Use science, business to improve soybean meal in poultry nutrition

Achieving a better soybean meal in poultry nutrition requires the use of science in the evaluation.

By **M. SIFRI***

TO achieve a better soybean meal for poultry, it is essential to understand the science and business associated with all of its attributes (Bajjalieh, 2012).

The National Oilseed Processors Assn. provides the official specifications for soybean meal, of which there are primarily two: 44% or 47.5-49.0% protein products.

The estimated world production of soybeans in 2016 was 333.41 million metric tons. Parallel to that was the estimated world output of 225.50 mmt of soybean meal. The major producers of soybeans are the U.S., Argentina and Brazil. The major users of soybean meal are the U.S., China, the European Union and Brazil.

There is a plethora of scientific knowledge and application of soybean meal in poultry nutrition. The references and websites listed in this article represent a fraction of the literature available.

Historical background

There is a definite need for further improvements in evaluating soybean meal for use in poultry feed. It is not surprising that such a goal has not been realized due to the emphasis on price.

Country of origin. The country of origin of soybean meal is of great interest for business and science since it has an effect on composition. The reasons for differences in soybean meal may include its origin within a country (Thakur and Hurburgh, 2007), the seed used (Wilcox and Shibles, 2001), environmental temperatures (Wolf et al., 1982) and the country of origin, such as Brazil, China or the U.S. (Grieshop and Fahey, 2001).

The country of origin typically is promoted to help differentiate pertinent attributes. Thus, many international surveys were conducted to elucidate the differences (de Costa-Sinova et al., 2008; Frikha et al., 2012; Garcia-Rebollar et al., 2016).

The surveys demonstrated that nutrient composition and digestibility may vary with soybean meal origin and were consistent with higher protein content and lower trypsin inhibitor activity (de Costa-Sinova et al., 2008). Such efforts were extended to assess the relationship among digestibility, crude protein content, potassium hydroxide protein solubility, reactive lysine, neutral detergent fiber (NDF) and oligosaccharides (Frikha et al., 2012).

From a business point of view, these extensive studies led to the judgment that soybean meals from the U.S. and Brazil were processed under better conditions than meal from Argentina.

A more comprehensive assessment of soybean meal origin as it relates to the multitude of nutrients was reported by Garcia-Rebollar et al. (2016).

Soybean meal quality. Many scientific achievements led to the establishment of quantitative techniques and measurements to help the soybean meal industry and the poultry industry. It is evident that using only one compositional attribute might not lead to a conclusive assessment; however, utilizing a few or all of them may lead to a quantitative decision.

It is prudent to list the major soybean meal attributes and comment on them briefly. Some of the measurements are more closely associated with the country of origin. Historically, the soybean meal industry and the poultry industry considered primarily dry matter, ash, crude protein, ether extract (for fat content) and crude fiber as the basis for the soybean meal price.

It was also recognized that measurements of sucrose, stachyose, raffinose, amino acids, minerals and NDF improved the assessment of soybean meal. Even though these measurements were chemically quantitative, they were not totally reflective of the biological and performance values.

Other measurements gained tremendous attention because of their practical applications, including urease activity, protein dispersibility index, potassium hydroxide protein solubility, trypsin inhibitor activity and heat damage indicator. All of these parameters were addressed comprehensively by Garcia-Rebollar (2016).

Some of the pioneering efforts that paved the way for a better understanding of these measurements include: Araba and Dale (1990), Balloun (1980), Choct et al. (2010), Evonik (2010), Lee et al. (1991 and 2004), Parsons et al. (1991) and Van Eys (2012).

Impact of genetics. Due to the direct and indirect effect of genetics on soybean meal, including the use of genetically modified organisms, it is pertinent to consider any changes that might affect the value of soybean meal.

Photo: United Soybean Board.

*M. Sifri is with Sifri Solutions LLC in Quincy, Ill. This article is based on an invited lecture presented at the 2017 European Symposium on Poultry Nutrition.

Other modifiers

The effects of components that are not part of the inherent composition of soybean meal should not be ignored. They include alternative feed additives (modifiers) such as enzymes, prebiotics, probiotics, short- and medium-chain fatty acids, plant extracts, yeast cell components or antibodies.

Managing the impact such additives have on soybean meal brings tremendous challenges. Using this approach mirrors what is happening in the industry; these components are used in varying degrees and combinations in the poultry industry.

Recently, Sifri (2016 a, b and c) outlined the effects of such modifiers and their interactions with nutrients that may result in changes in soybean meal value. Valuable reviews have been published to address this issue (Adeola and Cowieson, 2011; Bedford and Partridge, 2001; Choct, 1997; Ravindran, 2013).

It is unfortunate that the use of modifiers in poultry nutrition is often associated with numerous limitations. Some of those limitations come from unrealistic and unsubstantiated claims about the contributions of such products.

Even though there are numerous publications about how feed enzymes affect soybean meal nutrition, there is still a serious void in assessing their values properly.

The exception to these concerns is the use of phytase in poultry nutrition. The impact of phytase on the release of phytate phosphorus and other nutrients in soybean meal is well recognized. The availability of many sources of phytase for the poultry industry remains a great opportunity but continues to bring new confusion related to their contributions. It is incumbent upon the enzyme industry to provide credible documentation about the specificity and contributions of the enzymes.

The use of non-starch polysaccharide enzymes in poultry feeds containing soybean meal faces more challenges, primarily because there are many different enzymes and substrates.

With feed enzymes, it is of interest to recognize the potential role protease enzymes play in the value of soybean meal. The opinion on protease is mixed, and the application appears to be limited to specific situations (Douglas et al., 2000; Fritas et al., 2011; Ghazi et al., 2002; Simbaya et al., 1996). Regardless of the outcome, feed enzymes have the potential to help improve soybean meal nutritional value for poultry.

Other processes

Physical manipulation of soybean meal may have great potential in improving the nutritional value for poultry.

Enzyme hydrolysis. Examples of these processes include enzymatically hydrolyzing raffinose and stachyose in soybean meal (Graham et al., 2002) or using varieties that are inherently low in oligosaccharides (Baker et al., 2011), which was shown to result in better chick and broiler performance.

Particle size. Varying the particle size of soybean meal has also gained popularity; a larger particle size was better utilized than smaller particles in broilers (Kilburn and Edwards, 2004). However, Pacheco et al. (2013) concluded that soybean meal particle sizes larger than 1,300 µm depressed bodyweight but improved protein digestibility in broilers.

Feed form. Studies by Serrano et al. (2012) documented that the feed form and soybean meal source are related, where crumbling and pelleting of higher soybean meal protein from the U.S. led to better broiler performance.

Elusieve process. Srinivasan et al. (2013) conducted a more in-depth study using the Elusieve process, which is a combination of sieving and eutriation (air classification technique). This classification has been successful in separating fiber from soybean meal and other products such as ground corn and dried distillers grains with solubles. The study demonstrated that using the Elusieve process on soybean meal led to improved broiler performance.

Processed full-fat soybeans. Comparisons between full-fat processed soybeans and soybean meal led to the conclusion that both may be used successfully when formulated based on their respective nutritional contributions (Hamilton and Niven, 2000).

Soy protein concentrate and isolate. Comparisons of soybean meal, soy protein concentrate and soy protein isolate demonstrated reductions in cecal fermentation in young turkeys and bodyweight (Jankowski et al., 2009); however, feed utilization was improved in association with the gradual reduction of oligosaccharides in soy protein concentrate and soy protein isolate.

Conclusions

Achieving a better soybean meal in poultry nutrition requires the use of science in the evaluation.

Selected websites

www.feedipedia.org; www.soymeal.org; www.nopa.org; www.ussec.org; united soybean.org; www.soyconnection.com; soygrowers.com.

References

Adeola, O., and A.J. Cowieson. 2011. Board-invited review: Opportunities and challenges in using exogenous enzymes to improve nonruminant animal production. J. Anim. Sci. 89:3189-3218.

Bajjalieh, N. 2012. Value proposition of soybean meal must grow. Feedstuffs, 84 (22), May 28.

Baker, K.M., P.L. Utterback, C.M. Parsons and H.H. Stein. 2011. Nutritional value of soybean meal produced from conventional, high-protein or low-oligosaccharide varieties of soybeans and fed to broiler chicks. Poult. Sci. 90:390-395.

Balloun, S.L. 1980. Soybean Meal in Poultry Nutrition. Ovid Bell Press, Fulton, Mo.

Bedford, M.R., and A.J. Cowieson. 2012. Exogenous enzymes and their effects on intestinal microbiology. Anim. Feed Sci. Technol. 73:76-85.

Bedford, M.R., and G.G. Partridge. 2001. Enzymes in Farm Animal Nutrition. CABI Publishing, CAB International, Wallingford, Oxon, U.K.

Choct, M. 1997. Feed-non-starch polysaccharides: Chemical structure and nutritional significance. Feed Milling International. June. p. 13-26.

De Coca-Sinova, A., D.G. Valencia, E. Jimenez-Moreno, R. Lazaro and G.G. Mateos. 2008. Apparent ileal digestibility of energy, nitrogen and amino acids of soybean meals of different origin in broilers. Poult. Sci. 87:2613-2623.

Douglas, M.W., C.M. Parsons and M.R. Bedford. 2000. Effect of various soybean meal sources and Avizyme on chick growth performance and ileal digestible energy. J. Appl. Poult. Res. 9:74-80.

Evonik, 2010. Special Edition. Analytic: AMINORED. AMINONews. Evonik-Degussa GmbH, Hanau-Wolfgang, Germany.

Freitas, D.M., S.L. Vieira, C.R. Angel, A. Favero and A. Maiorka. 2011. Performance and nutrient utilization of broilers fed diets supplemented with a novel mono-component protease. J. Appl. Poult. Res. 20:322-334.

Frikha, M., M.P. Serrano, D.G. Valencia, P.G. Rebollar, J. Fickler and G.G. Mateos. 2012. Correlation between ileal digestibility of amino acids and chemical composition of soybean meals in broilers at 21 days of age. Anim. Feed Sci. Technol. 178:103-114.

Garcia-Rebollar, P., L. Camara, R.P. Lazaro, C. Dapoza, R. Perez-Maldonado and G.G. Mateos. 2016. Influence of origin of the beans on chemical composition and nutritive value of commercial soybean meals. Anim. Feed Sci. Technol. 221:245-261.

Ghazi, S., J.A. Rooke, H. Galbraith and M.R. Bedford. 2002. The potential for the improvement of the nutritive value of soyabean meal by different proteases in broiler chicks and broiler cockerels. Br. Poult. Sci. 43:70-77.

Graham, K.K., M.S. Kerley and G.L. Firman. 2002. The effect of enzyme treatment of soybean meal on oligosaccharide disappearance and chick growth performance. Poult. Sci. 81:1014-1019.

Grieshop, C.M., C.T. Kadzere, G.M. Clapper, E.A. Flickinger, L.L. Bauer, R.L. Frazier and G.C. Fahey. 2003. Chemical and nutritional characteristics of United States soybeans and soybean meals. J. Agric. Food Chem. 51:7684-7691.

HAMILTON, R.M.G., and M.A. Niven. 2000. Replacement of soybean meal with roasted full-fat soybeans from high-protein or conventional cultivars in diets for broiler chicks. Canadian J. Anim Sci. 80:483-488.

Jankowski, J., J. Juskiewicz, K. Gulewicz, A. Lecewicz, B.A. Slominski and Z. Zduncz-zyk. 2009. The effect of diets containing soybean meal, soybean protein concentrate and soybean protein isolate of different oligosaccharide content on growth performance and gut function of young turkeys. Poult. Sci. 88:2132-2140.

Kilburn, J., and H.M. Edwards. 2004. The effect of particle size of commercial soybean meal on performance and nutrient utilization of broiler chicks. Poult. Sci. 83:428-432.

Pacheco, W.J., C.R. Stark, P.R. Ferket and J. Brake. 2013. Evaluation of soybean meal source and particle size on broiler performance, nutrient digestibility and gizzard development. Poult. Sci. 92:2914-2922.

Parsons, C.M., K. Hashimoto, K.J. Wedekind and D.H. Baker. 1991. Soybean protein solubility in potassium hydroxide: An *in vitro* test of *in vivo* protein quality. J. Anim. Sci. 69:2918-2924.

Ravindran, V. 2013. Feed enzymes: The science, practice and metabolic realities. J. Appl. Poult. Res. 22:628-636.

Serrano, M.P., J. Valencia, J. Mendez and G.G. Mateos. 2012. Influence of feed form and source of soybean meal of diet on growth performance of broilers from 1 to 42 days of age. 1. Floor pen study. Poult. Sci. 91:2838-2844.

Sifri, M. 2016a. Measurements, proofs for modifier's economic efficacy in poultry feeds. Poultry Service Industry Workshop, Banff, Alb.

Sifri, M. 2016b. The science and application of non-starch polysaccharides (NSP) enzymes for poultry and pig nutrition "what are the facts." 77th Minnesota Nutrition Conference, Prior Lake, Minn.

Sifri, M. 2016c. Interactions of nutrients and feed additives and their impact on gut health. Fifth Mediterranean Poultry Summit of World Poultry Science Assn., Italy, Spain, France.

Simbaya, J., B.A. Slomminski, W. Guenter, A. Morgan and L.D. Campbell. 1996. The effects of protease and carbohydrase supplementation on the nutritive value of canola meal for poultry. Anim. Feed Sci. Technol. 61:219-234.

Srinivasan, R., B. Lumpkins, E. Kim, L. Fuller and J. Jordan. 2013. Effect of fiber removal from ground corn, distillers dried grains with solubles and soybean meal using the Elusieve process on broiler performance and processing yield. J. Appl. Poult. Res. 22:177-189.

Thakur, M., and C. Hurburgh. 2007. Quality of U.S. soybean meal compared to the quality of soybean meal from other origins. J. Am. Oil Chem. Soc. 84:835-843.

Van Eys, J.E., 2012. Manual of Quality Analyses for Soybean Products in the Feed Industry, 2nd ed. U.S. Soybean Export Council, Chesterfield, Mo.

Wilcox, J.R., and R.M. Shibles. 2001. Interrelationships among seed quality attributes in soybean. Crop Sci. 41:11-14.

Wolf, R., J. Cavins, R. Kleiman and L. Black. 1982. Effect of temperature on soybean seed constituent oil, protein, moisture, fatty acids, amino acids and sugars. J. Am. Oil Chem. Soc. 59:230-232. ■