Corn Processing Co-Products
Practical Utilization in Lactating Dairy Cow Diets

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INTRODUCTION

The availability of feedstuffs derived from the production of ethanol and corn sweeteners has greatly increased in the last 5 years. By-products or co-products of the distilling and brewing industries have been utilized successfully in dairy cattle diets for at least several decades. However, the recent increase in ethanol and corn sweetener production has increased the availability of co-products as well as the interest in utilizing these products in dairy diets.

There are 2 basic types of grain processing utilized today to produce co-products. The dry milling process grinds grains and then uses a fermentation process to transform the starch into ethanol for either fuel or human consumption. Various grains can be utilized; however, corn or grain sorghum is the most common. Once the starch is fermented into ethanol, the remaining germ, seed coat, and solubles are utilized in the production of the primary co-product, distillers grains with solubles, either in a wet (**WDGS**) or dry form (**DDGS**). Usually not all the solubles are utilized in the production of DDGS and WDGS. The remaining solubles are condensed into a solid and sold as condensed distillers solubles (**CDS**).

Wet milling involves soaking the grain, followed by a coarse grinding, which separates the starch, germ, and seed coat. The starch is further processed into corn sweeteners or utilized in ethanol production. The germ is further processed into corn oil and corn germ meal. The seed coat (bran) and steep liquor (liquid from the soaking process) are combined and result in corn gluten feed, either in a wet (**WCGF**) or dry form (**DCGF**).

Recent changes in processing methods have resulted in significant changes in the nutrient composition of some of the dry milling co-products. This presentation will explore the practical application of corn processing co-products in the diets of lactating dairy cattle.

DEFINING THE CO-PRODUCTS

No matter which co-product is being produced, by dry or wet milling, the name of the primary grain (corn, sorghum, wheat, barley, etc.) utilized in the fermentation process should precede the term.

Co-Products of Dry Milling

Dried distillers grains **(DDG**) is the residue remaining following the fermentation of the starch into ethanol. Because of the variability in the nutrient content of grains utilized in the production of DDG, there is a range of nutrient contents expected in the DDG. In general, the content of other nutrients will increase in proportion to the amount of starch removed in the fermentation process.

Distillers dried solubles (**DDS**) represent the liquid fraction that is separated from the grain particles following fermentation. In most cases, most if not all of the DDS is added to the DDG to form DDGS.

Condensed distillers solubles is similar to DDS except it contains a higher level of moisture. This product is generally added back to the DDG to produce DDGS; however, it is usually not practical to use all the CDS in DDGS. A significant amount of CDS is utilized to produce liquid feed supplements for dairy and beef cattle.

Distillers dried grains with solubles is the primary co-product of the dry milling ethanol industry. It is produced by drying the solids that remain after the fermentation process has removed most of the starch. Generally a majority of the solubles are removed and condensed. The remaining solids are then combined with a smaller portion of the CDS and dried.

In addition to the DDGS, many processing plants also produce a wet form, WDGS. A major portion of the energy consumed in an ethanol plant is utilized in removing water from the co-products. Due to increased energy costs, reducing the amount of drying of the co-products is important to the overall efficiency of the industry. Storage and variability in moisture content are major management issues when utilizing these products.

Hominy is a co-product of dry corn milling utilized to produce hominy and grits for human use. Hominy is similar to CDG, except it generally contains more residual starch and less oil. Due to variations in processing methods, nutrient content of hominy can be variable.

Co-Products of Wet Milling

Gluten feed (**GF**) is the primary co-product of the wet milling industry. It is comprised mostly of the bran or seed coat and represents what remains after the starch, gluten, and germ are removed. This fibrous product is very available in the rumen and can be used as a limited replacement for forages. It is sold in a wet (**WGF**) or dry (**DGF**) form. As with DDGS, energy costs are driving the interest in utilizing the WGF over DGF.

Gluten meal (**GM**) is the solid remaining after the oil is extracted from the germ. While it contains a high level of protein, the value in other applications generally limits the use of GM in dairy diets.

SPECIAL CONSIDERATIONS IN UTILIZING CORN MILLING CO-PRODUCTS

Nutrient Variations

One of the major concerns in utilizing co-products of any type is the potential for nutrient variation. As we attempt to balance diets to meet the needs of the animal while limiting the amounts of excess nutrients, nutrient variation becomes a major issue. Precise ration balancing is limited by the variability of feedstuff nutrient content. With wet co-products, dry matter (**DM**) content is the first concern. Consistency between plants and within an individual plant can be an issue. Once wet products are delivered to the farm, moisture sometimes migrates to the bottom of the pile resulting in variation within an individual pile. More modern processing plants generally produce wet products with more consistent moisture contents; however, production issues arise that significantly impact the moisture content of wet feeds.

Cereal grain and the quality of the cereal grains utilized in wet or dry milling applications influence the nutrient content of the resulting co-products. There is greater potential for this issue in dry milling as a variety of cereal grains may be utilized throughout the year. Some plants will also mix cereal grains, again increasing the variability in the nutrient content.

Drying practices at the plant greatly influence the amount of ruminally undegradable protein (**RUP**) and may influence the protein digestibility. Higher drying temperatures and longer drying times increase the RUP value of a feedstuff. Reported RUP values for dried distillers grains range from 47 to 69 %. It is important to note that excessive drying temperature particularly damage the protein rendering it indigestible. Checking for heat damaged protein is advisable if the DDGS is a major source of dietary protein.

Feed testing and establishing a single source (plant) are the key ways to reduce the impact of nutrient variation upon your dairy herd. Regular analysis of the co-products is necessary for accurate ration formulation. Work with your nutritionist to establish a regular feed testing program for co-products. Work with your commodity supplier to determine if your co-product supply is from a single processing plant or multiple plants.

Wet vs Dry Products

Producers need to carefully consider all the costs associated with utilizing wet co-products in dairy rations. First, variation in moisture content as the product is delivered to the farm, influences the cost on a DM basis. Products delivered to the farm with higher than expected moisture contents cost more per ton of DM. In short, your feed cost just increased because you purchased more water than you had anticipated. Buying water in feed is not very economical. When comparing prices, compare on a DM basis and make certain the wet products received at your farm contain the correct amount of moisture.

Shrinkage

On farm shrinkage is becoming more of an issue as the price of all feedstuffs increase. Carefully consider all the costs associated with utilizing a wet co-product on your farm. What is the difference between the amount of feed that was delivered to the farm and the amount of feed that was placed in the TMR mixer? This difference is shrinkage and it is a true cost to your operation. Wet feeds generally have higher shrinkage than dry feeds. How much of a wet product is going to be discarded as spoiled feed? In some cases, 10-15 % of the feed might be discarded. Wet products will tend to have more spoilage in the warmer months. Do you notice an increase in the amount of delivered feed during the summer relative to what is fed? Many producers do not carefully measure shrinkage and as a result may be underestimating the true cost of a wet co-product.

Sulfur Content

One of the concerns often raised in the discussion of DG is the issue of sulfur content. There are many sources of sulfur in the dry milling process. First, corn contains sulfur. This sulfur is concentrated in the fermentation and drying processes by about 3 times, thus the resulting DG will have about 3 times the amount of sulfur as found in corn grain. Second, the bacteria used to ferment the ground grains contain sulfur and these bacteria are concentrated in the resulting DG. Third, several acids utilized to maintain the pH of the fermentation vat

contain sulfur. As a result, many of the co-products contain higher levels of sulfur. However, recent changes to manufacturing processes at many plants have reduced the sulfur levels found in the co-products. When fed at normal recommended levels, sulfur contents are not generally an issue for lactating dairy cattle. However, sulfur levels should be monitored in feedstuffs and evaluated by a qualified nutritionist.

Phosphorous Content

Co-products may contain significant levels of phosphorus. In many cases, when feeding recommended levels of co-products, additional supplementation of phosphorus is not necessary. Many farms today are subject to nutrient management plans. Feeding excess phosphorus increases the number of acres required for nutrient disposal. Newer manufacturing processes are removing significant amounts of the phosphorus, reducing the amount left in the feedstuffs. In many cases this reduces dietary phosphorus levels to a reasonable level. Regular feed testing is highly recommended to determine the actual phosphorus levels in feeds.

Fat Content

Co-products and in particular, DDGS contain high levels of unsaturated fats. In general, most nutritionist will attempt to limit the level of vegetable fat to 0.5 lb/cow/d. Unsaturated fats, when fed at high levels and when ruminally unprotected, can reduce milk fat test as well as rumen fermentation. Newer processing methods are also reducing the fat content of DDGS. As energy prices increase, the value of the fat in corn increases. Some plants are producing DDGS with greatly reduced levels of fat; thus increasing the amount of DDGS which can effectively be included in lactating dairy cow diets, from the standpoint of limiting vegetable fats.

Value of Co-Products

Traditionally, feedstuffs have been evaluated monetarily based on the prices of corn, soybean meal, dicalcium phosphate, and limestone. However, several changes have occurred. First, currently corn and soybean meal may not be the correct comparison feeds. Use of more robust evaluation programs that include the prices of additional feedstuffs, may give a more accurate value for these feeds. Second, many of these co-products contain greater amount of phosphorus than needed. As a result, values need to be negatively adjusted to reflect the disposal cost of this excess phosphorus.

CONCLUSIONS

Effective utilization of corn milling co-products in dairy diets today is determined by careful evaluation of the true costs of these products and how these products will be utilized by the cow. Careful consideration and monitoring of the nutrient content and management of nutrient variation is necessary if diets are to be more closely balanced to the actual requirements of the animal. Farms utilizing these products should have a regular sampling program for co-products and work closely with a qualified nutritionist. It is also important to monitor manufacturing plants for changes in manufacturing processes. New products will likely become available as plants change processes to develop new products for use in other applications.

RESOURCES

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