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Value proposition of soybean meal must grow

An ingredient's value proposition is a function of several factors, with nutrient profile and cost being the most obvious. Other factors, such as compositional consistency and market availability, are also important.

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FOR more than a half-century, soybean meal has brought tremendous value to the animal production industries, initially as a source of crude protein and, also, as the understanding of amino acid nutrition evolved, as a source of essential amino acids.

However, as good as soybean meal may be, there is always room for improvement. Efforts funded by the United Soybean Board (USB) and others have focused on approaches for further expanding the value proposition for soybean meal. Such approaches include improvements in the product itself and the development of informational tools that allow for it to be used more effectively.

An ingredient's value proposition is a function of several factors. Nutrient profile and cost are among the most obvious. Other factors, such as compositional consistency and market availability, are also important.

In our constantly changing world, constant improvement has become an expectation. The poultry and swine industries have continued to improve their product and the value it represents to their end users. As they have adapted to meet the increasing expectations of their customers, they have come to expect more from their ingredient and service suppliers.

For soybean meal to remain competitive as a feed ingredient over time, its value proposition must expand.

USB recognized this fact more than 10 years ago. Since then, a number of USB-funded projects have focused on various aspects of the soybean meal value proposition.

Since improving a plant-based product is a complex process, it has required a comprehensive approach. Components of this process have included:

- Identifying soybean meal improvement targets with feed industry guidance;
- Assessing the feasibility of making a beneficial change, and
- Enabling this change through the creation of tools and information.

Improvement targets

Soybean meal is used in animal feed formulations due to its compositional characteristics. One obvious approach for expanding soybean meal's value proposition is to change the composition of the soybean.

Since soybean meal serves primarily as a supplemental source of essential amino acids, changing amino acid levels to better complement end-user needs is one important approach. This is a classical approach to product improvement whereby the characteristics that make it most attractive to customers are enhanced.

While soybean meal is used primarily in poultry and swine feeds as a supplemental source of limiting essential amino acids, its "value bundle" is contributed to by other "tag-along" nutritional characteristics. One such example is the level of nutritionally available energy, such as metabolizable energy, it provides.

In a least-cost formulation, the soybean meal value proposition is a function of all attributed nutritional characteristics. So, any beneficial change to a nutritional characteristic recognized and valued by a nutritionist expands its value proposition.

With the guidance of industry nutritionists, a series of nutritional targets for soybean meal improvement were developed more than 10 years ago. Since then, these targets have periodically been re-evaluated, and the latest version is presented in the Table.

Feasibility of change

Identifying trait improvement targets is relatively easy. Being able to describe a process to create those improvements is the greater challenge.

Due to the many issues associated with transgenic approaches to plant improvement that existed at the time, USB chose to access the potential for effecting improvement through classical plant breeding techniques.

Change through classical plant breeding is predicated on the extent to which compositional variation exists between the genetic background of soybeans.

To gain an understanding of the extent to which such variation might exist, an initial project solicited exotic sources of soybean genetics and then determined

Soybean meal trait improvement targets

Primary traits	Multiplier relative to "typical" meal
Increased metabolizable energy (from improved carbohydrate characteristics)	Swine: 1.1X, Broilers: 1.13X
Increased methionine+cysteine	1.5X
Secondary traits	
Improved utilization of protein/amino acids	1.05X
Increased levels of:	
Lysine	1.23X
Threonine	1.21X
Tryptophan	1.23X
Reduced phytate-bound phosphorus	-1.5X

Example: If "typical" soybean meal lysine level is 3.02%, the target is 1.23 x 3.02% = 3.71%.
Note: Must ensure that improvements in one area do not result in overriding losses in another area.

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their compositional characteristics. The goal was to probe the boundaries for a number of compositional characteristics.

This initial work involved the wet chemistry analysis of more than 300 soybean samples for multiple compositional characteristics, including amino acid levels. The laboratory results showed a greater degree of compositional variation than many had anticipated. Observed differences were important since they indicated the potential for plant improvement through classical plant breeding approaches.

Enabling change

Plant breeding could be considered a "numbers game" since it requires the analysis of large numbers of samples. This is true not only for initial trait discovery but the subsequent backcrossing of identified characteristics into yield-competitive genetic backgrounds. The cost of using wet chemistry analysis, especially where amino acids are concerned, was prohibitive.

As a result, a subsequent project embarked on a process that evaluated the feasibility of using near-infrared spectroscopy (NIRS) to predict amino acid levels in soybeans. Promising results from this initial effort led to an expanded process for developing, refining and evaluating NIRS to predict amino acids in soybeans. This effort involved a number of NIRS technology companies.

The resultant tools and experiences have been employed to describe the extent to which compositional variation exists in soybeans both in exotic/research lines and in the U.S. crop as it comes out of farmers' fields. Describing the current crop is critical to establishing benchmarks for evaluating future progress.

Compositional variation

Compositional variations in exotic/research lines describe the extent to which future improvements are possible through classical plant breeding, thus showing the long-term opportunity for improvement.

An encouraging amount of compositional variation has been observed within these types of samples. Individual sample results for a subset of lines from the U.S. Department of Agriculture's Soybean Germplasm Collection have been made available to the soybean plant breeding community and other interested parties through www.ars-grin.gov/cgi-bin/npgs/html/eval.pl?494186.

Compositional variation in the current soybean crop describes a near-term opportunity for capturing greater value.

Using samples collected directly from farm fields by USDA's National Agricultural Statistics Service, another project has described the extent to which soybean composition can vary within and between multi-county districts. USB found that composition can vary as much within a multi-county district as it does across broad geographic regions.

Use of this information holds promise for making near-term improvements in the composition of the domestic soybean crop. This information can be accessed at www.unitedsoybean.org/ussm-avail-data.

As part of a comprehensive approach, other projects have sought to gain a better understanding of the relationship among compositional characteristics, genetic background, environment and yield.

Example

Plant breeders have developed lines of soybeans with reduced levels of raffinose and stachyose. Poultry and swine lack the enzymes required to digest these carbohydrates. If a decrease in raffinose and stachyose is associated with an increase in constituents that can be digested, the resultant meal should be higher in nutritionally available energy.

With today's high cost of supplying feed energy, such a change would represent considerable incremental value. In addition, other nutritional benefits could result as well.

Preliminary chick feeding trial work with some early materials indicated a potential for improving the metabolizable energy of soybean meal for poultry by approximately 90 kcal/lb. For every 100 lb. of soybean meal fed, this represents an additional 9,000 kcal.

Supplying this amount of energy using animal fat at 3,800 kcal/lb. equates to 2.3 lb. of fat. Multiplying 2.3 lb. of fat by the current price for animal fat would provide a static estimate of added value per 100 lb. of soybean meal fed.

Some newer materials in the pipeline have even lower levels of raffinose and stachyose.

Better nutrient use

In the absence of detailed information, a typical approach is to assume the worst. This results in all products being described in terms of the lower portion of the quality spectrum and valued accordingly.

One result is that a majority of product ends up being underutilized and undervalued. This is a lost efficiency that, if reclaimed, has an immediate impact on the product's value proposition.

While soybean meal is typically considered to be more consistent in composition than other bulk ingredient sources of supplemental protein, it does still vary. Whether this variation represents a cost or an opportunity depends upon how it is managed.

One way to reclaim this lost value is through measurement. As mentioned, projects have focused on the NIRS measurement of soybean meal constituents, including amino acids. Tools from these and other efforts are available for the better management of compositional variation as it currently exists.

A second approach is to reduce the extent of variation by eliminating lower-quality product from the marketplace. This adds value not only because it reduces variation-associated risk but, at the same time, raises the overall average. One way to accomplish this is to include soybean composition, in addition to yield, in the soybean variety selection process prior to planting.

Handling soybeans and processing them into meal also play important roles.

Realizing change

Expanding the inherent value of any business segment creates opportunities for all who participate in it. Expanding the value proposition for soybean meal is one such opportunity.

The information on soybean compositional variation describes the potential for improvement both short term as it relates to today's crop and long term as a result of plant breeding. The measurement tools that have been developed enable better management of this variation. If properly used, they represent an opportunity for improving the soybean value proposition.

However, information and tools, by themselves, are not enough. Beneficial change requires changes in behavior. USB is now at the stage where the information that has been developed can be used to encourage the different but complementary changes in value chain behavior required for beneficial change to occur.

Critical to the success of these efforts is the relevance of what is being accomplished with end users of soybean meal. For more than five years, a group of industry nutritionists has provided guidance to USB efforts focused on improving soybean meal composition and approaches for the ingredient's more effective use. Other outreach activities have been undertaken as well, including one with a goal of improving communication and understanding between soybean processors and feed manufacturers.

USB is working to make soybeans a more effective resource that creates more value for the feed industry and that ultimately brings benefit to soybean farmers, soybean processors and animal agriculture. ■

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