CHAPTER 30

Frequently Asked Questions about DDGS

Why are U.S. ethanol plants partially extracting oil before manufacturing DDGS?

The current market price and demand for crude corn oil is very economically attractive for U.S. ethanol plants to create another revenue source. The growth of the U.S. biodiesel industry has resulted in increased demand for fats and oils, and distillers corn oil is an economically attractive lipid source. The capital investment to add corn oil extraction equipment to existing ethanol plants is relatively low, and this investment can easily be fully recovered in less than one year (see **Chapter 3**).

Can distillers corn oil be exported for use in animal feed?

Yes. Distillers corn oil has an approved definition and quality specifications from the Association of American Feed Control Officials and significant quantities are being used in the U.S. poultry and swine industries. It is approved for use in biodiesel production and for animal feed, but not for human consumption. Recent studies have determined the metabolized energy and AME_n content of distillers corn oil for poultry and swine (see **Chapter 4**), and have shown that it is an economical and high energy lipid source for animal feed. Some U.S. marketers have experience in exporting distillers corn oil, and although large quantities are available, limited quantities have been sold.

Does reduced-oil DDGS have less energy than conventional high-oil DDGS?

Several studies have shown that the crude fat content of DDGS is a poor single predictor of metabolized energy content for swine and AME_n content for poultry (see **Chapter 6**). Prediction equations have been developed and validated using several chemical analysis measures to accurately predict metabolized energy and AME_n among DDGS sources with variable content for swine and poultry, respectively. In these equations, a measure of fiber is more predictive than crude fat content. Limited studies have been conducted to determine the net energy content of reduced-oil DDGS for dairy and beef cattle, but it appears to be slightly reduced in reduced-oil DDGS compared to high-oil DDGS. See **Chapters 17 and 19** for more details on the net energy estimates of reduced-oil DDGS for ruminants.

How does partial extraction of corn oil in DDGS affect its feeding value?

Partial extraction of corn oil does not necessarily reduce the metabolized energy and AME_n content for swine and poultry because several studies have shown that some sources of reduced-oil DDGS have equal or greater metabolized energy and AME_n content than traditional high-oil DDGS sources. However, limited data in ruminants suggests that reduced-oil may has less energy value than conventional high-oil DDGS, but energy content is equal to or greater than the energy value of corn. Recent studies for swine and poultry have shown that reduced-oil DDGS sources have slightly reduced amino acid digestibility compared with high-oil DDGS sources, but responses of individual amino acids vary. Furthermore, although amino acid digestibility is generally less in reduced oil DDGS sources, total amino acid content is increased resulting in minimal change in digestible amino acid content among reduced-oil and high-oil DDGS sources (see **Chapter 6**). No studies have been conducted to compare phosphorus digestibility between reduced-oil and high-oil DDGS sources for poultry and swine.

What is the average protein content of reduced-oil DDGS?

In a recent comprehensive meta-analysis study, Zeng et al. (2017) showed that the average crude protein content of corn DDGS is 27 percent (88 percent dry matter basis) with a coefficient of variation of 8.7 percent (see **Chapter 6**). Although many DDGS traders and nutritionists expected the crude protein content to slightly increase with partial extraction of corn oil to produce reduced-oil DDGS, this is not a consistent response when comparing protein content among sources.

Is high-protein DDG available in the export market?

Yes. Several new technologies have been implemented in some U.S. ethanol plants to produce high protein corn co-products containing 40 to 50 percent crude protein (see **Chapter 5**). Limited research is available on the maximum diet inclusion rates and performance responses from feeding these new high protein corn co-products to various species. It is important to realize that the energy and nutrient content, especially the amino acid profile of these new high protein co-products is substantially different than the energy and nutrient content of high protein DDG produced by front-end fractionation processes several years ago. Therefore, although some published studies have shown that feeding high protein DDG produced from front-end fractionation processes results in excellent performance, these results are not directly applicable to the new high-protein co-products currently being produced.

Is DDGS color a reliable indicator of quality and nutritional value of DDGS?

Extremely dark colored DDGS has been shown to reduce digestibility of protein and amino acids, but recent studies have shown a very poor relationship between color and amino acid digestibility among DDGS sources (see **Chapter 10**). Color is an unreliable and poor indicator of nutritional value because many factors in addition to drying temperature affect color. Therefore, purchasers and nutritionists should not assume that darker-colored DDGS has less nutritional value than lighter-colored DDGS sources.

Can DDGS replace soybean meal in animal feeds?

Each individual feed ingredient is a package of nutrients in various quantities and proportions. The three most expensive nutrients in livestock and poultry feeds are energy, amino acids and phosphorus. Depending on relative ingredient prices, DDGS partially replaces some of the energy, amino acid and phosphorous sources in commercial livestock and poultry diets. In typical corn and soybean diets DDGS partially replaces corn and soybean meal. But where a greater variety of energy and protein sources are available, DDGS may replace other ingredients without reducing the soybean meal in the ration.

The differences between soybean meal and DDGS in swine and poultry rations are:

- The energy value of DDGS is greater than dehulled soybean meal in livestock and poultry diets.
- The protein content of DDGS typically averages about 27 percent whereas soybean meal contains 44 to 48 percent crude protein.
- The amino acids most likely to be limiting in corn-soybean meal based swine and poultry diets are lysine, methionine, threonine and tryptophan. Soybean meal is substantially higher in these essential amino acids, and they are more digestible than in DDGS.
- Soybean meal contains about the same concentration of phosphorus as DDGS, but the majority of the phosphorus in DDGS is in a chemical form that is easily digested and utilized by swine and poultry compared to the indigestible form of phosphorus (phytic acid) found in soybean meal. This nutritional advantage for DDGS allows nutritionists to significantly reduce the amount of inorganic phosphorus supplementation needed in the diet, diet cost and phosphorus concentrations in manure, while supporting optimum swine and poultry performance.

In contrast, several studies have shown that DDGS is an excellent replacement for soybean meal in ruminant diets.

Does DDGS contain mycotoxins?

Most of the corn used to produce DDGS is grown in the upper Midwest of the United States. Depending on the weather conditions during a given crop year, various mycotoxins can be produced during unusual growing conditions that stress the corn plant (e.g. drought, excessive rainfall, extreme high temperature and high humidity). When these growing conditions occur, they are often more isolated in a portion of the major corn production region and not in the entire corn crop. If mycotoxins are present in corn used to produce ethanol and co-products, they are not destroyed during this process and are concentrated by about three times in DDGS. Therefore, most U.S. ethanol plants have implemented maximum standards for the major mycotoxins (e.g. aflatoxins, deoxynivalenol, fumonisins, zearalenone) before accepting incoming corn sources at the ethanol plants. These ethanol plants test incoming loads of corn and reject loads that exceed these standards in order to produce DDGS below these maximum mycotoxin concentrations. In general, recent surveys have shown that the prevalence of various maycotoxins in U.S. corn for a specific year is less than corn produced in Asia, Central and South America.

Does DDGS contain ethanol?

No. The distillation process used in ethanol plants is very complete and, because alcohol is very volatile (evaporates easily), any alcohol remaining is lost during the drying process used to produce DDGS.

Are there antibiotic residues in DDGS?

Small amounts of antibiotics are used to control bacterial infections during corn fermentation to produce ethanol and corn co-products. The two most common antibiotics used are virginiamycin and penicillin. Studies have shown that when these antibiotics are added at recommended doses, they are completely degraded due to the low pH and high temperature conditions used during the production process. Recent research conducted at the University of Minnesota indicated that only about 12 percent of DDGS samples collected in the U.S. ethanol industry contained detectable but very small amounts of one or more antibiotic residues. However, due to the processing conditions used to produce ethanol and DDGS in ethanol plants, these antibiotic residues did not have biological activity. Therefore, even though antibiotics are used in ethanol production, DDGS is safe to feed to animals based on current U.S. Food and Drug Administration regulations.

Why do some DDGS sources contain high sulfur content?

To optimize ethanol production and produce high quality DDGS, ethanol plants need to optimize pH during fermentation. To do this, small amounts of sulfuric acid are used to reduce pH, and as a result, can increase sulfur content in DDGS. The sulfur content can range from 0.6 to 1.0 percent among DDGS sources. Recent studies have shown that feeding diets containing high sulfur content to swine has no negative effects on growth performance and may actually improve antioxidant status of pigs (see **Chapter 14**). However, feeding high sulfur DDGS sources at high dietary inclusion rates to ruminants can increase hydrogen sulfide production and increase the risk of sulfur toxicity leading to the development of polioencephalmalacia. Furthermore, feeding high sulfur diets to ruminants can reduce dry matter intake, fiber digestibility, and growth performance (see **Chapters 14, 17,** and **19**). Therefore monitoring sulfur content of DDGS is important to avoid exceeding the recommended 0.4 percent of total sulfur in the diet for dairy, beef, sheep and goats.

Can DDGS be safely stored at feed mills for a long-period of time?

There are limited studies that have evaluated the effects of long-term storage of DDGS under various storage times, temperatures, and relative humidity. Corn DDGS has some unique chemical and physical properties compared with other feed ingredients including an ability to attract moisture and relatively high oil content. The ability of DDGS to attract moisture can influence its handling characteristics and potentially increase mold and mycotoxin production if moisture content exceeds 15 percent. The corn oil present in DDGS contains high concentrations of polyunsaturated fatty acids which are susceptible to peroxidation during storage. However, a recent study has shown that adding commercially available antioxidants can be effective in preventing lipid peroxidation in DDGS and distillers corn oil when stored in high temperature and high humidity conditions (see **Chapter 9**).

Can bridging and caking of DDGS in containers be prevented?

Corn DDGS has some unique chemical and physical properties compared with other feed ingredients that cause it to bridge or cake which reduces flowability. Although some flow agents have been used to prevent flowability problems when transporting DDGS in containers, studies have shown that they are generally ineffective (see **Chapter 9**). However, studies have shown that minimizing moisture content improves flowability, and reduced-oil DDGS tends to have improved flowability properties compared with traditional high-oil DDGS. It is essential that DDGS be cooled and cured at the ethanol plant for at least 24 hours after being produced before loading to prevent caking and difficult unloading.

How does adding DDGS to poultry, swine and aquaculture feeds affect pelleting and extruding?

The high fiber and low starch content of DDGS has been shown to reduce pellet durability index and pellet mill throughput. However, adjusting pelleting conditions and use of binders can improve pellet quality, mill throughput, and reduce energy use (see **Chapters 16, 21**, and **24**).

How do you determine economic value DDGS in relation to price?

There is a disconnect between the market price of DDGS and the economic value it provides to diets in least cost formulations (see **Chapter 2**). There are many reasons for this. First, feed ingredients are traded on the basis on minimum guarantees of protein and fat content, but diets are formulated on a metabolizable or net energy, and digestible amino acid basis. Although, protein and fat content are related to energy and digestible amino acid content, using protein and fat content to determine market price underestimates the true economic savings of DDGS in all animal diets. Second, because the energy and protein value of DDGS is greatest in ruminant diets, compared to swine and poultry diets, it also has greater economic value. In fact, studies have shown that there is up to a $60/metric ton greater value for DDGS in swine diets than the purchase price paid in the market. Therefore, the best method of determining DDGS value in various types of livestock and poultry diets is to obtain a complete nutrient profile and the digestibility coefficients of the source being considered, along with the price at which it can be purchased, formulate least cost diets to determine the shadow price at which it will be used in the formula compared with prices of other competing ingredients.

What should be included in the certificate of analyses for DDGS?

Typically, DDGS is traded based on minimum guarantees for crude protein and crude fat, but many traders continue to use the pro-fat combination for nutrient guarantees. The use of pro-fat in DDGS pricing has led to much confusion among traders because the reduction in crude fat content in reduced-oil DDGS does not proportionately increase the crude fat content. Therefore, it is recommended that minimum guarantees for crude protein and crude fat be used instead of pro-fat. However, more DDGS customers are asking for additional guarantees such as minimum mycotoxin concentrations and color scores, beyond moisture, crude protein, crude fat and crude fiber depending upon the intended feeding application. These additional guarantees need to be negotiated between the buyer and seller. In addition, it is extremely important to agree on the commercial laboratory and testing method that will be used for any nutrient analysis being guaranteed or checked because the testing procedure can have a significant influence on whether or not a guarantee is met.

How do I identify a DDGS supplier who can meet my needs?

Due to the variability in processes used by ethanol plants to produce ethanol and DDGS, there can be significant variation in nutrient content and digestibility among sources. This variation in nutrient content and digestibility makes it unwise for nutritionists to formulate diets using typical nutrient values. Therefore, many DDGS users have chosen to contact direct marketers of DDGS, request nutrient information and samples from specific ethanol plants of interest, develop a preferred supplier list of ethanol plants that meet their quality criteria and purchase and use only DDGS from those sources.