Effects of heat stress and nutritional regulation measures in poultry

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What is heat stress

- Chicken body temperature is usually 40.5 to 42℃, the standard temperature is 41.5 ℃.
- When the ambient temperature of chicks was 0 ~ 30℃, there have no significantly effects on chickens.
- However, when the temperature exceeds 30℃, the body temperature will increase slightly with the increase of ambient temperature.
- When it reaches 35℃, it will generate heat stress, and death may occur at temperatures above 38℃

Causes of heat stress

- For chickens, the growth rate is fast and metabolism is vigorous, which will produce more metabolic heat.
- The whole body is covered with feathers and there is no sweat gland, which will inevitably induce more serious heat stress.

Causes of heat stress

- The heat stress mainly because of intensive feeding :
- excessive humidity,
- poor ventilation,
- excessive light and feeding nutritionally unbalanced feed,
- especially in intensive chicken farms.

Heat stress inhibits feed intake of chickens

- The higher the ambient temperature, the greater the decrease of feed intakes.
- The results showed that when the ambient temperature was between 20 ℃ and 30℃, the feed intake of laying hens decreased by 1.5% to 1.6% for each 1℃ increase of ambient temperature.
- When the temperature over 32℃, the feed intake of chickens decreased greatly.
- In the range of 32-38 ℃, the feed intake of chickens decreased by 5%/℃

Heat stress inhibits egg production of chickens

- At 28 ℃, it can only meet 90% of the egg production of laying hens and can not be used for growth.
- When it exceeds 28 ℃, the production availability will decrease sharply, resulting in the decline of egg production.
- At 33 ℃, laying hens appears negative balance of body energy.

Heat stress affects digestibility of chickens

- Heat stress could reduce the peristalsis speed of food in the digestive tract, prolong the residence time of food, and reduce the enzyme activity of the digestive tract.
- It is the result of changing the hemorheology of digestive tract and even destroying the microecological environment in digestive tract.
- The activities of total proteolytic enzyme, lipase and amylase decreased by 27.05%, 32.89% and 29.32%, respectively, at ambient temperature of 34.7°C.
- And it is closely related to the decrease of daily weight gain of broiler chickens.

Heat stress affects protein and fat metabolism

- At high temperature, protein deposition rate decreased for chickens, decomposition into glycogen ability enhancement, serious protein decomposition than absorption, urine nitrogen excretion increased, which result in negative nitrogen balance, weight loss, and the growth performance decreased significantly.
- Heat stress can promote fat deposition and significantly increase the abdominal fat rate.
- It was found that the total fat of chickens increased by 0.8% and the abdominal fat increased by 1.6% when the temperature increased by 1℃.

Heat stress affects vitamins requirements

- Under heat stress, the absolute intake of VA is not affected by temperature.
- The requirement of VB1 for chicken growing at 32℃ was 3 times higher than that at 21℃.
- Heat stress could inhibit the transformation of VD into its active form.
- Under heat stress, the absorption of dietary VC in breast muscle of broilers reached the peak 2 hours earlier than that in the control group, and began to decrease 2 to 4 hours later, while the decrease in the control group was 2 hours later.

Effects of heat stress on laying rate and egg weight

- When the temperature increased from 21℃ to 29℃, the laying rate had no effect, but the egg weight decreased significantly.
- When the temperature exceeded a certain limit, the laying rate also decreased significantly.
- The chickens were kept at 21℃, 32℃ and 38℃ for 8 weeks, the daily egg production was 79%, 72% and 41%, respectively.

Effects of heat stress on eggshell quality

- High temperature makes the quality of egg shell decline, the performance of eggshell thin and brittle, coarse surface, broken egg rate increased.
- The deterioration of eggshell quality can contaminate surrounding high-quality eggs due to breakage, affecting the grade of eggs,
- Among the eggs collected in heat stress environment, the rate of soft shell eggs or eggs without shell eggs ranged from 2.4% to 16.1% (average 7.77%).
- Eggshell defects and cracked eggs accounted for 21% of total egg production in tropical environments.

Adjust nutrient level in feed

- In the high temperature environment in summer, sufficient nutritional supplements are needed to maintain normal physiology and production.
- When the ambient temperature exceeds 27℃, the feed intake of laying hens will decrease with the increase of temperature.
- To solve this contradiction, feed nutrition must be adjusted according to feed intake and nutrient concentration should be increased to compensate for inadequate intake of energy, crude protein, minerals and multivitamins caused by heat stress.
- The range of increase depends on the decrease of feed intake, generally about 5% ~ 10% increase.

Adjust nutrient level in feed

- The performance of heat-stressed chickens was improved by replacing isoenergetic carbohydrates (such as corn) with oils at high temperatures.
- However, when using oil at high temperature, we must pay attention to prevent its oxidation and rancidity. We can add a certain proportion of antioxidants to the oil, and store it in a space with proper ventilation and temperature to alleviate the oxidation of oil.
- Under normal circumstances, the amount of oil added in feed in summer is 1%~3%.

Adjust nutrient level in feed

- During the high temperature in summer, the heat stress of chickens leads to less feed intake.
- In order to meet the nutritional needs of chickens for energy and protein, the nutrient concentration of feed must be increased.
- The nutritional characteristics of oil are that the intake of poultry leads to low heat gain and consumption, and the energy storage in chicken body increases.
- At the same time, oil can improve the palatability of feed to a certain extent, so as to improve the performance of chickens.

Adjust nutrient level in feed

- Increasing the content of energy substance in feed can improve the energy intake caused by heat stress.
- At present, an ideal way to increase energy in feed is to replace carbohydrates with fat.
- Because carbohydrates generate more heat in the process of digestion and metabolism, it is easy to increase the heat dissipation burden, so the proportion should be appropriately reduced.

Adjust nutrient level in feed

- Meanwhile, fat can change the palatability of feed and prolong the retention time of feed in digestive tract, thus improving the feed intake and digestion and absorption of laying hens.
- During heat stress, 2% ~ 3% of fat should be added to feed, but fat is easy to oxidize and deteriorate, so antioxidants should be added at the same time.

Adjust nutrient level in feed

- In terms of protein, although increasing protein levels can supplement the decrease in protein intake caused by the decrease in food intake, in fact, the method of increasing protein levels is not beneficial to prevent heat stroke.
- The main reason is that when protein is converted into energy, excretion of metabolites such as uric acid increases the heat production of chicken body, and the body heat consumption increases.

Adjust nutrient level in feed

- Studies have shown that appropriate increase methionine, lysine and other essential amino acids to a certain extent alleviate the heat stress.
- Low protein diet and appropriate supplementary essential amino acids, such as lysine, methionine, etc. to reduce the protein using the heat produced by increased consumption, alleviate the heat stress.
- During heat stress, the protein to energy ratio of feed can be slightly reduced, and the formula of low protein and high energy with amino acid balance can alleviate the heat stress of chickens

- According to the surplus or deficiency of amino acids in the diet, essential amino acid should be added, and egg amino acid can be added by 10% to 15%.

Adjust nutrient level in feed

- Different feed protein sources also have different feeding effects on chickens under heat stress.
- During heat stress, the use of protein raw materials with high digestibility of protein and essential amino acids, less indigestible parts, can reduce the burden of intestinal metabolism and excretion, and reduce heat stress.
- Under normal circumstances, soybean meal type feed preparation, low digestibility of raw materials such as blood meal and hydrolyzed feather meal should be carefully used or not used.

Adjust electrolyte balance

- Under heat stress, potassium and sodium in chickens increase with the excretion of urine, resulting in imbalance of blood and electrolyte balance in chickens.
- Adding sodium bicarbonate and potassium chloride in feed or drinking water can supplement and restore electrolyte balance in chickens, so as to improve the performance of chickens under heat stress.

Adjust electrolyte balance

- Using sodium bicarbonate (baking soda) in chicken feed or drinking water can increase the concentration of H+ in blood, slow down the respiratory alkali poisoning caused by heat stress, improve the ability to resist heat stress.
- Baking soda can improve the calcium metabolism of the body, decompose CO2 in the digestive tract and take away a lot of heat from the digestive tract, which is conducive to maintaining the body's thermal balance at high temperature.
- Under heat stress, 0.1%~0.3% bicarbonate of soda could be added to feed, and the amount of salt (sodium chloride) could be reduced.

Adjust electrolyte balance

- Generally, the added concentration of potassium chloride is 0.15% ~ 0.30%.
- Adding 0.5% suds to the diet plays an important role in maintaining carbon dioxide or pH value in blood of heat-induced chickens, and can reduce defective eggs by 1% ~ 2%, increase laying rate by 2% ~ 3%, increase eggshell thickness and increase protein utilization rate in diet.

Proper vitamin supplements

- Heat stress reduces feed intake in chickens.
- And increased demand for certain vitamins.
- Vitamin levels need to be raised appropriately.

Proper vitamin supplements

- The absolute intake of vitamin A was not affected by heat stress, but the intake of vitamin E, vitamin C and B group vitamins was greatly changed, and the supplemental level could be adjusted to 2 ~ 3 times of the normal level.
- Under the condition of high temperature, the synthesis of vitamin C in the body of laying hens is inhibited, and additional compensation is needed, which can be added in drinking water from 150 to 200 mg/kg.

Proper vitamin supplements

- The absorption of vitamin A by chickens also decreases at high temperatures, so the amount of vitamin A used in breeding is two to three times the normal amount.
- Heat stress can reduce the activities of uterine carbonase and vitamin D, affect the eggshell quality and blood calcium of laying hens.
- Production trials have shown that supplementation with 25-hydroxyvitamin D3 in hot conditions can see better feeding results, particularly in terms of reduced mortality rates.

Proper vitamin supplements

- Vitamin C and vitamin E have been reported more frequently.
- Under normal circumstances, the vitamin C synthesized by chickens can meet their needs without additional supplementation, but under heat stress, the demand for vitamin C increases and additional supplementation is required.
- Because vitamin C is easy to be oxidized and inactivated in practice, it is recommended to use coated vitamin C.
- In the case of heat stress in summer, 200~400 grams of feed should be added to one ton, or 100~200 grams of drinking water should be used in one ton.

Proper vitamin supplements

- protecting the cell membrane stability during heat stress improves survival E levels, which reduce cell membrane permeability, prevents excessive calcium ion from flowing in on normal fine cell metabolism interference is beneficial to improve chicken immunity epidemic response, reduce chicken body enzymes or hormones metabolic disorders and decreased bioactivity caused by a level imbalance.
- The amount of vitamin E added in the generally, 20~50 mg/kg, heat stress use 100~200IU/kg.

Proper vitamin supplements

- In terms of other B vitamins, it has been reported that when the temperature is above 32℃, the demand for vitamin B1 of chickens is twice that of 21℃.
- Increasing vitamin B6, vitamin B12 and other B vitamins can improve the performance of heat stress chickens.
- A large number of studies have shown that most of the vitamins are beneficial to relieve the heat stress of chickens.

Proper mineral supplements

- Zinc is an essential trace element in energy and protein metabolism of chickens to achieve enzyme activities.
- Many studies have confirmed that zinc is involved in the composition of various enzymes and functional proteins and the metabolism and activity of various substances in animals.
- A large number of studies have shown that zinc plays an important physiological and biochemical function in alleviating the damage caused by heat stress to chickens.

Proper mineral supplements

- Zinc enhances the antioxidant effect of chicken cells under heat stress, promotes the digestion and absorption of feed nutrients in chickens under heat stress, and improves the body immunity of chickens under heat stress.
- Studies have shown that when chickens are subjected to heat stress, the morphology of the small intestine will change: intestinal mucosal cells are damaged.
- Zinc can enhance the tight connection of intestinal epithelial cells and relieve the intestinal injury of chickens under heat stress.
- In general, the feed dosage is recommended 90~100mg/kg.

Proper mineral supplements

- In order to ensure the intake of at least 3.5g Ca per day, the dietary calcium content can be increased to 4%, but the ratio of calcium to phosphorus should be kept at 4： 1, and more than 50% of the total calcium is the source of granular calcium.
- Where conditions are available reliable quality shell powder can be used to replace stone powder, stone powder, shell powder mixed use, so that the ratio of shell powder and stone powder is 1:3 ~ 1:4.

Proper mineral supplements

- Heat stress results in the disorder of glucose metabolism and mineral metabolism in chickens, and the glycogen degradation and heterogenesis are strengthened.
- Supplementing chromium source under heat stress can enhance glucose utilization, which is conducive to relieve the adverse reactions of heat stress.
- Some studies have also shown that chromium can improve the immune function of chickens under heat stress.
- Generally, 0.2~0.5mg/kg chromium was added in the feed to relieve the heat stress of chickens.

Proper mineral supplements

- Selenium is an antioxidant that prevents the lipid structure of the cell membrane destroyed.
- Selenium supplementation in feed has certain effect on performance of chickens under heat stress
- To alleviate and regulate its effects in feed, the optimal supplemental level is 0.5mg /kg.

Proper feed additives supplements

- The main function of acidifier is to decrease the pH value of digestive tract and improve the activity of digestive enzymes. Improve gastrointestinal microflora, relieve diarrhea and other intestinal problems.
- Research shows that compound acidifier can alleviate the heat stress, make protein metabolism and immune function tend to normal, regulate the body's immune system, improve the body's immunity.
- Generally speaking, the dosage of compound lactic acid acidifier in feed is 2~5mg/kg, and the dosage of envelope acidifier is half of compound acidifier.

Proper feed additives supplements

- High temperature and humidity in summer, diarrhea and other intestinal problems are more common, which makes the digestion and absorption of feed nutrition worse.
- Therefore, beneficial bacteria such as bifidobacteria, lactobacillus and streptococcus faecalis can be added to feed or drinking water to regulate intestinal health environment, improve feed nutrition digestion absorption rate, reduce the breeding of harmful bacteria.

Strengthen feeding management to prevent heat stress

- Check and maintain ventilation, cooling equipment and drinking water facilities in advance.
- Check whether the ventilation equipment is perfect and effective, that is, check whether the fan motor is running normally in the chicken house with longitudinal ventilation (the requirements of the fan should meet the maximum wind speed of 3m/s in the house), check whether the belt is aging and lax;
- Shutters should be repaired in time. Clean and smooth, ensure its normal opening and closing, check whether the chicken house is good airtight, accurately calculate the area of the air inlet, scientific setting and adjustment of the air inlet position.

Strengthen feeding management to prevent heat stress

- Improve the greening work improve the microclimate in the chicken coop around planting trees and grass.
- Tall trees, so not only does not affect the ventilation and can play a role of shade, avoid direct sunlight, planting lawn can absorb a lot of heat, avoid sunlight reflection to the chicken coop, practice has proved that reasonable greening can effectively reduce the temperature 3~5℃.

Strengthen feeding management to prevent heat stress

- Water spraying cooling every day in the morning 11： 00 to 16： 00 in the afternoon the hottest period, that is, the temperature of more than 33℃, with a sprayer or spray machine to the top of the chicken house water.
- The temperature of chicken house can be reduced 2~3℃ by spraying water on the roof.

Strengthen feeding management to prevent heat stress

- Adjust the density of chicken group in the summer
- each chicken cage as far as possible to put a few chickens.

Strengthen feeding management to prevent heat stress

- Increase ventilation in summer high temperature and humidity, so it is necessary to timely ventilation of the chicken house, keep the fresh air in the house, do not feel dazzling, tears, not a choking nose, no excessive ammonia taste is appropriate.
- To ensure the air flow in the chicken coop, it is best to take the way of longitudinal ventilation.

Strengthen feeding management to prevent heat stress

- The increase of night light can promote the feeding of chickens, which can be increased by 2 hours in the rearing stage, less than 1 hour in the next rearing stage, and 0.5~1 hour in the laying stage.
- The increase of night light can increase the feeding of chickens by 2~3 g, so as to effectively relieve the heat stress of chickens.

Water

- Water occupies a large proportion in chicken body, the water content of young chicken body can be as high as 70%, especially 1within weeks of age, the water content in the body is 85%, mainly exists in the cell fluid and extracellular fluid, of which the water in the intracellular fluid accounts for 50%, the water in the extracellular fluid accounts for 15%.
- Most of the water intake by the chicken body is through drinking water, the rest is from the water in the feed and nutrients in the body after the metabolism of metabolic water.

Water

- Provide clean and fresh water for chickens, and properly add electrolyte into the water for chickens.

THANK YOU

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