HEAT STRESS MANAGEMENT IN POULTRY FARMING

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ABSTRACT

Heat stress leads to considerable economic losses in poultry farming, particularly in tropical and arid regions globally. Numerous studies have explored the impact of heat stress on poultry welfare and productivity. The adverse effects of heat stress on various poultry species encompass reduced growth rates, diminished appetites, inefficient feed utilization, and compromised meat and egg quality. Recent research has concentrated on the negative effects of heat stress on avian behavior, welfare, and reproductive performance. The main strategies employed to alleviate heat stress in poultry operations have involved dietary supplements and management practices, although the outcomes have been inconsistent. This review article examines the physiological consequences of heat stress on poultry health and production, along with different management and nutritional strategies to address the issue.

INTRODUCTION

Animals are categorized into two primary groups: ectothermic and endothermic. Birds are classified as homeothermic due to their capability to sustain a consistent body temperature year-round; however, their thermoregulatory processes function optimally within specific thermoneutral ranges, specifically between 27.5 and 37.7 °C. Furthermore, as endotherms, birds possess the ability to control their body temperature through the heat produced internally. This internal heat generation occurs as a byproduct of metabolic processes (including glycolysis, the Krebs cycle, and the pentose phosphate pathway) and muscular exertion. Various factors such as enzyme, vitamin, and hormone levels; physical activity; oxygen intake; environmental temperature; and circadian rhythms influence the heat production in avian species. To regulate their body temperature and prevent

HEAT STRESS – CONTRIBUTING FACTORS

The imbalance of energy is affected by various environmental factors, including sunlight, thermal radiation, air temperature, humidity, and stocking density, as well as animal-specific factors such as body weight, feather coverage and distribution, dehydration levels, metabolic rate, and thermoregulatory processes. When environmental temperatures exceed the thermoneutral zone, animals engage thermoregulatory mechanisms to dissipate heat through behavioral, biochemical, and physiological adaptations. Heat stress is categorized into two primary types: acute and chronic. Acute heat stress is characterized by a rapid and temporary rise in environmental temperature lasting a few hours, while chronic heat stress involves prolonged exposure to elevated temperatures over several days. Research indicates that poultry may exhibit some resilience to acute heat stress under certain conditions; however, their compensatory mechanisms ultimately prove inadequate for sustaining tissue integrity, health, and performance over the long term.

THE ANIMAL'S RESPONSE TO HEAT STRESS

When the environmental temperature is above the thermoneutral zone, the animals activate thermoregulation mechanisms to lose heat through behavioral, biochemical, and physiological changes and responses.

Behavioral changes

Panting and exposure of low/non-feathered body areas (raising wings) are the main behavioral mechanisms in which chickens regulate their body temperature when exposed to heat stress. These actions help the chickens to cool down, at a high toll: high energy demands, dehydration, respiratory alkalosis, lethargy, decrease in feed intake, loss of intestinal function and oxidative stress.

Physiological changes

The cardiovascular system also responds to high temperatures by deviating blood to the peripheral areas of the body to maximize the dissipation of heat. This implicates a reduced supply of nutrients and oxygen to the gastrointestinal tract, hindering its functions and provoking inflammation and oxidative stress.

The hypothalamic-pituitary-adrenal (HPA) axis gets activated, increasing the levels of circulating corticosterone, skeletal protein synthesis and the immune system is suppressed, therefore the animals stop growing and are more susceptible to disease.

Heat stress also changes the gene expression of cytokines, upregulates heat shock proteins (HSP), and reduces the concentration of thyroid hormones. When heat stress persists, these cascades of cellular reactions result in tissue damage and malfunction. The animals exposed to heat stress suffer adverse effects in terms of performance, which are widely known and include high mortality, lower growth, and production (Figure 1), and a decline in meat and egg quality.

STRATEGIES TO AMELIORATE HEAT STRESS

A continuous increase in the environmental temperature globally emphasizes the use of different strategies to overcome the effects of Heat stress. Several approaches have been tried with limited success and are discussed below.

Environment and housing

Several rearing systems have been employed to influence the welfare, health and production performances of poultry species. The most commonly used rearing systems are litter rearing system (LRS),

cage rearing system (CRS) and perforated plastic slate rearing system (PSRS) . Growth performance was not affected and found to be similar when broilers were reared in CRS and LRS. However, in comparison with PSRS, the other systems (CRS and LRS) were preferred in terms of growth performance and carcass yield under HS. Due to the high installation costs associated with CRS, LRS is more famous for rearing broilers in developing countries. In contrast, LRS systems are more preferable for the rearing of laying hens due to better immune responses and fewer chances for pathogenic infections.

To avoid economical loss due to heat stress, several methods have been tried including lowering stocking density, better housing and ventilation, and proper cooling systems. However, the poultry industry is extremely competitive in nature and any additional cost will imply enhancing the price of the final product. So, it is extremely important to keep the expenses towards the lower side. Modification of housing, ventilation, and cooling systems are probably applicable on a regional basis and sometimes require a high cost to build and maintain. Due to their impracticality and high cost, some of the aforementioned methods, however, cannot be applied in some regions and farms in the developing countries. Nutritional strategies were therefore given more importance in comparison with housing and management.

Ventilation

In most cases, you can manage heat in your flock through air flow. Airflow at the birds' level is key to removing bird heat. Increasing ventilation to remove heat from the birds should be your first

priority. However, some cases exist where ventilation is limiting.

Naturally ventilated barns are at risk of heat stress if the air is calm and supplemental fans are not present. Mechanically ventilated barns can also be at risk if they lack ventilation capacity and air mixing for the size and number of birds present.

Feeding

Birds are usually hungriest in the morning and tend to fill up, which makes them more prone to heat stress in the afternoon. Withdrawing feed six hours before peak warm temperatures in the afternoon can lower the risk of heat stress. You can reintroduce the feed

after peak temperatures have started to decline. Birds can then feed during nighttime hours when we expect cooler temperatures to occur. You can use lighting during nighttime (midnight) feeding to allow intake. Depending on how often you use this feeding method, you may notice some body weight loss. Only use this feeding method when you expect heat stress temperatures.

Water

Chickens drinking from a waterer. During heat stress, birds will increase their water intake by 2 to 4 times the normal amount. Sufficient water space, operating waterers, and cool water temperatures will encourage the birds to drink. Flush water lines and waterers routinely to keep the water fresh and cool.

Electrolytes

Heat stress causes increased loss of several minerals, including potassium, sodium, phosphorus, magnesium and zinc. You can add electrolytes to your flock's drinking water for up to three days. Potassium chloride electrolytes, provided in drinking water at a 0.6 percent concentration, appear to increase water intake. They have been generally more effective than other potassium and sodium salts. You should start providing electrolytes before the heat stress period.

Sodium bicarbonate

Sodium bicarbonate in the feed or carbonated water is especially useful for hens in egg production. Panting and carbon dioxide release can change the acid-base balance in poultry and the bicarbonate available for eggshell formation. Sodium bicarbonate can help lessen these changes.

Vitamins

Supplementing drinking water with vitamins (A, D, E and B complex) can effectively tackle heat stress mortality in broilers. In breeding poultry, vitamin C can effectively moderate warm temperature declines in egg production and eggshell quality in laying hens and sperm production in breeder males.

Other practices

Delay activity in the barn, such as moving birds or litter conditioning. Provide shade for pastured poultry or decrease sun exposure in the barn.