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Popular Article

Beating the Heat: Mitigating Heat Stress in Poultry During Summer

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Abstract

Heat stress has emerged as a serious challenge in poultry production, particularly when the global temperatures continue to rise and extreme heat events have become more frequent. Commercial broilers and layers are especially susceptible to elevated temperatures due to their feather coverage and inability to sweat, thus making their thermoregulation difficult under high ambient conditions. When environmental temperatures surpass the birds' thermoneutral zone of 18–21°C, particularly above 25°C, chickens begin to exhibit signs of heat stress, such as panting, wing spreading, decreased feed intake, and lethargy. Prolonged exposure to heat stress adversely affects physiological functions, leading to oxidative stress, acid-base imbalance, suppressed immune responses, and ultimately increased mortality rates. These physiological disruptions significantly impair productivity, resulting in reduced feed efficiency, body weight gain, egg production, and overall meat and egg quality. A range of strategies have been developed to mitigate the effects of heat stress in poultry, which include environmental modifications, nutritional interventions, welfare and behavioural management, as well as genetic selection, as detailed in this article.

INTRODUCTION

With global temperatures on the rise and summers becoming increasingly intense, heat stress has emerged as a significant challenge for poultry producers, leading to considerable economic setbacks. Commercial broilers and layers are particularly at risk due to their dense feather coverage and inability to sweat. If not effectively managed, elevated temperatures can severely impact poultry health and productivity. Heat stress causes a range of physiological, behavioural, and performance-related issues, and in extreme cases, can lead to high mortality. It is associated with oxidative stress, disruption in acid-base homeostasis, and a compromised immune response, all of which contribute to reduced feed efficiency, slower weight gain, decreased feed intake, diminished egg output, and lower quality in meat and eggs.

This condition arises when birds are unable to regulate their body temperature effectively, resulting in excess internal heat that leads to physiological and behavioural disturbances. Such thermal imbalance can impair growth, reduce reproductive output, and increase the risk of death. Heat stress is driven by various environmental factors, including high temperatures, humidity, radiant heat, and insufficient ventilation, with ambient temperature being the most critical factor. Chickens typically maintain an internal body temperature between 41 and 42 °C and thrive best within a thermoneutral range of 18 to 21 °C. Studies show that when environmental temperatures surpass 25°C, birds begin exhibiting stress responses such as panting, wing spreading, reduced appetite, and lethargy. Prolonged heat exposure interferes with metabolic functions, lowers immune defences, and adversely affects growth and egg-laying performance.

PHYSIOLOGICAL IMPACT OF HEAT STRESS

Heat stress induces a range of physiological disruptions in poultry that compromise their overall health and productivity. One of the primary effects is the reduction in feed intake, which subsequently lowers the energy and nutrient availability required for growth and production. To cope with elevated body temperatures, birds exhibit an increased respiratory rate, or panting, which can lead to respiratory alkalosis. Additionally, heat stress increases the generation of reactive oxygen species (ROS) leading to oxidative stress. Hormonal imbalances, particularly elevated levels of corticosterone, have also been observed, resulting in suppressed immune function. Moreover, heat stress can compromise the integrity of the intestinal barrier, increasing susceptibility to pathogenic infections. These physiological alterations highlight the importance of implementing targeted nutritional strategies to sustain bird health and performance under heat stress conditions.

HEAT STRESS MITIGATION STRATEGY

A range of strategies have been developed to lessen the effects of heat stress in poultry, which include environmental modifications, nutritional interventions, welfare and behavioural management, as well as genetic selection, as detailed in this article.

A. Managing The Environment

1. **Ventilation and Airflow:** Good airflow is the first line of defence. Open-sided houses, roof vents, and exhaust fans help maintain air circulation.
2. **Cooling Systems:** Mist sprayers, foggers, and evaporative cooling pads can significantly reduce the ambient temperature inside poultry sheds. However, it’s important to use them correctly to avoid excess humidity, which can worsen conditions.

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3. **Shade and Insulation:** Providing natural or artificial shade and insulating poultry houses with reflective materials or double roofing can reduce heat gain. Orientation of sheds (east-west direction) also helps minimise sun exposure.

B. Nutritional Management

1. **Feed Restriction**: Limiting feed availability during peak heat periods is an effective strategy to reduce metabolic heat production in poultry. This approach has been associated with decreased rectal temperatures, reduced mortality, and lower abdominal fat deposition in broilers subjected to heat stress. However, its practical application is limited due to potential drawbacks, including slowed growth rates and delayed market readiness.
2. **Dual Feeding Strategy**: Implementing a dual feeding regimen involves providing high-protein feed during cooler times of the day and energy-dense feed during hotter periods. This approach supports continuous nutrient intake while managing the metabolic heat load associated with digestion.
3. **Water Management**: Ensuring access to clean, cool, and sufficient drinking water is vital under heat stress conditions, as water intake can double during hot weather. Enhancing water availability by increasing the number of drinkers and maintaining optimal flow and cleanliness of water lines is essential. Additionally, the use of additives such as organic acids and probiotics may promote gut health and overall resilience during stress.
4. **Wet Feeding**: Incorporating water into feed (wet feeding) during periods of heat stress has been shown to promote water intake, improve digestion, enhance nutrient absorption, and positively impact poultry performance.
5. **Pelleted feed**: Pelleted feed reduces the energy birds use while eating by making feed easier to consume. It improves nutrient intake by preventing selective feeding and enhancing digestibility. This leads to better growth performance and feed efficiency, especially under stress conditions
6. **Dietary Fat Supplementation**: High-energy diets supplemented with fat can partially mitigate heat stress effects. Compared to carbohydrates and proteins, fats generate lower metabolic heat during digestion, making them a preferable energy source under thermal stress.
7. **Vitamin Supplementation**: Vitamins that have antioxidant properties play a crucial role in alleviating heat stress. Vitamin E (α-tocopherol), a fat-soluble antioxidant, neutralises free radicals in the cells and supports immune function in heat-stressed birds. Vitamin A contributes to immune modulation by enhancing antibody production and T-cell activity,

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while also functioning as an antioxidant in low-oxygen environments. Vitamin C, a water-soluble antioxidant, helps counteract oxidative stress by scavenging reactive oxygen species (ROS).

8. **Mineral Supplementation**: Minerals such as zinc are integral to the antioxidant defence system, immune response, and skeletal health. Zinc supports the function of several antioxidant enzymes, including superoxide dismutase and glutathione-related enzymes. Additionally, the combined supplementation of zinc and chromium has demonstrated positive effects on thermo tolerance by enhancing metabolic and immune responses.
9. **Electrolyte Supplementation**: Heat induced panting disrupts the acid-base balance in poultry, often resulting in respiratory alkalosis. Supplementing diets with electrolytes such as ammonium chloride (NH_4Cl), sodium bicarbonate ($NaHCO_3$), and potassium chloride (KCl) can help restore this balance and support physiological stability.
10. **Phytochemical Supplementation**: The inclusion of phytochemicals in poultry diets has emerged as a natural strategy to combat heat stress. These compounds, derived from plant sources, possess strong antioxidant and anti-inflammatory properties. For instance:

Phytochemical	Source	Function Under Heat Stress
❖ **Lycopene**	Tomatoes and tomato products	Enhances antioxidant enzyme activity
❖ **Resveratrol**	Grapes, peanuts, berries, and turmeric etc	Boosts antioxidant capacity in broilers
❖ **Epigallocatechin gallate (EGCG)**	Green tea extract	Exhibits potent antioxidant and anti-inflammatory effects
❖ **Curcumin**	Turmeric	Provides both antioxidant and anti-inflammatory benefits

11. **Osmolyte Supplementation**: Compounds such as betaine and taurine serve as osmolytes that protect cellular integrity during heat stress. Betaine supports osmotic balance by improving cellular water retention, while taurine contributes additional antioxidant protection, aiding in cellular defence mechanisms under thermal stress.

C. Choosing the Right Birds

1. **Genetic and Breed Adaptation:** Some poultry breeds are naturally more heat-tolerant. Using hardy indigenous breeds or heat-tolerant strains for production during peak summer months can reduce losses. Genetic selection for traits like feather colour and body size is being explored to enhance thermal tolerance in commercial birds. Genes like the "naked

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neck" (Na) and "frizzle feather" (F) reduce insulation and help dissipate heat more effectively.

D. Welfare and Behavioural Adjustments

1. **Space and Comfort:** Lowering stocking density allows birds more space to spread out and reduces body heat accumulation. Providing perches and dust baths can encourage natural behaviours and reduce stress.
2. **Handling and Transport:** Avoid handling or transporting birds during the hottest parts of the day. Stressful practices should be minimised, and cooling measures should be ensured during transit.
3. **Smart Farming Technology to the Rescue:** Precision farming tools like temperature and humidity sensors, automated ventilation, and climate control systems can help maintain optimal conditions 24/7. Real-time monitoring alerts farmers to take action before birds begin to suffer.

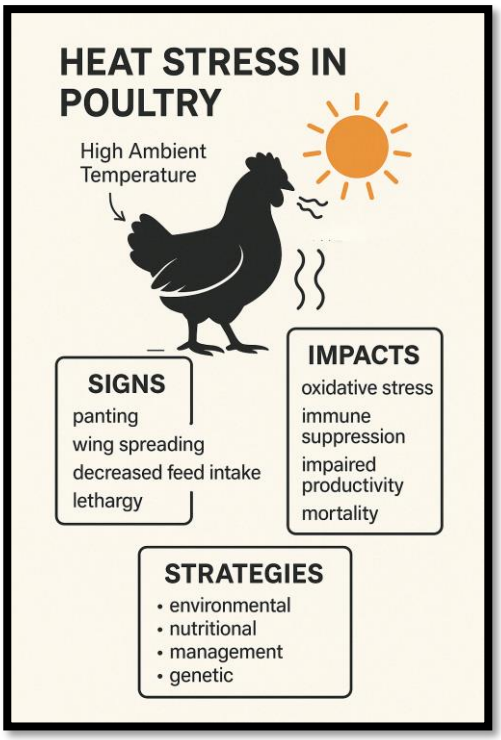

Figure 1. Effects of heat stress in poultry. *High ambient temperatures lead to physiological signs such as panting, wing spreading, decreased feed intake, and lethargy. Heat stress impacts include oxidative stress, immune suppression, impaired productivity, and increased mortality. Management strategies to mitigate these effects involve environmental modifications, nutritional interventions, improved management practices, and genetic selection.*

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CONCLUSION

With the ongoing rise in global temperatures, heat stress has emerged as a significant challenge in poultry production, adversely impacting bird health, growth performance, and both egg and meat yield. Affected birds typically exhibit reduced feed intake, slower weight gain, and increased susceptibility to disease. To mitigate these effects, producers must adopt a comprehensive strategy that integrates environmental modifications, such as improved ventilation, shading, and cooling systems, with targeted nutritional approaches, including supplementation with electrolytes, vitamins, phytochemicals, and high-energy feed sources. Technological advancements in climate control and environmental monitoring offer additional support by enabling real-time adjustments to housing conditions. Ultimately, a multidisciplinary approach that combines effective management practices with scientific innovation and long-term resilience planning is essential for maintaining productivity and poultry welfare under increasingly challenging climatic conditions.

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