Amino Acid Content in Organic Soybean Meal for the Formulation of Organic Poultry Feed

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Over the past several years, organic poultry production has been rapidly expanding (Rogenburg *et al*., 2008). This alternative to conventionally produced poultry meets consumers' expectations for healthier animal protein sources (ATTRA, 2010). According to standards set by the U.S. Department of Agriculture (USDA) National Organic Program, to be certified "organic poultry," birds must be raised with outdoor access, fed certified organic feed, and should not be fed with feed containing antibiotics, animal byproducts, drugs, or synthetic parasiticides (USDA, 2012).

A total of 20 amino acids are the building blocks of proteins and are derived from plant and animal feedstuffs (Reid *et al*., 2006). Some amino acids, called "essential amino acids" (EAA), cannot be synthesized by the chicken and must be supplied in the diet (Reid *et al*., 2006). When the dietary protein has less of an EAA relative to the animal's requirement for that EAA, it's referred to as a "limiting amino acid." Protein synthesis becomes limited by the first limiting amino acid; the limiting EAA will then impair the utilization of all the other amino acids. Methionine (MET) is the first limiting amino acid for poultry when they are fed diets formulated from the most commonly used feed ingredients (Chalova *et al*., 2015). It is involved in the synthesis of proteins and can be found in many body parts (ATTRA, 2010). As methionine is an EAA that cannot be synthesized by the body, the quantity needed for protein synthesis must be provided in the diet. It is also possible to manufacture MET as a pure amino acid.

Synthetic MET was allowed in organic poultry feed because of its importance in avian physiology and the limited availability of organic protein that is rich in MET (USDA, 2012). There is a limit on the period that synthetic MET can be used in organic poultry feed. Companies in the U.S. that grow organic birds are concerned that fast-growing birds with reduced MET levels will perform poorly and will also have welfare issues such as impaired immune function, which can result in poor feathering, feather pecking, cannibalism, and eventually, mortality (ATTRA, 2010). To avoid the inclusion of synthetic MET in animal feed, high-MET corn varieties that contain up to 50% higher levels of methionine have been developed (Phillips *et al*., 2008). While it has been shown to be a suitable replacement for conventional corn, the Methionine Task Force (2008) concluded that the lower yields and higher cost of the high-MET corn would deter its widespread use.

Methionine and cysteine (CYS) are referred to as the "sulphur amino acids" (SAA) and they are involved in complex metabolic processes. While CYS is not an essential amino acid because it can be formed from MET, its synthesis is not enough to meet the body's requirement when a diet is deficient in MET (ATTRA, 2010). While corn does contain a sufficient amount of SAA relative to a chicken's requirements, it is deficient in the EAA arginine (ARG) and lysine (LYS). Soybean meal has an excess of those amino acids, so the two together make a balanced protein source when blended. However, soybean meal has less SAA than what a chicken requires, and while the ARG and LYS needs are met, a corn-soybean meal blend remains deficient in SAA.

Essential amino acids do not just need to be present in the diet; amino acid availability is an important measure of protein quality. Availability is a measure of how much of what is in the feed the animal is able to digest and absorb. The formulation of diets based on EAA availability can help to decrease feed cost and reduce excess nutrients being excreted into the environment. Determining the availability of amino acids in organic ingredients is critical for formulating suitable organic poultry diets. A study was conducted where a number of organic feed ingredients were evaluated and compared to nonorganic feed ingredients for the formulation of organic feeds for organic poultry production. Table 1 provides a comparison of EAA in conventional soybean meal (CSBM) with those in organic soybean meal (OSBM).

Soybeans are used as the predominant source of amino acids in poultry diets (Gandhi *et al*., 2008). Soybean meal has a high protein content as well as highly digestible amino acids which make it a useful supplement in monogastric diets (Meng and Slominski, 2005; Gandi *et al*., 2008). The amino acid in an ingredient is expressed as its average percentage in the total ingredient, and the digestibility is expressed as the percentage of the total amount that is available through digestion.

Organic SBM has higher total amounts of CYS and MET and higher digestibility for CYS. This can help compensate for the inability to use synthetic MET in the diet.

The crude protein and individual amino acid content of organic soybean meal compares favorably with that of conventionally grown soybean meal (Table 1). The digestibility of the essential amino acids in the OSM is high and compares favorably with the conventional soybean meal. As seen in conventional poultry diets, organic poultry diets should be formulated with organically grown soybean meal, as the digestibility of the amino acids in organic soybean meal is similar or higher than in conventional poultry diets.

Table 1. Essential amino acid content and digestibility of organic soybean meal and conventional soybean meal.

			Digestibility (%)			
Amino Acid	**Average Total Amino Acid Organic Soybean Meal**	**Average Total Amino Acid Conventional Soybean Meal**	**Average Organic Soybean Meal**	**Average Conventional Soybean Meal**	**Average Available AA Organic Soybean Meal**	**Average Available AA Conventional Soybean Meal**
Arginine	3.21	3.38	92	92	2.96	2.53
Cysteine	0.69	0.66	82	79	0.56	0.53
Histidine	1.19	1.21	91	90	1.09	1.10
Isoleucine	2.20	2.11	90	87	1.98	1.90
Leucine	3.50	3.53	90	88	3.14	3.14
Lysine	2.97	2.81	91	89	2.71	2.50
Methionine	0.66	0.62	90	90	0.59	0.56
Phenylalanine	2.26	2.36	91	89	2.07	2.13
Threonine	1.70	1.80	86	83	1.47	1.58
Tryptophan	0.69	0.62	93	89	0.64	0.56
Valine	2.33	2.20	88	87	2.04	1.98
Crude Protein	46.3	46.5				

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