



## Review article

## Specialized protein products in broiler chicken nutrition: A review

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## ABSTRACT

In poultry nutrition, most attention is given to protein products, due to the importance of protein as a major constituent of the biologically active compounds in the body. It also assists in the synthesis of body tissue, for that renovation and growth of the body. Furthermore, protein exists in form of enzymes and hormones which play important roles in the physiology of any living organism. Broilers have high dietary protein requirements, so identification of the optimum protein concentration in broiler diets, for either maximizing broiler performance or profit, requires more knowledge about birds' requirements for protein and amino acids and their effects on the birds' growth performance and development. It also requires knowledge about the protein sources available that can be used in poultry diets. The broad aim of this review is to highlight the importance of some of the available high-quality specialized protein products of both animal and plant origins which can be explored for feeding broiler chickens. Minimization of the concentration of anti-nutritional factors (ANFs) and supplementation with immunologically active compounds are the main focus of gut health-promoting broiler diets. These diet characteristics are influenced by feed ingredient composition and feed processing. The general hypothesis is that these protein products are highly digestible and devoid of or contain less ANFs. Feeding these products to broiler chicks, especially at an earlier age, can assist early gut development and digestive physiology, and improve broiler growth performance and immunity.

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## 1. Introduction

Broiler chicks have been shown to benefit from immediate access to feed. Although the focus of nutrition has been on provision of energy, chicks would benefit from a more balanced nutrient profile, particularly protein and amino acids. To cope with market demand for protein (meat), modern broilers are reaching market age sooner each year (Kleyn and Chrystal, 2008). Therefore advances in nutrition will be fundamental to securing this rapid growth achievement and maintaining sustainable broiler production. Accordingly, the common focus of nutrition, to simply supply nutrients for maintenance and growth has become obsolete.

Specialist areas such as immuno-nutrition, are rapidly gaining attention (Field et al., 2000; Okamoto et al., 2009). Therefore during broiler diet formulation, choosing ingredients to maximize nutrient availability, rather than simply meeting energy or amino acid levels, is necessary (Ravindran, 2005).

When formulating broiler diets, the main emphasis is placed on the crude protein (CP), because protein is the critical constituent of poultry diets, and together with the other main nutrients such as carbohydrates, fat, water, vitamins, and minerals, is essential for life (Cheeke, 2005). Proteins are polymers that are composed of  $\alpha$ -amino acids, which are linked together by peptide bonds. Proteins are broken down and hydrolyzed in the digestive system into amino acids. Then, after absorption, the amino acids will be assembled and metabolized to form proteins that are used in the building of different body tissues (Aviagen, 2009). They also serve vital metabolic roles as blood plasma proteins, enzymes, hormones, and antibodies, each of which has a specific role in the body (Pond et al., 1995). However, protein is also one of the most expensive ingredients in poultry diets. Therefore, nutritionally and economically, proper protein usage is essential in all feeding systems, and wasteful usage increases the cost of production.

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The main objective of this review is to highlight the importance of some special protein ingredients, which are high-quality in nature and the potential of their inclusion in poultry diets.

## 2. Sources of protein for poultry

In poultry feed formulation, after the energy-yielding raw materials, protein supplements constitute the biggest component, and attention has been focused on the protein and energy levels of the feed. Meeting the bird's requirements for dietary protein contributes considerably to the feed costs (Skinner et al., 1992). Vegetable (plant) and animal products are the two most important protein sources in poultry diets.

The usefulness of a protein feedstuff for poultry depends upon its ability to supply a sufficient amount of the essential amino acids (EAA) that the bird requires, as well as the protein digestibility and the level of toxic substances associated with it (Scanlan et al., 2004).

The majority of an animal's dietary protein requirement is supplied by plant protein sources. Worldwide, traditionally, the most used energy and protein sources are respectively, maize and soybean. Cereals, like wheat and sorghum, and some plant protein meals are used all over the world as well. Soybean meal (SBM) is the preferred protein source used in poultry feed manufacturing. Its CP content is about 40–48%, and this depends on the quantity of hulls removed and the oil extraction process. Compared to the protein meal of other oilseed grains, soybean protein is favoured due to its well-balanced amino acid profile, especially the essential ones, enabling it to balance most cereal-based diets (Ravindran, 2013). Because of their deficiency in some amino acids, plant proteins usually require a supplementary source of amino acids or other protein sources such as animal protein. Plant proteins are usually cheaper than animal proteins; however, there is a limitation to their use because of their content of anti-nutritional factors (ANFs). Most of these ANFs can be destroyed by thermal processing that causes an increase in the nutritional value sometimes and protein level of plant proteins (Adeyemo and Longe, 2007) due to the elimination of ANFs and freeing the protein in the plant protein products.

In general, vegetable (plant) protein sources are nutritionally unbalanced and poor in certain EAA and this decreases their biological value as they may not furnish the required limiting amino acids needed by birds for egg and meat production. Poultry nutritionists have paid more attention to the use of animal protein sources to create a balanced diets (Akhter et al., 2008). Animal proteins are well balanced in terms of EAA that are necessary for body growth and development, but they are expensive for commercial broiler production. Therefore, they are usually used to complement the amino acid balance in the diets rather than as the main protein source. Also the concern associated with disease transmission from products of animal origin is also taken into consideration. In general, the quality of animal protein sources is dependent on the composition of the raw material used. Animal protein supplements are derived from poultry and poultry processing; meat packing and rendering operations; fish and fish processing, and milk and dairy processing (Denton et al., 2005). Bone meal, meat meal, poultry meal, hydrolyzed feather meal and to a lesser extent blood meal have all been used as important feedstuffs for poultry feeding (Pearl, 2002). Animal proteins are a beneficial component of poultry diets because they offer a high level of protein/amino acids, a high level of available phosphorus, reasonable amounts of other minerals, and moderate levels of energy.

Thus, it is necessary to include one or more of these animal protein sources in chicken diets. Hatchery by-products, feather and blood meals, and spent hens, have also been used for feeding non-ruminant animals (Moritz and Latshaw, 2001). To improve

performance, there has also been some interest in substituting part of the SBM in poultry diets with animal products. Supplementation of animal protein sources may considerably improve performance parameters over standard diets. However, this may be because of the high concentration of EAA or it may be due to the lower percentage of indigestible carbohydrates present in SBM (Firman and Robbins, 2004).

In various countries, during poultry feed manufacturing, care is taken that animal protein ingredients should be incorporated in the feeds, particularly for young birds, which require a high level of amino acids. The essential amino acid requirements are gradually decreased as the birds age, and it is possible to supply diets that contain lower animal protein content and relatively higher levels of plant protein to meet the demands of older birds (Ravindran, 2013).

## 3. Role of special protein products in poultry nutrition

### 3.1. Synthetic amino acids

The prohibition of the use of animal protein sources in poultry nutrition in many countries, and also the relatively high costs of these products demand new alternative products. The possible alternative in this situation is the use of plant protein. However, depending on the source, it is well known that there is a deficiency in one or more EAA in plant-based proteins. Achievement of an optimum balance of nutrients to meet the animal's requirement from a particular range of raw materials is a distinctive problem in feed formulation. As the ratio between the individual amino acids in protein concentrates varies significantly, there may be occasions when it is impossible, within the variety of raw materials available, to meet the animal's requirement for all amino acids. In these situations, supplementation with free synthetic amino acids would be very successful. In addition to this, dietary supplementation of synthetic amino acid to poultry diets increases feed conversion efficiency, lowers feed cost per unit of weight gain or production, reduces nitrogen excretion, and has other positive effects.

Instead of animal protein feeds in poultry nutrition, plant protein feeds are used with the supplementation of synthetic amino acids (Cmiljanić et al., 2005). Increasing the efficiency of protein and amino acid utilization is crucial for the reduction of feed costs and maximization of meat production with an absolute minimum intake of amino acids. Synthetic amino acids have been found to facilitate the formulation of diets with an ideal amino acid profile (Han and Lee, 2000).

It is well known that one of the important roles of synthetic amino acids in animal nutrition is their ability to enhance the volume of readily available amino acids (nitrogen), as well as their promotion of lean meat production. Amino acids are also linked to the production of antibodies in animals (Han and Lee, 2000). Therefore, the development of immune function in poultry will be enhanced if they get an adequate amount of amino acids in their diets.

Formulation with commercially available synthetic EAA to meet broiler requirements not only improves the overall amino acid balance, but allows for a reduction in CP, while also improving the general performance of broiler birds (Zarate et al., 2003). Investigations have demonstrated that poultry production can be considerably improved by the addition of synthetic amino acids along with probiotics and enzymes (Cmiljanić et al., 2003).

Supplementation with limited amounts of synthetic amino acids (0.1–0.3%) to diets of swine and poultry could spare 2–3% of dietary protein and considerably reduce nutrient excretion, particularly nitrogen (Han and Lee, 2000). Researchers working on turkeys and broilers have indicated that the CP content can be significantly reduced in poultry diet with EAA supplementation, and the birds

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