

NUTRITIONAL STRATEGIES FOR OPTIMAL BROILER GROWTH

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The broiler industry in India is in a dynamic state, the chicken meat production is expected to increase from 120 thousand metric tons in 1981 to 1800 thousand metric tons in 2005. The rate of growth in the recent past is unimaginable, from 20th position in world chicken meat production ranking in the year 2000, India has reached the 5th position in 2005. The present day broiler is like a machine growing from a 45 to 50 gm body weight on day one to 2 kg body weight in 40 days time, which is nearly 40 times its initial body weight. The magnitude of the growth indicates that every day in the life of a broiler is very important to achieve the target, as it forms nearly 2.5% of its life period.

To plan the nutrition of the broiler we have to keep in mind the following points

1. Weight of the hatching egg and its influence on final body weight
2. The yolk and its importance
3. First seven days in the life of the broiler
4. Energy utilization growth vs. maintenance

1. Weight of the hatching egg and its influence on final body weight

It is a well known fact that the weight of the egg influences the growth rate and the final body weight of the birds. The effect of 1g increase in egg weight on the final body weight of females is 8gms and in males it is 5gms, the increase is more in dressed weight, it is 14gms in females and 11gms in males. The impact in terms of economic advantage will be nearly 20paise/chick and about 17 paise/hatching egg.

2. The yolk and its importance

The chick during incubation is totally on fat and protein diet with fat as the major source of energy. The common impression is that the hatchling is supposed to depend on the yolk for the energy and protein need till it is housed and fed, which may take 24 or 36h. Considering the fact that the yolk contains 50% dry matter with protein and fat in equal quantities the above statement is justified. Although the protein fraction is partly albumen, a large fraction of the egg protein in the hatchling consists of antibodies. Under normal circumstances, maternal antibody is not digested during the incubation process, leaving these immunoglobulins intact and fully functional at the time of hatch, indicating that the protein in the yolk sac is to be used for the passive immunity of the chicks and not as a source of amino acids. Similarly, the residual yolk lipid should be used for growth and not as an energy source for maintenance as some fatty acids in the yolk lipid may influence the partitioning of nutrients and the pace of development of certain organs systems.

3. First seven days in the life of the broiler

a) Development of digestive organs

In the post hatched chicks intense changes occur in the intestines compared to other parts. The proportional weight of the intestine compared to the whole body mass steeply increase from 0.02% on day 1 to 0.08% on day 8. The pace of development of the intestine is in tune with the concept that supply organs developing in advance of demand organs. At hatching the villi of the small intestine are undeveloped and the crypts in the intervillus spaces are not detectable. The crypts begin to form in the first few hours and become defined in 72h time, the process continues and the villi are well defined by 336h after hatch. The total villi surface area in the jejunum increases from about 50 cm² at hatch to about 550 cm² on the 10th day. The development of the intestine though is rapid during the first 72h it continues up to the 10th day indicating that careful planning is needed in the formulation of the diet during the first week of the bird's life.

b) Secretion in the gut and utilization of nutrients

Reviewing the various reports on the enzyme's secretion, it was found that the secretion of various enzymes increased by 15 fold between 4th and 21st day, with the major increase between 4th and the 10th day. The trypsin secretion was the highest at day 4, which was about 8iu/gm of feed intake, it reduced to about 4iu/gm of feed intake on day 7. The amylase secretion increased from about 17iu on day 4 to about 20iu on day seven and subsequently reduced to about 14iu/ gm of feed consumed. The lipase secretion increased from about 1.4iu on day 4 to about 2iu on day 7 and subsequently reduced to about 1iu/gm of feed consumed on day 14. The sucrase and maltase activity reached a peak on the 4th day. Viewing reports on the enzyme secretion it is understood that the enzymes are secreted in sufficient quantities, but the development of the gut even though faster compared to other organs may be the bottle neck in the utilization of the nutrients. Even though the duodenal bile acid secretion increased by more than two fold between 4th and 7th day and between 7th and 10th day, the quantum secreted was only 6mg/gm feed consumed on the 4th day and 10mg/gm feed consumed on the 10th day compared to 21mg on the 14th day. The pattern of phospholipids secretion was also similar to the bile salt secretion. The persistent question we get from the farmers and feed manufacturers is about the digestibility of fat during the 1st week of the broilers life, as the opinion created is that the secretion of lipase is insufficient and hence supplementation of lipase will be needed if addition of fat is to be done in the feed. The quantum of bile acids and phospholipids secreted indicates that for effective digestion of the fat supplementation of emulsifiers will be more helpful than supplementing lipase.

The rate of passage of the ingesta influence the utilization of the nutrients in the intestine. Slower rate of passage improves nutrient absorption by increased time of contact with absorptive cells and increased the digestibility of fiber by allowing more time for microbial fermentation. The time taken for the passage of the contents in the duodenum and intestines were significantly higher on the 4th day compared to that on the 7th day. The time taken for the ingesta to pass through the intestine decreased from 161 min on day 4 to 110min on day 14, even though the stay time of the gut contents are more in the first week compared to subsequent weeks, due to the incomplete development of the intestines the efficiency of absorption may not be as that of the subsequent weeks, hence enhancing the stay time will be more beneficial.

Increase in the content of fiber in the diet has been observed to reduce the rate of passage of the intestinal contents. In a study in this Department, inclusion of palm kernel containing 47% oil in an iso-caloric iso-nitrogenous broiler starter mash at 3,6,9 and 12% levels increased the weight gain, even though the fiber levels increased from 3.86% in the corn soybean meal control to 7.31% in the 12% palm kernel fed group. The better weight gain observed in the palm kernel fed groups may also be due to reduced rate of passage caused by the increased fiber contributed by the addition of de-oiled rice bran, added to compensate the higher energy value of the oil in palm kernel.

c) First feeding

The hatchling uses the liver glycogen store for its energy purpose immediately after hatch. The embryo utilizes the albumen as a source sugars for glycogen synthesis, the level of blood glucose begin to increase prior to hatching and the liver glycogen store is just sufficient to support the energy need of the hatchling for just one day, which means that the glycogen store of the early hatchling will be depleted in the hatcher itself and the yolk will be the source of nutrients for meeting the maintenance need of the hatchling, there by wasting important body building units and immunoglobulins. The yolk an important contributor of nutrients for early body building and the immunity of the hatchling, if used for meeting the maintenance need will affect the performance of the bird. Hence it should be planned effectively to meet the nutrient requirements of the chicks at the earliest. Feeding the chicks at the earliest possible time was found to influence the absorption of certain nutrients. The glucose absorption increased from less then 50% at hatch to 61% on day 2 in chicks fed immediately, in fasted chicks it was only 56%, on the 4th day it was 80 and 76% respectively. Similarly, methionine absorption at hatch was also low (43%) and it increased to 62% in fed chicks and 58% in fasted birds. In contrast to glucose and methionine, oleic acid uptake was significantly higher from hatch and throughout in all groups, which was close to 80%. Early feeding of the chicks also enhances the utilization of yolk. The reduction of yolk weight in 2 days time was nearly 4.25g in the fed chicks and 3.75g in the fasted chicks. Early feeding of chicks not only improves the utilization of yolk but also initiates important metabolic changes.

Reports indicate that feeding the hatchlings immediately, increased the body weight by 5.7g on the second day, while in the chicks held without feed for 24h a reduction of 7.5g was noticed, the 40th day body weight was higher in the immediately fed group (1915 vs 1805g), in addition to feeding of hatchlings with feed, dosing them with 0.5ml of nutrient solution (starch:glucose:oil at 1:1:1) further increased the 40th day body weight (2032g). The fasting and consequent generation of glucose in the body of the hatchling stimulates the secretion of corticosteroids which are powerful inhibitors of immune cell proliferation not only making the chick vulnerable to infections but also affecting the response to vaccination. Immediate feeding not only increased the body weight but significantly reduced the mortality (6.3 vs 10.5%) compared to the birds held without feed for the 1st 24h.

d) Feeding of Juvenile broilers

The feeding of the broiler during the first week needs special care as it forms nearly 17% of its life. There are several agencies like NRC, ARC, Breeder companies have come out with various recommendations of the nutrient concentration to be maintained for the starter, grower and finisher feeds. The critical nutrients to be considered are crude protein, ME, lysine, methionine plus cysteine, threonine,

tryptophan, calcium, available phosphorus and sodium. A protein level of 22% and a calorie protein ratio of 132, lysine level of 1.3% and methionine + cysteine, threonine and tryptophan, at 72%, 67% and 16% respectively of the level of lysine, calcium at 1%, available phosphorus at 0.5% and sodium at 0.2% levels will be ideal for the 1st week chick. The crude fiber level not less than 4.5% and not above 5.5% will be suitable for optimal growth.

The physical characteristics of the feed is also important. Since bigger particle size or fine powder will affect the feed intake and growth. Even though larger particle size is recommended for optimal gizzard development, in the first week the ideal particle size should be between 400 to 600 μ for optimal feed intake and growth.

Feeding of chicks with a diet containing highly digestible and absorbable nutrients for the first 4 days was found to enhance the final body weight by 200 gms, this additional gain means that the bird will fetch at least Rs. 6 more, even if we spend Rs. 2/chick for the first four days we gain Rs. 4 more.

e) Brooding

The importance of brooding need not be stressed, as it is well known. The point to be considered is whether it is being properly done. The increase in the incidence of ascites during colder months is suggestive of improper brooding. Hence, great care is to be taken to ensure that the recommended temperature is maintained in the sheds during the 1st week or feeding the birds with very high nutrient density will be counter productive.

4. Energy utilization growth vs. maintenance

The utilization of the energy for maintenance and growth varies with the age. Nearly 80% is used for growth and only 20% is used for maintenance during the 1st week. The proportion used for growth reduces to 70, 60, 50, 40 and 30% during 2nd, 3rd, 4th, 5th and 6th weeks respectively. Hence, planning to achieve maximum growth rate in the first four weeks will be more economical and efficient.

Conclusions

1. Concentrating on the hatching egg weight is essential for efficient performance.
2. Immediate feeding of nutrient solution to the hatchling will be beneficial
3. The earliest access to feed is essential for efficient utilization of yolk nutrients
4. Proper planning of 1st week nutrition and feeding will enhance the growth
5. Proper brooding during the 1st week will help to exploit the genetic potential of the chick to the maximum
6. Attaining the maximum growth rate and body weight during the first four weeks will lead to better FCR.