

Co-Products of the Dry Milling Industry

Corn is about two-thirds starch, which is converted to ethanol and carbon dioxide during a distilling and fermentation process. The remaining nutrients in corn, such as protein, fat, minerals and vitamins, are concentrated in three different ways and end up as distillers grains or condensed distillers solubles. Distillers grains are a co-product of the dry mill process used to make ethanol from corn.

Corn distillers grains contain the remaining nutrients after the corn starch is fermented to alcohol. The distillers grains can be sold wet or dried. Wet distillers grains are higher in protein and energy than corn gluten feed because gluten and oil remain in distillers grains. When distillers grains are dried they lose some energy value compared to wet products. Dried distillers grains and dried distillers grains with solubles are marketed widely around the world as a feed commodity.

Corn distillers dried grains (DDG) is obtained after the removal of ethyl alcohol by distillation from the yeast fermentation of a grain or a grain mixture by separating the resultant coarse grain fraction of the whole stillage and drying it by methods employed in the grain distilling industry.

Corn distillers dried grains/solubles (DDGS) are recovered in the distillery and contain all the nutrients from the incoming corn minus the starch. Thus, the DDGS has at least threefold the nutrients as the incoming grain. Since the stillage is recycled, the ratio of these more valuable amino acid types continues to increase so that eventually they represent approximately 16% of the final DDGS's amino acid content. No other feed ingredient results from such a great percentage of microbial products and their back stocking. DDGS typically analyzes at 27% protein, 11% fat and 9% fiber.

Corn condensed distillers solubles (CDS) is a term generally used to refer to the evaporated co-products of the grain fermentation industry. Most of the CDS is added to the dried grains, but some is available as a liquid feed ingredient. On a dry matter basis CDS typically is 29% protein, 9% fat and 4% fiber. The solubles are an excellent source of vitamins and minerals, including phosphorus and potassium. CDS can be dried to 5% moisture and marketed, but generally the dry matter content is between 25-50%.

Wet distillers grains (WDG) can be sold as livestock feed or dried into distillers grains (DDG). If syrup is added to wet distillers grains and dried, the resulting product is referred to as distillers dried gains with solubles (DDGS).

Co-Products of the Wet Milling Industry

Wet-milling produces four major co-products for the feed industry from the isolated steep water, bran, germ meal and gluten. Together these co-products represent about 25% -30% of the corn processed.

Condensed corn fermented extractives or corn steep liquor is a high-energy liquid feed ingredient. The protein value analyzes at 25% on a 50% solids basis. This product is sometimes combined with the corn gluten feed or may be sold as a pellet binder and is a source of B-vitamins and minerals.

Corn germ meal is golden-yellow and is mainly gluten, the high-protein portion of the corn kernel. **Corn gluten meal** typically analyzes at 20% protein, 2% fat and 9.5% fiber. It has an amino acid balance that makes it valuable in poultry and swine rations. It is also used as a carrier of liquid feed nutrients.

Corn gluten feed is an intermediate protein product that is rich in highly digestible fiber. It may or may not contain the condensed corn extractives. This product is sold as wet or dry. The bran and condensed extractives (sometimes germ meal) are combined and dried in a rotary dryer. The dried corn gluten feed is made into pellets to facilitate handling. It analyzes typically as 21% protein, 2.5% fat and 8% fiber. **Wet corn gluten feed** (45% dry matter) is similarly combined but not dried. It is a perishable product in 6-10 days and must be fed or stored in an anaerobic environment. These feeds are widely used in complete feeds for dairy and beef cattle, poultry, swine and pets.

Corn gluten meal is a high-protein concentrate typically supplied at 60% protein, 2.5% fat and 1% fiber. It is a valuable source of methionine. Corn gluten meal also has a level of xanthophylls, which offers the poultry feed formulators an efficient yellow pigmenting ingredient. Corn gluten meal also is excellent cattle feed providing a high level of rumen bypass protein.

New Generation Co-Products

Corn Oil Extraction

Removing crude corn oil from the syrup before it is mixed with distillers dried grains provides a potential feedstock for biodiesel production. This technology creates a new co-product and additional revenue stream for ethanol refineries along with reduced emissions and energy use. The resulting feed co-products have a higher protein content and improved flow ability for better product handling and storage.

Corn Fractionation

Increasing ethanol production from a single bushel of corn is now being done by separating the corn kernel into its various components instead of grinding the entire kernel. Additional starch from the endosperm is available through this method for fermenting into ethanol. The germ and fiber are used as feed co-products, providing extra protein and improved flow ability. These advancements also reduce refinery energy inputs and emissions

Average Nutritional Profile

Nutrient	Wet Corn Distillers Grains	Corn Distillers Liquid Solubles
Moisture	66%	71%
	Dry Matter	
Protein	33%	18%
Fat	10%	15%
Fiber	10%	3%
Ash	3%	8%
Calcium	.04%	.04%
Phosphorus	.50%	1.25%
Lysine	1.05%	.70%
Methionine	.65%	.25%
Threonine	1.25%	.70%
Tryptophan	.30%	.20%

***Feeding Recommendations** – Usage rates dependent on nutritionally balanced rations

Beef Cattle – Typically 20-40% on a dry matter basis of wet or dry distillers grains with solubles will maximize growth and weight gain and allow you to minimize your ration cost.

Dairy Cattle - Typically 15-25% on a dry matter basis or 10-15 lbs per head per day will allow you to maximize growth and minimize rations costs

Poultry – Rations balanced with essential amino acids and energy levels can utilize 10-20% in broiler and layer feed rations.

Sheep – Added 10-20% distillers grains to your sheep rations can improve feed efficiency and weight gain when incorporated into a high roughage diet.

Swine – Rations balanced with essential amino acids, such as lysine, can utilize 10-20% in growing-finishing pigs and 35-40% in gilt/sow formulations.

*Distillers Grains Technology Council – <http://www.distillersgrains.org/index.html>