

Heat Stress in Poultry & Ways to Ease its Effects

High environmental temperature is one of the most serious factors affecting broilers, turkeys, and quail by reducing their feed intake, body weight gain, immune system, disturbing acid-base balance as well as increasing mortality. Life threatening combinations of high temperature and humidity call for emergency procedures to reduce mortality.

Heat is produced by the bird through metabolic activities for maintenance, growth, muscle activity, feeding and egg production. Heat can also be gained from the environment as air temperatures increase, energy from building lights, possible sunlight, or contact with warm surfaces or other birds. In trying to minimize the effect of warm temperature, heat loss needs to be equivalent to the heat gained. Under most conditions heat transfer is managed through ventilation system. However there may be times which ventilation maybe limiting and birds continue to gain heat.

In general, heat stress occurs as the core body temperature continues to increase to fatal temperatures because heat removal is insufficient and metabolic coping mechanisms are limited. For most poultry, the thermoneutral zone is between 60 to 75° F which is the temperature range where heat production is at a minimum. As temperatures increase to the upper critical temperature of 85 ° F, the bird adjusts to the increasing temperature by behavioral changes and decreases in feed intake and production. These adjustments are sufficient to keep core body temperature from increasing. As air temperature increases toward the critical thermal maximum temperature of 100° F, heat gain exceeds heat loss and core body temperature will increase toward lethal body temperatures unless relief is provided. As air temperature continues to increase past 85 ° F, the bird responds by trying to lose more heat through evaporative cooling which is accomplished by panting.

The panting process as a physiological mechanism for controlling body temperature also generates heat through muscular activity. Hyperventilation results in dehydration and loss of carbon dioxide from blood and tissues. In turn, the lower concentration of hydrogen ions causes a rise in plasma pH and ultimately, respiratory alkalosis, which is also related to negative mineral balance for K⁺ and Na⁺. During respiratory alkalosis, naturally birds attempt to correct blood pH by excreting negatively charged bicarbonate ions. The bicarbonate ions must be coupled with positively charged ions, such as sodium (Na⁺) or potassium (K⁺), before being excreted through urine. Ultimately, the losses of Na⁺ or K⁺, or both, in urine result in acid-base imbalance. Potassium, the most abundant

intracellular cation, is involved in many metabolic processes, including nerve conduction, excitation-contraction in muscles, and regulation of cell volume. Consequently, changes in K⁺ homeostasis profoundly affect cellular functions. Without corrective action, the changes become acute and bird can no longer sustain itself.

Ways to alleviate heat stress:

- Ideally, increasing ventilation to remove heat from the birds should be the first priority. However, situations may exist where ventilation is limiting. Heat stress strategies when ventilation becomes limiting would involve those to limit heat gain and increase efficiency of heat loss.
- Another management strategy for turkeys and broilers has been to withdraw feed 6 hours prior to the peak warm temperature in the afternoon. Feed can be re-introduced after peak temperatures have started to recede which allows feeding during night time hours when cooling is expected. Some body weight reduction might be observed depending on the frequency of use and therefore should be used only when heat stress temperatures are expected.
- Also the use of electrolytes in the drinking water may be of some help. Heat stress causes increased loss of several minerals including K, Na, P, Mg and Zn.
- Potassium chloride appears to increase water intake when supplemented in the drinking water at concentrations of 0.6% and has been generally more effective than other potassium and sodium salts. As in feed restriction therapy, the supplementation should occur prior to the heat stress period.
- Sodium bicarbonate in the feed or use of carbonated water is especially useful for hens in egg production as panting and carbon dioxide release impacts the acid base balance and the bicarbonate available for egg shell formation.
- Water supplementation with vitamins A, D, E and B complex can also be effective combating heat stress mortality in broilers.
- In breeding poultry, Vitamin C has been shown to be effective in moderating warm temperature declines in egg production and eggshell quality in laying hens and sperm production in breeder males.

- Having sufficient water space, operating waterers and cool water temperatures will help encourage water intake.
- Protein ingestion cause a greater increase in heat production than carbohydrates or fat. It has been reported that providing heat-stressed broilers with dietary crude protein higher than their requirements is detrimental to weight gain, feed efficiency, and carcass composition. Thus, reduction of dietary protein in heat-stressed chickens with adequate fortification of several essential amino acids may improve performance.