The heat is on

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Modern, fast-growing broiler chickens have been genetically selected for a rapid growth rate and improved muscle tissue deposition, which leads to greater metabolic heat production. This, in turn, makes them more susceptible to high temperatures and humidity when compared to older, native breeds. Beside their high metabolic heat production, broilers also have abundant feathers and a lack of sweat glands, which increases their vulnerability to heat stress.

When the temperature and relative humidity exceed the comfort level of a broiler, it loses the ability to efficiently dissipate heat. This leads to physiological changes that result in a reduction in feed intake to reduce metabolic heat production, reduced feed efficiency and a decreased growth rate. Chronic heat stress can also affect the carcass characteristics of broilers by decreasing the percentage of breast muscle and increasing the amount of abdominal fat on the carcass, which will further reduce the profitability of the poultry business during processing of the carcass.

Broilers can be exposed to heat stress in two ways: acute heat stress or chronic heat stress. Acute heat stress can be described as a short and rapid rise in ambient temperature, while chronic heat stress refers to high ambient temperatures over a long period (days to weeks).

The high mortality of broilers in hot environments is mainly due to inefficient evaporative cooling, which leads to an increasing body heat load. The build-up of heat causes a continued increase in body temperature until the birds die from heat exhaustion.

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Over 20 years ago, researchers had already established that high environmental temperatures decreased retention rates of calcium, iron, potassium, sodium and zinc in

broilers. Several researchers have also found that the environmental temperature can influence the immune response of poultry. The means by which high temperatures may act as an immune suppressor are not yet clearly understood, but increases in mineral excretion and hormonal changes may offer some explanation. We do know that the consequences of heat stress include increased mineral excretion and decreased serum and liver concentrations of vitamins such as vitamin A, C and E. Therefore, heat stress may intensify a marginal vitamin and mineral deficiency or lead to increased mineral and vitamin requirements.

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Finding solutions

The harmful effects of high temperatures on poultry performance can be reduced using suitable housing design, installing cooling systems, and by making certain adjustments to feed formulations after taking feed intake and weather conditions into consideration.

Management interventions

Management interventions to reduce the negative impact of heat stress on broiler farms include house positioning and design, water supply and house management. Broiler houses should be built to maximise airflow between the houses on the site and minimise the amount of direct sunlight the houses are exposed too. Roofs should be high and well insulated and can be painted with reflective paint to reduce the temperature inside the broiler house.

The supply of good-quality, cool drinking water during heat stress is critical. The number of drinkers should be sufficient, the pressure in the line high enough to keep up with consumption and the height of the lines correct. If possible, water should be cooled with ice to reduce the effect of heat stress on the broilers. Insulating header tanks will also assist in keeping the water as cool as possible.

Sufficient ventilation is critical in reducing heat stress in a broiler house and wet pads will contribute to cooling down the birds further. Reducing the stocking density during warmer months can also reduce the impact of heat stress on profitability. The movement of people in the house should be kept to a minimum during the hot hours of the day.

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Nutritional interventions

Nutrition can also contribute to the reduction in stress of animals reared in high temperatures. Vitamins such as ascorbic acid can be used to reduce the detrimental effects of heat stress on the performance of broiler chickens. Poultry can synthesise ascorbic acid under normal physiological conditions, but this synthesis is insufficient under stress conditions such as high environmental temperatures and high humidity. Research has shown that environmental stressors can alter the use or synthesis of ascorbic acid in poultry. Therefore, supplementation of ascorbic acid in water during heat stress may have a positive effect on poultry performance.

Specific trace minerals can also be used to alleviate the negative effects of high environmental temperature on the performance of broilers. Two minerals that have been studied extensively in this regard are zinc and chromium.

One of the most important functions of zinc is the role it plays in the prevention of oxidative stress. When zinc is deficient, the oxidative damage to cell membranes caused by free radicals is increased. There are many hypotheses on the exact role of zinc as an antioxidant, including that zinc decreases reactive oxygen species generation. Producing antioxidant enzymes such as superoxide dismutase and glutathione peroxidase is extremely important when broilers are exposed to heat stress. The production of these enzymes can only happen effectively when cofactors such as selenium for glutathione peroxidase, and copper, zinc and manganese for superoxide dismutase, are readily available to the broiler.

The addition of chromium to poultry diets under conditions of heat stress has also been reported by numerous researchers. During periods of stress, the metabolism of chromium in tissues is increased and the products of the metabolism must be excreted through the urine. This may exacerbate a borderline chromium deficiency and/or increase the chromium requirements of heat-stressed broilers

Betaine is another feed additive that may improve broilers' tolerance to heat stress. Betaine has two significant metabolic properties: it can either perform as a methyl group donor and or as an osmolyte, promoting the maintenance of cellular osmolarity. The betaine not used as a methyl donor acts as an osmolyte and protects cells from environmental stresses, such as osmotic variation, extreme temperatures and dehydration. It improves water retention of cells by regulating the surface tension of water and maintaining cellular volume in this way.

Conclusion

Heat stress is a challenge for poultry producers worldwide with huge implications on poultry meat production. The damaging effects of heat stress on broilers reduces the liveability and feed efficiency of birds, as well as the quality of meat produced. Heat stress also has a negative impact on poultry welfare.

An abundance of research has been published on the effects of heat stress on productivity and immune response in poultry, but a better understanding of the physiological processes associated to the reported effects is necessary.

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There are many possible intervention strategies to deal with heat stress conditions and finding the most cost-effective way of utilising these tools will need to be thoroughly investigated together with your nutritionist.