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Lysine and methionine supplementation in commercial broiler chicken: A review

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Abstract
At present poultry farming is the most dynamic, fastest expanding segment in animal husbandry sector and profitable meat producing industry in the country. But availability of quality and quantity of feed is the major problem to feed the poultry and increse production of poultry. Cereal grains which make up the bulk of poultry rations are deficient in critical amino acids like lysine, methionine, threonine and tryptophan. Moreover animal protein supplements such as fish and meat meal though rich in these essential amino acids, their use in poultry ration are not affordable for their short supply and very expensive and restriction for use due to adulteration. Now in addition of feed protein, it become necessary for supplementation of commercially available synthetic amino acids in rations to meet the amino acid needs of broilers for improve production as well as to production of cost effective diets.

Keywords: Lysine, methionine, broiler, performance

Introduction
Improvement of broiler meat production from the present scenario (2.47 million MT) is become necessary to meet the ICMR recommendation of 11 kg per capita per annum against the availability of only 2.96 kg poultry meat for the people of India [1]. It is only possible by improving performance in terms of rapid growth rate of birds. To achieve this goal, broilers are to be raised on high-quality cost-effective diets which may be obtained by using some specific feed additives along with the main feed ingredients since feed additives play vital role in improved feed quality, palatability, nutrient availability, digestibility and performance of birds. For example, amino acid lysine and methionine can be used in broiler diet since lysine is the most limiting amino acid in cereal grain and methionine is limiting in vegetable protein except soya bean meal for optimum growth of broiler chickens [2]. The animal protein supplements such as fish and meat meal though rich in these essential amino acids, their use in poultry ration are not affordable for their short supply and very expensive and restriction for use due to adulteration. Now in addition of feed protein, it become necessary for supplementation of commercially available synthetic amino acids in rations to meet the amino acid needs of broilers for improve production as well as to production of cost-effective diets. Lysine has been shown to exhibit specific effect on carcass composition and breast meat yield [3]. The level of dietary lysine needed in the grower-finisher period to optimize breast meat yield may be higher than that needed for optimal live performance [4-6]. Increasing lysine over and above NRC (1994) recommendation has been reported to improve body weight gain, feed efficiency and breast meat yield [7] and reduce the deposition of extra fat in the carcass [8]. Methionine plays roles in poultry such as involve in protein synthesis acts as methyl donor for cellular metabolism and formation of coenzyme S-adenosylmethionine, act as precursor of important intermediates in metabolic pathways such as cystine or carnitine, involves in polyamine synthesis, act as sulphur donor and as lipotropic agent. The current trend of intensive poultry keeping and omnipresent disease threats require specific attention towards improving the immune status of birds through nutrition. Broilers on well balanced diets are immunologically competent and able to cope up better with disease showing optimal growth performance. The addition lysine and methionine in the poultry diets improve immunity of birds against different diseases [9, 10].

Lysine and methionine content of feedstuffs

Cereal grains which make up the bulk of poultry rations are deficient in critical amino acids like lysine, methionine, threonine and tryptophan [11]. In most of the poultry diet, methionine is the first limiting amino acid followed by lysine, threonine and tryptophan or isoleucine [12]. The requirement of threonine, tryptophan and arginine in broiler diet can be met by careful selection of feed ingredients, but the requirement of lysine and methionine is difficult to meet since lysine is the first limiting amino acid in diet free from soya bean meal, the most commonly used vegetable protein ingredient whereas methionine has been the most limiting one in diet based on soya bean meal [13]. Unfortunately, protein from a single source is not always adequate to satisfy these essential amino acids requirements because cereal protein are deficient in lysine, whereas soybean meal added corn based diet can satisfy the lysine requirements but not methionine requirement adequately. The animal protein supplements such as fish and meat meal though rich in these essential amino acids, their use in poultry ration are not affordable for their short supply and very expensive and restriction for use due to adulteration. Now in addition of feed protein, it become necessary for supplementation of commercially available synthetic amino acids in rations to meet the amino acid needs of broilers for improve production as well as to production of cost-effective diets.

Growth performance of broilers

Growth is a complex phenomenon and defined as a correlated increase in the muscle of the body in definite intervals of time in way characteristics of the species [14]. Growth takes place both by means of hyperplasia and hypertrophy. The true growth involves an increase in the structural tissue and organs. Protein synthesis is necessary for proper growth. Methionine is needed for protein synthesis because methionine is the initiator of protein synthesis and lysine is needed for optimize breast muscle growth. Body weight gain was significantly (P<0.01) improved in 23 per cent crude protein and 4.8 per cent lysine than 17 per cent crude protein and 4.8 per cent lysine was supplemented in diet [15]. The highest body weight gain was observed in supplementation of methionine and lysine in low quality feed ingredients in broiler chicken diet [16]. Body weight gain was significantly (P<0.05) improved by supplementing methionine 110 (2302g) and 130% (2384g) of NRC methionine [17]. An experiment with 240 day old broiler chicks with completely randomised design by supplement lysine in flaxseed based diet and found lysine supplementation improved growth [18]. Maximum weight gain where diet was supplemented with herbal- lysine as N-Lysine at 1.0 kg/ ton of feed [19]. Higher gain in body weight at the end of 6th week of age in broiler feeding rations supplemented with herbal and synthetic methionine @ 1kg/tone of feed [20]. Higher gain in body weight might be due to the effect of balance of both lysine and methionine and their combined effect in improving feed and nutrient digestibility and utilization and more availability of lysine and methionine for protein synthesis.

Feed intake and feed conversion efficiency

The most important factors that affect feed intake are type and performance of bird, quality of feed and the environment. Birds that grow faster consume more feed than the average. The quality of feed depends on the supplementation of required nutrients in required amount because diet deficient in one or more essential nutrients depress appetite causing low feed intake and decline in growth performance. Feed conversion ratio is the amount of feed consumed per unit of gain. Feed conversion ratio was significantly (P<0.01) improved in 23 per cent crude protein and 4.8 per cent lysine per cent of crude protein than 17 per cent crude protein and 4.8 per cent lysine per cent of crude protein [21]. Addition of methionine over and above the NRC recommended requirement of broilers improved the performance in terms of feed intake and feed conversion efficiency [22].

Intake and utilization of nutrients

Level of intake of different nutrients for optimum performance is governed by their density in the diet in addition to their associative effects. Chicks fed low-protein diets with essential amino acid supplementation excreted less nitrogen (P<0.01) than did chicks fed the high- protein diets [23]. Improved in digestibility of nutrients from supplementation of herbal amino acids with equal competence as that of synthetic amino acid [24]. Broilers fed 20 per cent crude protein diet supplemented with 110 per cent methionine and lysine had the significantly higher (P<0.05) nitrogen retention (74.28 %) [25]. Inclusion of 17% CP and 1.3% lysine diets resulted in lowest and highest nitrogen excretion [26].

Blood biochemical profiles

Blood plays an important role in the transportation of nutrients, metabolic water products, gases and heat. Biochemical constituent of blood are changed due to breed, sex, age, plane of nutrients, density of nutrients in ration, type of fed, addition of some supplements in the ration, disease and climatic condition. Blood biochemistry may monitor the quality of nutrition and health of birds.

Higher values of serum protein is due to higher metabolizability of crude protein and higher nitrogen retention due to proper balance of amino acid in diet lead to increase absorption of amino acid into blood. Lysine and Methionine (30% and 40% more than NRC recommendation led to significant increase in plasma cholesterol (P<0.05) whereas plasma triglycerides were the least in these two treatment groups [27]. Unsupplemented has lowest serum protein as compared to supplemented group [28]. The higher serum triglycerides value in higher supplemented group might be attributed to the lipolytic action of both lysine and metionine since higher concentration of lysine and methionine stimulate pancrease for secretion of insulin into blood. Insulin in poultry versus mammals is not an antilipolytic hormone, on the contrary, it can exert glucagon effect on release fatty acids and amino acids from body store and leading to protein synthesis lowering triglyceride level.

Carcass characteristics and body composition

Meat production is the interaction of growth and feed efficiency and meat quality is determined by the relative growth of tissues in the body. Efficiency of meat production is influenced by growth rate, breed, type of nutrition and density of nutrients in diet. Adequate dietary level of limiting amino acids is needed to support optimum growth and carcass yield of fast growing broilers. Sulphur amino acid like methionine plays a very important role in growing broilers because it is essential for optimum muscle accretion and feather synthesis as well as biochemical processes. Besides lysine has been shown to exhibit specific effect on carcass composition and breast meat yield, improved protein content

and reduced the deposition of extra fat in the carcass. There is increase in values of all muscular portion of the carcass due to the effect of lysine and methionine which tend to stimulate pancreas for further secretion of insulin into blood which can exert the glucagon effect on release fatty acid and amino acids from the bodily saved sources and lead to protein synthesis and development of muscular portion of the body. Breast muscle yield, thigh and leg percentage significantly increased with the increase level of methionine and lysine in excess of NRC (1994) recommendation [29]. Low level of abdominal fat in higher level of supplementation is due to that lysine and methionine act as precursor of L-carnitine and augment its supply for use in metabolism, thereby facilitating fully acid oxidation and reducing the amount of long chain fatty acids available for storage fat especially as abdominal fat pad. There is reduction in the amount of fat in the carcass is due to higher level of lysine in diet that increased energy expenditure for protein deposition and maintained greater muscle mass, providing a lower amount of energy for fat deposition [30].

Immune response

A fully functional immune system is a requirement of a healthy life in modern animal production. Nutrients have been found to contribute immunity and immune response in several ways. The avian immune system plays an important role in defence against pathogens including viruses, bacteria, pathogenic fungi and parasites. The specific immunity in birds includes humoral immunity that involves the synthesis of specific antibodies by B-cells and cell mediated immunity that involves T-cells. The current trend of intensive poultry keeping and omnipresent diseases threats require specific attention towards improving the immune status of the birds through nutrition. Lysine and methionine constructively affect the immune system involving both cellular and humoral immune response [31, 32].

Economics of production

Feed is the major component of total costs of poultry venture as 80% of the total expenditure is on procurement of feed. Feed cost is major constraint but a major mean for manipulating production cost, so a regular supply of low cost balanced feed is essential for sustaining preference of broilers. Synthetic lysine and methionine supplementation of broiler starter diets produce positive results in broiler chicks and optimized the profits from broiler production [33]. The net profit from low protein group with amino acid supplementation was higher than control group and lowest net profit was evident in low protein dietary group without amino acid supplementation [34].

Conclusion

Poultry meat is the source of animal protein for fight against malnutrition and to overcome the problem of food scarcity. Dietary supplementation of lysine and methionine influenced the growth performance, utilization of dry matter and crude protein, balance of nitrogen and humoral immune status in broiler chicken. There fore it could be the strategy to increase performance and immunity in broilers.

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