
Broiler Production: Lower Risk with Improved Corn & Soybean Meal

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Broiler production, or the raising of chickens for meat, has seen enormous advances in overall productivity and efficiency over the past few decades. A large part of this can be attributed to genetic selection, as discussed here¹. Modern broilers are roughly three times as efficient at converting feed into breast meat tissue compared to birds used in the 1950's. As a result, the birds are much larger now at the same age and when fed the same diet (compared to older genetic varieties), and the entire industry is vastly more productive. Finally, consumers eat more chicken now than ever before, in part due to the ubiquitousness of the meat, and the resulting lower prices. Indeed, globally, more than 60 billion chickens are processed for food every year².

Often overlooked in the value provided by the broiler industry to the food supply is the element of risk. Humans have been involved in some form of farming for perhaps 10,000 years now, and this was often full of risk – from crop failures, to disease outbreaks, and post-harvest losses, people struggled to get food from time to time. The common thread in these struggles is the aspect to time. There is a lag time from the beginning of production to harvest, for both plant and animal agriculture. Plants take many months at least to develop and mature for harvest. For perennial tree crops, the time to harvest is measured in years. Animal agriculture is similar – ruminants, like cattle, sheep, and goats, can convert grasses and plant materials that are unsuitable for human consumption into nutritious food products, but this takes many months or even years. Monogastric animals, like pigs and fish, get to market faster, but still require many months before harvest. While there are many benefits to the production schemes mentioned above, one clear downside to a longer time to harvest is that there is more time for things to go wrong – the risk is greater.

With broiler production, chickens reach market weight at less than two months of age – sometimes at less than 1.5 months of age. In short, raising chickens is a relatively low-risk enterprise versus other types of food production.

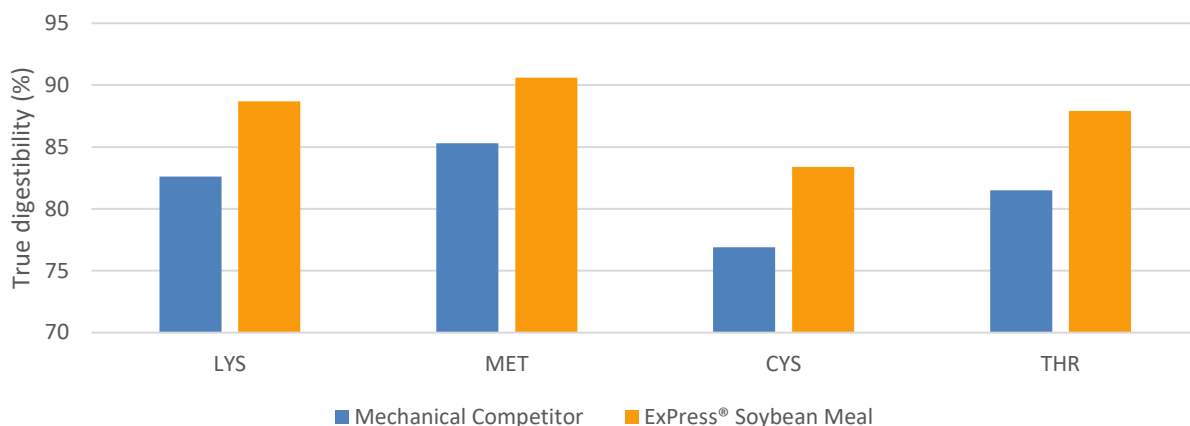
Even so, can productivity in the broiler industry be improved? It is at least possible that, with the altered genetics of the birds through selective breeding programs, additional gains can be had with improved production practices. Often, this is accomplished by altering the diet formulation used to feed the birds. The goal of the diet formulation program is to provide the required nutrients and energy in order to maximize growth performance, while minimizing feed costs, and perhaps reducing the total amount of feed consumed as well. Many, if not most, broiler diets consist of corn and soybean meal due to relative abundance around the world, low cost, and how well these ingredients are understood by nutritionists. Typically, corn is cleaned and ground to the desired particle size before inclusion in the diet, and soybeans are subjected to a solvent-extraction process for near complete oil removal, followed by toasting to remove harmful solvent residues and further cook the meal.



First, a common measure of ingredient quality is digestibility³, mostly used to assess the value of amino acids in proteins. Improving the digestibility of amino acids and other nutrients is one of the main ways to increase nutrient delivery to broilers and is the first mechanism for delivering more nutrients to the birds. Digestibility is measuring the disappearance of a nutrient or nutrients at a specific location in the digestive system. For example, with amino acids, it is important to minimize the effects of microbial fermentation, occurring in the ceca of birds, because amino acids that disappear here do not contribute to body protein synthesis. Diets formulated on a digestible basis often result in enhanced feed efficiency and economical production.

Therefore, it is useful to note that ExPress® (high-shear dry extrusion of soybeans, followed by mechanical oil pressing to partially deoil the extruded full-fat soy) results in a unique soybean meal with greater digestibility of amino acids versus commodity, solvent-extracted soybean meal⁴. Often, the improvement is on the order of 1.5-2.0% points and is mainly due to thorough physical rupturing of cell walls⁵ and reduced antinutritional factors⁶. For example, data⁴ from 2016 reported an improvement in lysine (an amino acid that often limits performance) digestibility of 1.2% points. We can assume that, during the first days of the starter phase, chick intake is 50 grams of complete feed, and that soy intake during this time is approximately 15 grams. Assuming the measured gain in lysine digestibility, and that feed intake is not altered (more on this below) and all else is constant, the use of ExPress® soybean meal will deliver 2 more milligrams of lysine to the birds during this critical, initial phase compared to birds fed commodity, solvent-extracted soybean meal. Therefore, the effect of improvements in digestibility alone will increase supply of a few more milligrams of each amino acid (20 individual amino acids make up proteins) from soy during the initial part of the starter phase. It is important to note that increases in amino acid digestibility of soy can be much greater than 1.5-2.0% points when comparing ExPress® soybean meal to other mechanically processed soy meals⁷, as shown below.

Mechanical Processing of Soy – Amino Acid Digestibility

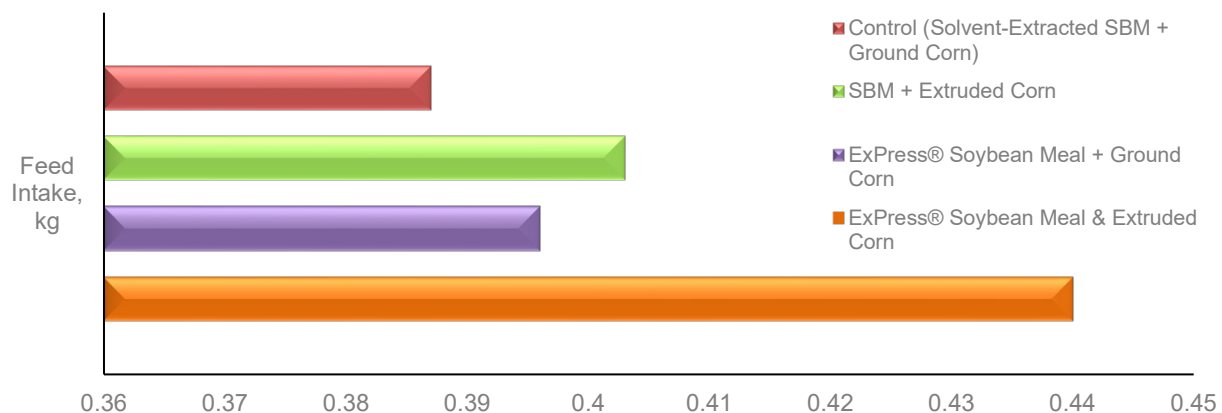


Of course, as the birds grow and consume larger quantities of feed each day, the benefits from increased digestibility will become more apparent – greater consumption of a better-digested diet. Therefore, the second mechanism for increased nutrient supply is greater feed intake.

It is well understood that many cereal grains, such as barley and rye, contain large, non-starch polysaccharides (some are considered to be antinutritional factors) that interfere with feed intake through the formation of viscous digestive contents, which can be alleviated using specific feed enzymes⁸. Interestingly, the reduced intake is especially injurious in chicks fed higher-fat diets, as young birds lack the digestive enzymes necessary for adequate digestion of fats and oils. Finally, corn-based diets in young birds are not assumed to hinder feed intake because viscosity of the digestive contents is lower than barley-based diets, and the addition of enzymes did not affect digestive viscosity when chicks were fed corn diets⁹.

However, recent data has indicated that improvements in feed intake can be made with higher-quality, corn/soy-based diets¹⁰. As shown below, feed intake was improved by over 4% during the starter phase when high-shear dry extruded corn was used to replace ground corn. Therefore, the use of high-shear dry extrusion on corn, which results in starch gelatinization of greater than 90%, is likely reducing the effects of polysaccharides, antinutrients, and other molecules in corn beyond what feed enzymes are capable of doing.

Total Feed Consumed During 14-Day Starter Phase



Interestingly, the use of ExPress® soybean meal in place of commodity, solvent-extracted soybean meal, and especially in combination with high-shear dry extruded corn, resulted in large improvements (13%) in feed intake during the starter phase.

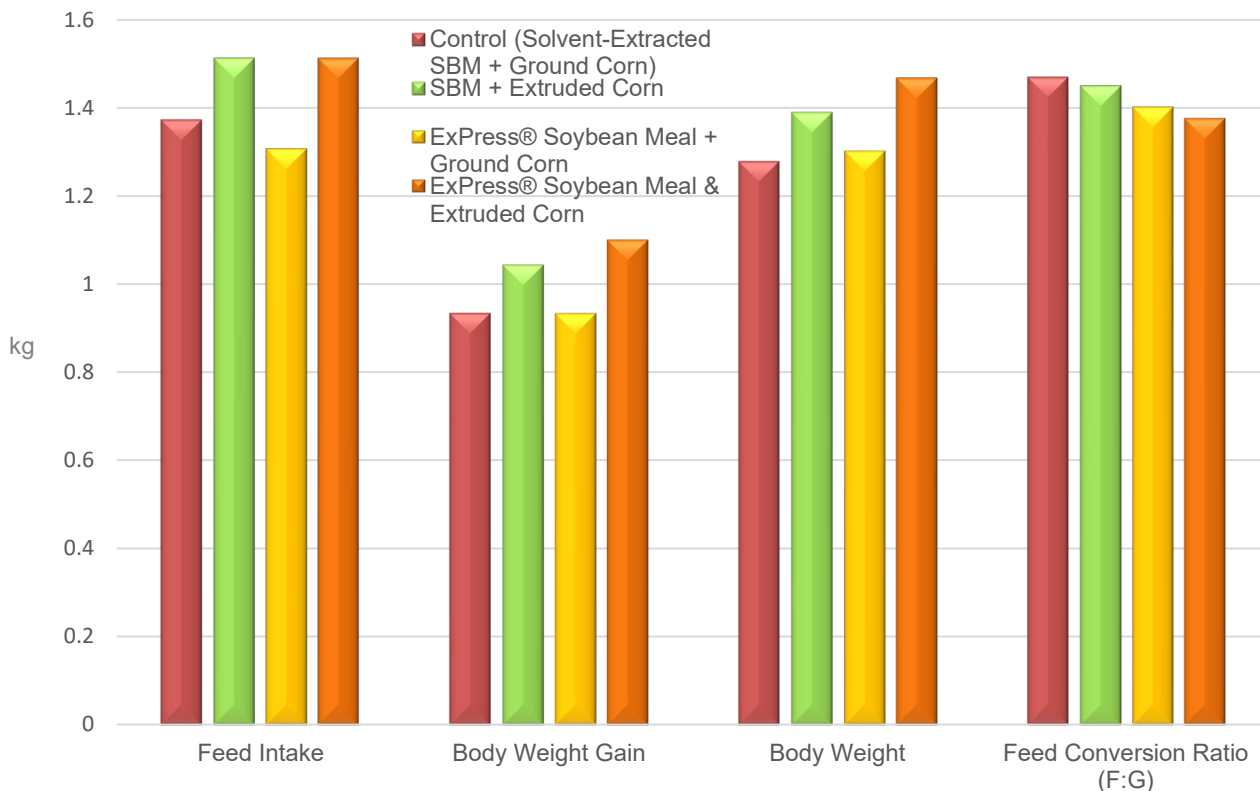
Returning to our starter phase chick example above, it is now clear that the use of ExPress® soybean meal will improve feed intake, along with amino acid digestibility. Therefore, taking this into account, the gain of 2 milligrams lysine supplied during the beginning of the starter phase, solely due to digestibility, now becomes 7 more milligrams of supplied lysine due to combined effects of intake and digestibility gains.



Furthermore, considering the large gains in feed intake with both high-shear dry extruded corn and ExPress® soybean meal, the amount of supplied lysine can now rise substantially to 26 more milligrams versus a diet of ground corn and commodity, solvent-extracted soybean meal. Therefore, including both mechanisms of increasing nutrient delivery to broiler chickens, and using recent data¹⁰, the use of high-shear dry extruded ingredients (corn and ExPress® soybean meal) reduced total feed consumption through all phases of growth, numerically improved feed efficiency, and reduced days to market by more than four. Throughout the course of a single year, one more flock per production unit can be obtained. One more unit of chicken meat each year to further reduce the already low risk associated with broiler production.

It is important to understand how this can happen at each phase of broiler production. As shown above, during the starter phase, feed intake is maximized with high-shear dry extruded corn and soybean ingredients, and this sets up the birds to maximize productivity during the grower phase, which is shown below¹⁰. When utilizing ExPress® soybean meal and high-shear dry extruded corn, both feed intake and body weight gain are maximized during the grower phase, resulting in the lowest feed conversion ratio (i.e., the most efficient conversion of feed intake to body weight gain).

Broiler Performance During the 14-Day Grower Phase



Finally, these benefits of high-shear dry extruded ingredients carry through to the finisher stage before market. Again, with the use of both high-shear dry extruded ingredients, broilers achieve the greatest feed intake and body weight gain during the final finisher phase of production, which is shown below.

Broiler Performance During the 14-Day Finisher Phase



Therefore, the benefits of using high-shear dry extruded corn and ExPress® soybean meal during the starter phase of production continue through all the phases to market. The two ingredients work well together, with dry extruded corn promoting feed intake, while high-shear ExPress® soybean meal promotes body weight gain and feed conversion ratio.

In this way, using two improved versions of typical, commodity ingredients for broilers helps to take advantage of the genetic capacity for intake and growth within modern birds. As outlined above, this will reduce the risk associated with raising chickens for meat, which is already quite low.

Recommendations:

- Use the decades of genetic selection for improved broiler productivity to your advantage.
- Use ExPress® soybean meal and high-shear dry Extruded Corn versions of commodity corn and soybean meal to increase broiler productivity.
 - Reduce time to target market weight by over 4 days
 - Produce one more flock of birds per year per production unit
- Reduce the risk associated with the time it takes to get broilers to target market weight



References

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- ⁸https://www.researchgate.net/publication/325632420_The_evolution_and_application_of_enzymes_in_the_animal_feed_industry_the_role_of_data_interpretation
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