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NUTRITIONAL MANAGEMENT TO ALLEVIATE HEAT STRESS IN BROILERS

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Poultry meat production has shown much higher growth than any other type of meat production. The hot regions of the world have probably the greatest potential for further growth since the level of poultry meat consumption is still very low. There are several constraints to the future development of the poultry meat industry in the hot regions of the world. The availability of adequate supplies of grain and protein supplements necessary for the production of feeds is another major constraint for development. The most obvious constraint to high production regions is climate. High temperature, especially when coupled with high humidity, imposes severe stress on birds and leads to reduced performance. Certain nutritional manipulations and feeding practices that have been found to be helpful in reducing heat stress in broilers.

Ideal temperatures

- Birds perform well within a relatively wide range of temperatures.
- This range extends between 10 and 27°C.
- Found that the highest growth rate of broilers occurs in the range of 10-22°C, while maximum feed efficiency is at about 27°C (Kampen, 1984). For growing broilers it is 18-22°C (Charles, 2002).
- It is known, however, that what is ideal for growth is not ideal for feed efficiency. The overall optimum range mainly depends on the market value of the product produced, relative to feed cost. As the price ratio widens, the best temperature falls, and vice versa.

Natural physiological response of broilers to heat stress

Broilers subject to high environmental temperatures exhibit many behavioral changes which allow them to re-establish heat balance with their surroundings. Broilers rest more during heat stress periods. Some birds will stand quietly while others simply crouch near walls (or) waterers. Usually, their wings are spread away from the body to promote cooling by reducing body insulation. Within the bird, blood flow is diverted from certain internal body organs such as the liver, kidneys and intestines to dilated blood vessels of the peripheral tissue (skin) in order to facilitate heat loss. Hyperventilation or "panting" increases during high

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environmental temperature. Heat loss through evaporative cooling allows the broiler to dissipate the heat. However, panting requires increased muscle activity and this results in an increased energy requirement which is associated with heat stress. Therefore, decreased energy efficiency also accompanies hot weather. Relative humidity influences evaporative heat loss through panting. Broilers, as well as other domestic poultry, cannot tolerate high temperature coupled with high relative humidity. Death due to heat exhaustion will occur very quickly, especially in heavier birds, if both temperature and humidity are high. In normal birds, panting will remove approximately 540 calories per gram of water lost by the lungs.

Panting influence pH or acid-base balance

Normally, blood pH is controlled by the lungs and kidneys along with the various buffer systems which prevent rapid changes in the pH. However, as the respiratory rate increases in heat stressed broilers, there is a corresponding decrease in the levels of blood carbon dioxide, which results in respiratory alkalosis (elevated blood pH). Heat stress also depletes potassium and other minerals in the body, altering the delicate electrolyte balance in the body.

Decrease in feed intake during heat stress

Broilers maintained in hot environments reduce their feed consumption. This is a part of their physiological adaptation to heat stress. The reduction in feed intake results in a decrease in the daily intake of nutrients responsible for growth. Thus, even though growth is slowed, the broiler can now more easily cope with the heat because of the lessened need for heat dissipation. The survival rate of broilers decreases as feed intake increases during heat stress, especially during the hottest part of the day.

WAYS OF HANDLING HEAT STRESS DURING SUMMER

1. Plant shade trees around the poultry house.
2. Reduce the thickness of the old built-up litter. Two inches of fresh litter may be provided in the place of old litter.
3. Hang wet gunny bags on the sides.
4. Stocking density

If the higher the bird density in farm, more heat will be produced. Birds in density stocked barns tend to absorb each other’s radiant heat load, which makes more difficult heat management for broilers. Reducing the bird density in summer will give more floor space per bird and allow more heat to escape from underneath their bodies and from the litter.

5. Evaporative cooling

Sprinklers are commonly used for evaporative cooling when temperatures are more then 79-86°F (26-30°C). Too much water can actually increases the barn to dangerous level. Generally foggers reduce the temperature of shed up to 5-10°C.

6. Ventilation

Proper ventilation is crucial for heat stress management. A good ventilation system performs the following

- Remove moisture laden air from the broiler house.
- Brings in an equal amount of fresh outside air.
- Directs incoming air to all areas equally.
- Keeps inside air moving to flush hot, humid air from between the birds.
- Providing exhaust fans on one side and pad cooling on other side with complete sealing of sheds side will bring down the temperature of below 8°C.

7. Flock walking helps to alleviate heat stress

The purpose of flock walking is to make birds release heat trapped under body. If this is carried out before birds shows the signs of stress. If the birds are very quite (or) have heads drooping, it is probably best not to disturb them any further.

8. Nutritional strategies to reduce heat stress in broilers

The most important factor affecting performance in broilers subjected to high temperature is reduced feed intake. Feed conversion in broilers is subject to marked fluctuations because of seasonal as well as ambient temperature changes. High temperatures reduce the efficiency of utilizing feed energy for productive purposes. Broilers not only eat less at high temperature, but also gain less per unit of intake, especially at temperatures above 30°C.

Benefits of fasting during heat stress

In addition to heat-stress mortality, economic losses associated with broiler heat stress also occur as a result of lowered growth rate and decreased feed efficiency. Therefore, it is natural for producers to want to stimulate feed consumption in hot weather. However, any management technique which promotes feed consumption (or) increased activity during the peak hot periods may be counterproductive. The extra feed consumed will increase the bird's heat load and probably result in additional mortality. Fasting the broiler prior to (or) during peak hot periods of the day lessens the heat load and enhances survival (Yalcin *et al*. 2001). During heat wave is not to feed between 8 am and 8 pm. Fasting will probably result in reduced weight gain, a longer growing period and thus a delay in marketing age, but also reduced mortality.

BROILER DIET IN HOT CLIMATES

- Increasing the energy content of the diet can partially overcome the growth depression.
- Boost the energy level of these diets by adding fat. This practice not only increases the energy intake but also reduces the specific dynamic effect of the diet, which helps birds to cope better with heat stress. High fat diets (5%) helped in reducing the detrimental effect of heat stress in broilers raised at 29-36°C (Ghazalah *et al*., 2008). High fat content of the diet helps to reduce heat production, since fat has a lower heat increment than either protein (or) carbohydrate. The addition of fat to the diet also appears to increase the energy value of other feed constituents (Mateos and sell, 1981) and has been shown to decrease the rate of food passage in the gastrointestinal tract and thus increase nutrient utilization (Mateos *et al*., 1982).
- Besides energy, consideration must be given to the amino acid balance of the diet during heat stress. Minimizing excess amino acids usually improves feed intake. During hot periods, lower protein diets supplemented with limiting amino acids (mainly methionine and lysine) will give better results than high protein diets.
- Several acid-base imbalances occur in heat-stressed broilers. The occurrence of alkalosis in heat stressed birds has been known for a long time and the addition of ammonium chloride, potassium chloride and/or sodium bicarbonate have improved performance of broilers by improving water and feed intake (Ahmad *et al*., 2008).
- Mineral therapy appears to be one of the effective means of reducing detrimental effects of heat stress in broilers.
- The dietary electrolyte balance (DEB), also known as acid-base balance is probably more critical at high temperature than at normal temperature, and different results have been reported on the most appropriate DEB for birds under high temperature conditions. Very high (360mEq/kg) and very low (0mEq/Kg) DEB can result in metabolic alkalosis and acidosis, respectively. Very high and low DEB should be avoided during diet formulation. The birds under heat stress will perform best at a DEB of 250 mEq/Kg (Ahmad and Sarwar, 2006).
- At the same time, excesses or deficiencies of any specific mineral should be avoided. Dietary requirements are 0.20-0.25 per cent sodium and 0.30 per cent chloride (Mushlag *et al*., 2007).
- Vitamin C supplementation (1 g ascorbic acid / liter drinking water) is probably the most beneficial among vitamins throughout heat periods. In addition, a vitamin pack of A, D,

E and B complex supplementation of drinking water is beneficial for both performance and immune function of heat–stressed broilers.

- Vitamin stability is of primary concern. Temperature, moisture, and oxidation by polyunsaturated fatty acids, peroxides and trace minerals are the most critical factors affecting vitamin stability in both complete feeds and vitamin-trace mineral premixes. Therefore, vitamin activity in feeds should be preserved by the incorporation of antioxidants.
- Gelatin-encapsulated vitamins, appropriate storage conditions, adding choline separate from the vitamin and trace mineral premix, delaying the addition of fats until just before the use of the feed and using feeds as soon as possible after mixing.
- For hot climates, that protein levels should be about 1-2 per cent lower than usually recommended for temperate regions. Energy levels should be adjusted to protein levels. The potassium level should be increased to 0.6 per cent in contrast to 0.4 per cent normally recommended in cool climates.
- Levels of critical amino acids should be about 5-10 per cent higher than normally used at the same protein level.
- In many cases, straight-run broilers are fed a starter diet for the first three weeks of age; a grower diet from three to five weeks of age; and a finisher diet from five weeks to market weight. If the growth rate is depressed due to hot climate, it may be necessary to feed the grower to six weeks.
- In hot and humid climates, slight increase in dietary protein later in the broiler cycle may be beneficial for growth and feed efficiency. These increases in dietary protein are also helpful in reducing abdominal fat content.
- Intermittent feeding programme have been used in some broiler operations. This method could have possible applications in hot climates since the hours of darkness provide minimum activity on the part of the birds and therefore reduced heat production.
- Water plays an important role in cooling broilers. The cooling of the drinking water, the better the birds can tolerate high environmental temperature.
- Farmers usually provide broilers with approximately 25 per cent more drinker space than the standard cool climate recommendation. Where possible, wide and deep drinkers, permitting not only the beak but all the face to be immersed, should be used.
- In case chlorinated water is being used in the farm, it is recommended to discontinue chlorination on extremely hot days.

- Maintenance of both carbon dioxide and blood pH is critical to the heat-stressed broiler and the addition of ammonium chloride and potassium chloride to the drinking water to maintain this balance is advised. The addition of extra vitamins and electrolytes to the drinking water will also be beneficial.

Conclusion

A range of intervention strategies to alleviate heat stress conditions in broilers including environmental management (such as facilities design, ventilation, sprinkling, shading, etc.), nutritional manipulation (i.e., diet formulation according to the metabolic condition of the birds), as well as inclusion of feed additives in the diet (e.g., antioxidants, vitamins, minerals, probiotics, prebiotics, essential oils, etc.) and water supplementation with electrolytes.

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