TECH LINE

SUBJECT: Impact of Distillers

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Key Points

- Distillers dried grains (DDGS) are not new to the commercial feed industry, having been available from the beverage ethanol industry for decades, if not centuries.
- The emergence of the fuel ethanol industry in North America has increased the supply, as well as the quality, of DDGS available to the livestock industry, but total feed grain supply (i.e. grains plus DDGS) has still decreased, creating a shortage of feed energy, and thus dramatically increased overall feed cost.
- New technology for production of fuel ethanol shows promise to further improve DDGS quality, and well as increase the range and specificity of products available for feeding. However, if successful, this will likely increase the overall value (cost) of DDGS, and further divert them away from their traditional, lower value ruminant market.
- Factors other than nutritional value and consistency, such as components that may affect health and safety, handling, transportation and storage, and inconsistency of supply, will continue to challenge the value and utilization of DDGS in the near future.

Introduction

"The more things change, the more they stay the same". As much could be said of the effect of the recent massive expansion of the fuel ethanol industry on the burgeoning supply of distillers grains, and its impact on the feed industry per-se. For the following discussion, the "Feed Industry" will be defined as the so-called commercial feed industry, those supplying feed ingredients and, more specifically, compounded feeds to the livestock industry.

Historically, the feed industry is well acquainted with distillers grains as a feed ingredient, having routinely used them in compounded feed as well as on-farm, in both the dry and wet form, for decades, albeit mostly in ruminant feeds. In the past, most distillers grains originated from the fermentation of grains for the production of ethanol for human consumption. The relatively small amount of DDGS "by-product" produced this way, and it's low value relative to the primary product (beverage ethanol), often resulted in product with extremes in nutritional and physical quality, as well as unreliable supply. It was therefore more generally viewed as an opportunity protein ingredient, and primarily for ruminants.

The development and rapid expansion of the U.S. corn based fuel ethanol industry in the last couple years has dramatically changed the supply of both corn and wheat distillers grains to both the feed industry and livestock producers. This has necessitated corn distillers grain, and soon wheat distillers grain in Canada, becoming a more standardized feed ingredient both domestically and internationally, but concerns with nutritional composition, variability, handling, and distribution will likely continue to affect its rate of adoption, inclusion rate in diets and subsequent economic value.

DDGS as a feed ingredient

"By-product" ingredients are generally accepted as being more variable in nutritional composition than their parent ingredients, and DDGS are no exception. Coefficients of variation for a range of nutrients in samples of DDGS collected from 34 ethanol plants ranged from a low of less than 2% for dry matter, to over 100% for selected minerals. This variability is caused by a number of factors including a) nutritional composition of the parent stock (e.g. corn, wheat or sorghum, due to variability in their inherent protein, oil and mycotoxins levels), b) fermentation processes and conditions (e.g. efficiency of fermentation and remaining starch, type and amount of acid used for pH control), c) control of microbial contamination (e.g. antibiotic residues), d) cleaning processes (e.g. detergents and acids used), e) disposal of contaminated or spoiled batches, f) syrup composition and proportion added to the solids fraction prior to drying, and g) drying conditions.

The components with high variability that are of greatest interest or concern in feed formulation are generally crude protein, specific essential amino acids (especially lysine), fat, fiber, phosphorus, sulphur, mycotoxins, and more recently, antibiotic residues. How these nutrients and other components affect a specific feed formulation, will depend on the target species.

Regardless of specie, however, variability of DDGS is generally best controlled by buying from selected plants, combined with separation of sources, and routine sampling and testing of those sources, to understand and control the within plant variability and how it will affect feed compounding or diet formulation.

DDGS in diet formulation

Numerous research papers have demonstrated that DDGS can be used at inclusion rates of up to 10-20% of total diet dry matter in swine, 5-15 % in poultry, 10-20% in dairy cattle and 30-40% in beef cattle diets, depending on stage of production, without negatively affecting performance. Inclusion rates in commercial diets, on the other hand, routinely do not exceed half the maximal research diet inclusion rates.

The reason for this does not appear to have been formally researched, but is likely due to a number of non-nutritional factors. First, nutrient variability of an ingredient is much harder to regulate and compensate for in the commercial setting than it is in a research setting. This increases the risk of a negative effect on performance, which generally has a much higher cost compared with the savings offered by a higher inclusion rate. Next, the higher fat and fiber of DDGS can decrease pellet durability, and impair handling and flowability characteristics of mash feeds. Also, commercial feed formulation is most often based on "least cost" or "best-cost" algorithms, and the opportunity cost of other ingredients required to compensate for changes in nutrient balance associated with inclusion of DDGS limits their "value" and subsequent inclusion rate in a given formula. Finally, health and environmental concerns involving dietary levels of phosphorus, sulphur, and mycotoxins become increasing important as level of inclusion increases, and may limit inclusion rates in some regions.

DDGS are classified as an intermediate ingredient, between grains as a primary energy source and oilseed meals as a protein source, offering both protein and energy. As such, DDGS generally cannot completely replace any of the traditional grain or protein sources in most feed formulation, but must complement and compete with them as a low cost source of specific nutrients, or a combination thereof, if they are to be of value in a ration. As such, DDGS also must complete with other so-called intermediate ingredients such as wheat shorts, canola meal, brewers grains, corn gluten feed, or even grain screenings, depending on the specie of interest. Since these relationships are often complex and involve not only protein and energy, but also other expensive ingredients such as phosphorus and purified amino acids, the true value and optimum inclusion rate of an ingredient is routinely determined by performing least-cost formulation using computer software. At today's inclusion rates, DDGS will on average decrease total ingredient cost by about 2-3%.

Other factors affecting DDGS use

Factors other than nutrient content and variability and savings in ingredient cost that potentially limit the use of distillers grains include health and safety, handling and storage, and inconsistency of supply.

Health and safety

Grains are subject to fungal growth and disease that can produce mycotoxins that are a concern for animal health and performance (e.g. vomitoxin, alflatoxin), as well as for human health via transfer through the food products that are produced (e.g. alflatoxin). These toxins, if present in the grain, are not affected by fermentation, and are thus concentrated approximately three fold in the resulting DDGS. Consequently, routine monitoring must be done, and adjustments made, to ensure that mycotoxins levels in the final diet do not exceed acceptable thresholds. There is concern that fuel ethanol DDGS may contain higher levels of mycotoxins than DDGS from beverage ethanol sources, but this has not been substantiated by research. The discount required to attract these types of often lower bushel weight or starch content grains into ethanol production would likely first divert them directly into livestock feeding, most likely into beef production.

Another emerging concern in the use of fuel ethanol DDGS for livestock feed has been regulatory agency (CFIA in Canada and USDA in the United States) investigation of cleaning procedures and antibiotic use in fuel ethanol plants. Ethanol production requires a pure yeast fermentation to be successful and efficient. Bacterial infections are always a concern and can spoil batches, which must then be discarded. To prevent this, sanitation is essential, and the system is cleaned thoroughly between batches. These cleaning agents are normally added to the syrup, and ultimately become part of the DDGS. To prevent bacterial contamination, small amounts of antibiotics (common virginiamycin) are added to the fermentation batches. Any residue that remains will therefore also be found in the DDGS. This has apparently either not been a concern with DDGS from the beverage industry, or was overlooked. However, at the moment, regulatory agencies in both Canada and the United States are investigating the materials and procedures that are being used to ensure that they are acceptable for producing a feed ingredient that is destined for food production.

Handling and storage

The attractiveness of DDGS can also be limited by its handling characteristics and need to expand ingredient storage. The combination of variable fat content, particle size distribution and "hot-loading" (loading of warm DDGS) can create a product that will "set-up" during transport, and even in storage. For those that have experienced it, they know the result can require many hours of hard labor and ingenuity to get the DDGS out of the rail car, truck or storage bin in which it has set-up. This experience has resulted in rail and trucking agencies refusing to transport DDGS, requiring specialized equipment for its transport, customers refusing to continue using the ingredient, and some trepidation for customers to try it

One of the significant limitations for using DDGS is the requirement to add storage. Since it cannot fully replace either a grain or a regular protein supplement, it generally requires adding extra commodity storage. This must then also become part of the economic equation of the net value of adding or increasing the use of DDGS as an ingredient.

Inconsistency of supply

A final challenge to the current use of DDGS is inconsistent supply. In North America, the production of fuel ethanol, and thus DDGS, is linked to the production and consumption of blended gasoline, which is seasonal. At the moment, individual ethanol plants are small relative to the size of the overall blending market, they are also located far from where blended gasoline is produced and consumed, and the industry has no medium or long term storage capacity, nor any dedicated transport network such as a pipe line to get it there. As a consequence, rate of production is a function of just-in-time delivery by truck and rail tanker to distant markets that must compete with transport of more traditional commodities for space. Add to this that individual plants must undergo routine shutdowns for maintenance, as well as periodically for repair, it becomes clear that there are a lot of factors that can affect the supply and price of distillers grains at any time, regardless of its production. Dramatic expansion of the export market will likely further affect price and availability of DDGS in North America. However, current exports are also being limited by logistics and handling concerns, especially in relation to its relatively low bulk density, which inflates transportation costs on a per tonne basis.

Next Generation DDGS

The fuel ethanol plants that are currently being constructed are larger, and are using more similar and improved technology. These businesses are also more aware of the value of DDGS as a "co-product" and revenue generator, in contrast to being perceived as a "by-product" that needs to be disposed. This alone will improve the consistency and feeding value of DDGS in the future.

However, there is also a wave of technological development coming that is designed to be "bolted on" to the front or back of the traditional fermentation process, that may dramatically alter the way co-products from the fuel ethanol industry are produced and marketed. The simplest of these involves initial dry or wet processing of the grain to remove most of the germ (oil) and bran (fiber) prior to fermentation. These co-products could then be sold either as food ingredients, select feed ingredients, or selectively blended back to the more consistent, higher protein DDGS that results from the modified fermentation process. Alternatively, there are methods being investigated for processing standard DDGS following the fermentation step. These process changes are also particularly attractive in terms of dealing with some of the current handling and logistics concerns. However, to be successful, such changes would have to increase the total value of the co-products beyond that of current DDGS. This would also likely drive more product towards human and monogastric consumption, and away from use by ruminants.

Conclusions

DDGS have been available from the beverage ethanol industry, and used by the feed industry for decades. As such, it closely resembled a classic "by-product" and concerns regarding consistency and nutrient availability were substantial. The emergence of the fuel ethanol industry has increased the quality and consistency of DDGS, but concerns still exist. Larger facilities, consolidation and new technologies involving processing of grains prior to fermentation, or DDGS post fermentation show promise in increasing feed ingredient quality, but will also likely increase the value or cost of these ingredients, as well as direct them away from their traditional ruminant market. Before this is fully realized, concerns regarding handling, storage and transportation of both ethanol and DDGS must be resolved before a stable market will be realized. After that, expansion of export markets will ensure that DDGS maintains a value at least close to that of the parent grains from which it is produced. As it was before, it will continue in the future, the use of DDGS in the feed industry will ultimately be based on how well it continues to least-cost against alternative ingredients in commercial rations.