytes plays an important role in maintaining acid-base balance and preventing dehydration during hot weather. The supplementation of probiotics and phytogenic products plays an important role in enhancing thermotolerance.

Water is equally important in enhancing thermotolerance in broilers, since the intake of water is higher in hot weather. Therefore, provision of clean and cool water is important in enhancing thermotolerance in broilers. The provision of more drinkers and ensuring proper flow is important in enhancing thermotolerance in broilers.

Management Practices:

Effective management practices are very important in minimizing the effects of heat stress in broilers. Handling, vaccination, and transportation should be done during the cooler parts of the day to avoid stressing the birds further. In addition, minimizing human interference and providing a calm environment can also contribute to minimizing stress levels in birds.

Litter management is another important factor to be considered in broiler farming. Wet conditions in the litter can contribute to increased humidity and an accumulation of ammonia levels in the birds' environment. Dry and clean conditions in the litter are very important in maintaining bird comfort and health.

During extreme conditions of heat stress due to heat waves, immediate action is necessary to prevent losses. This can be done by providing ice or cooled water to reduce the temperature of the water provided to birds for consumption. In addition, feed can be withheld to reduce metabolic heat production in birds.

Genetic and Technological Approaches:

Long-term methods of controlling heat stress include genetic selection and the use of modern technologies. Breeding for heat-tolerant broilers has become an area of interest in recent times. The naked neck gene, frizzle gene, and other characteristics that help to dissipate heat can be targeted for broiler improvement.

The use of precision farming techniques will create an avenue for the efficient control of heat stress. This will be achieved by monitoring temperature, humidity, and other environmental factors. This will help the farmer to take informed decisions regarding heat stress control. An automated system will help to maintain an optimal environment within the poultry house.

Future Perspectives under Climate Change:

The challenges associated with heat stress in poultry production systems are likely to increase in the future due to issues like climate change and global warming. The increase in temperature, heat waves, and changes in weather patterns are expected to add pressure to poultry production systems in the future. In order to address the challenges associated with heat stress in poultry production, it is imperative to employ a proactive and adaptive strategy, which is likely to involve scientific innovations and approaches in managing poultry production in the future. The focus in the future is likely to be on the development of housing, genetic resistance, and sustainable poultry production. The application of multidisciplinary approaches, which include the concept of One Health, can also be used to enhance the resilience of poultry production systems.

Conclusion:

Heat stress is one of the key factors acting as a constraint in broiler production, especially in areas

with high environmental temperatures and humidity. The negative impacts of heat stress on growth, feed efficiency, immunity, and mortality not only affect the profitability of the enterprise but animal welfare as well. However, it is important to point out that this constraint is one of the most manageable challenges in broiler production.

This is due to the fact that, by integrating environmental control, nutrition, animal husbandry, and modern technology, the impacts of heat stress in broiler production can be reduced to a minimum. In addition, long-term measures, which include building resilience in the infrastructure, will greatly contribute to the sustainability of poultry production in the midst of changing climatic conditions. Therefore, by adopting these measures, not only will the profitability of the enterprise be enhanced, but animal welfare in broiler production will equally be promoted.

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Citation: Prashant Prakash Rokade, Diksha Singh, Mukul Gajanan Gabhane. (2026). Combating Heat Stress in Broilers: Practical Approaches to Improve Productivity and Welfare. In Bio Vet Innovator Magazine (Vol. 3, Issue 3, pp. 40–44). Bio Vet Innovator Magazine. https://doi.org/10.5281/zenodo.19420507