

ethanol

coproducts

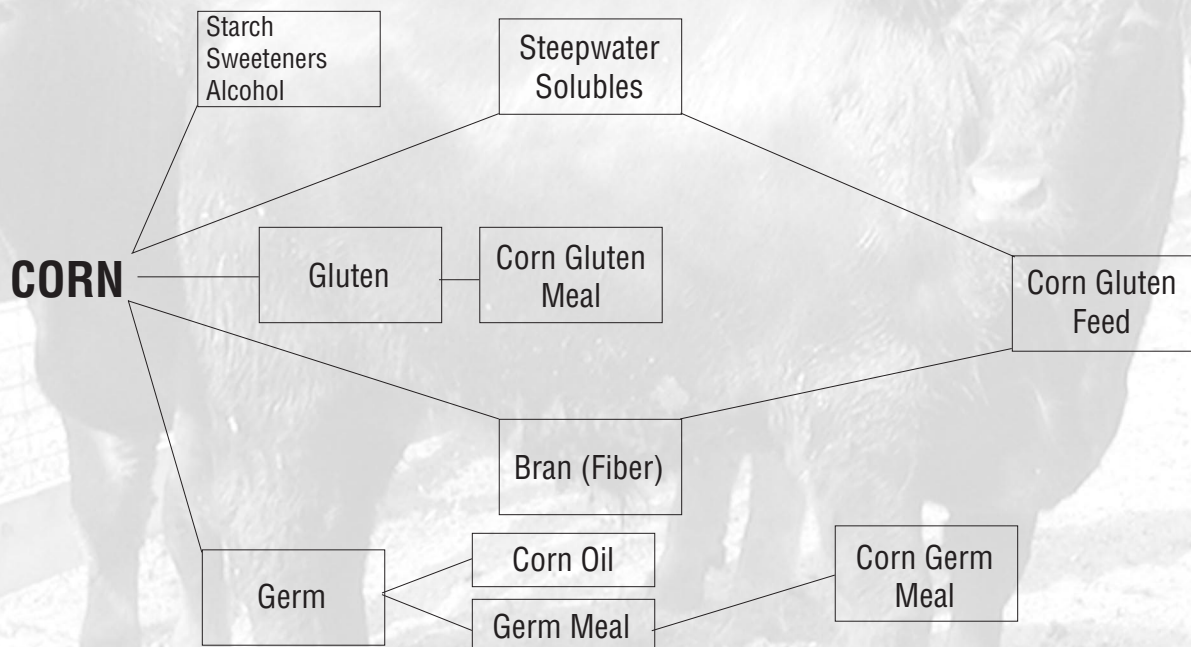
for cattle

The Process and Products

Iowa is in the center of a large and rapidly growing corn processing industry. The state is home to plants that produce ethanol, corn oil and corn sweeteners, using both the wet mill and dry mill processes. These plants also produce large quantities of by-products that can be successfully utilized by Iowa beef producers as a relatively inexpensive feed alternative.

Wet Milling Process

Wet mills are typically larger than dry mills and can produce corn sweeteners as well as ethanol. The wet milling process is very complex and produces a variety of products and by-products. Corn is steeped for 30 to 40 hours to begin the process of breaking the kernel down into its components. The germ is separated for the extraction of corn oil. The bran is screened, then the starch is separated from the gluten. The steepwater is condensed to the consistency of molasses and mixed with corn bran to produce corn gluten feed.



Products of the Corn Wet Milling Industry

Corn Gluten Feed

Corn gluten feed is a popular feedlot cattle protein and energy source because it is an intermediate protein product that is rich in highly-digestible fiber. It is the highest volume coproduct of the wet corn milling industry. Dry corn gluten feed is often pelleted and marketed to domestic and European dairy industry. Corn gluten feed actually contains no gluten but a mixture of corn bran and condensed steepwater solubles. It may contain corn germ meal as well as other coproduct streams from the plant.

Corn gluten feed can vary in composition due to the ration of condensed distillers solubles to corn bran. This will vary from plant to plant depending on the markets available. Corn gluten feed that is higher in bran will be lower in protein, as well as phosphorous and sulfur.

Corn Gluten Meal

Corn gluten meal is golden-yellow and is mainly gluten, the high protein portion of the corn kernel. Corn gluten meal is used primarily in the swine and poultry industries and is high in Xanthophyl, a yellow pigment that imparts yellow color to poultry. Corn gluten meal is a high bypass protein source and although expensive may be useful in beef diets that require bypass protein, such as lightweight calves.

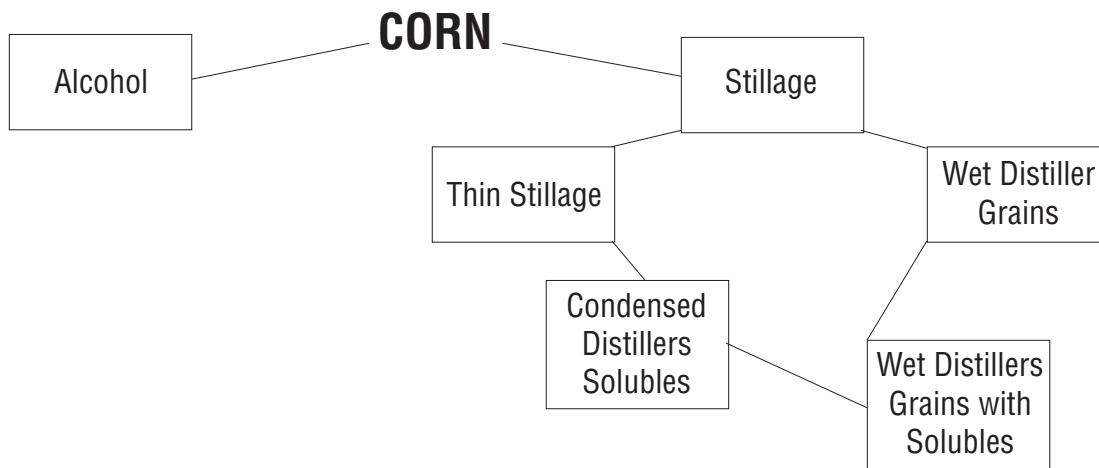
Condensed Steepwater Solubles

Condensed steepwater solubles are an excellent source of soluble protein for liquid beef supplements. Most condensed steepwater solubles are used in corn gluten feed, however, it has the consistency of molasses and can also be used in liquid supplements. It is about 35 percent protein and can be extremely high in phosphorous and sulfur.

In 1999, the wet corn milling industry used 1.4 billion bushels of corn (14.8 percent of the U.S. corn supply). Wet milling yields 31.5 pounds of starch with corn being processed into 33 pounds of sweetener or 2.5 gallons of ethanol. Also 13.5 pounds of gluten feed, 2.5 pounds of gluten meal and 1.6 pounds of corn oil are produced. In 2000, 10.6 billion pounds of corn gluten feed and corn germ meal were produced.

Dry Milling Process

Corn is nearly two-thirds starch. The starch is the primary substrate for alcohol fermentation. Therefore, the nutrients in the remaining one-third of the corn kernel are concentrated into distillers feeds. The process begins by grinding the grain. Starch must be converted to sugar by enzymes before the yeast can ferment the sugar to produce ethanol and carbon dioxide. The fermentation process takes 40 to 50 hours. The ethanol is collected and refined. A centrifuge separates the distillers grains from the solubles. The solubles can then be condensed to about 30 percent dry matter (condensed distillers solubles). These wet coproducts can then be used locally for livestock feed or the produce distillers dried grains, or distillers dried grains with solubles. While the dried grains can be transported longer distances, some feeding value may be lost and drying is expensive.



Products of the dry corn milling industry

Distillers Grains

Wet distillers grains and distillers grains with solubles contain the remaining nutrients after the corn starch is fermented to alcohol. Therefore, the original nutrients in the corn are concentrated approximately three times. Wet distillers grains are higher in both 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 distillers dried grains with solubles are marketed widely around the world as a feed commodity. Like corn gluten meal, dried distillers grains are a good bypass protein source for cattle.

Condensed Distillers Solubles

Distillers solubles can be added to the distillers grains, or condensed and used as a liquid cattle feed supplement. Condensed distillers solubles appear to be slightly higher in energy and similar in protein to wet distillers grains when adjusted for moisture. The protein level is similar to distillers grains at approximately 30 percent. Because condensed distillers solubles are 70 percent moisture, upper Midwestern feeders should use heated or underground tanks to prevent freezing.

Nutrient Values: Wet vs. Dry Corn CoProducts

Tables 1 and 2 show the range in reported nutrient values for selected wet and dry corn co-products. These values were gathered from industry publications as well as the National Research Council. In general these products concentrate many of the nutrients from corn into a nutritious, palatable livestock feed.

For beef cattle in Iowa, wet corn gluten feed and wet distillers grains have particularly high values and can serve as an excellent source of protein, energy, and several minerals. In some diets the concentration of certain minerals may be excessive and require special management. Feed coproducts from the corn processing industry provide an opportunity for the livestock industry to lower cost of products through locally produced, high quality feeds.

Nutrient Value of Selected *Wet* Corn Milling Coproducts.

Table 1.	Dry Corn Gluten Feed	Corn Gluten Meal	Wet Corn Gluten Feed	Condensed Steep Water Solubles
Dry Matter	90	90	42 - 44	50
Protein	20	66	17 - 21	35
Fat	2.8	2.2	3 - 4	3
Fiber	11.1	3.3	3.5	--
ADF	37.6	14	12 - 14	6 - 1
NDF	12.4	5	38.48	1.5
TDN	80	86	80	91
NEm	0.96	1	0.9 - 0.97	1
NEg	0.59	0.69	0.62 - 0.67	.72
Ca	0.055	0.08	0.03 - 0.1	0.07
P	1.1	0.53	0.5 - 1	2
K	1.6	0.22	1	3
Mg	0.5	0.088	0.3	0.9
Na	0.16	0.066	0.1	0.4 - 0.5
S	0.33	0.72	0.4 - 0.5	1.8 - 2
Fe	178	313	80 - 110	127 - 178
Cu	5.5	27	5 - 7	8
Zn	83.3	34	46 - 64	113 - 164
Mn	23.3	7.8	0.3	42 - 50

Nutrient Value of Selected *Dry* Corn Milling Coproducts.

Table 2.	Distilled Dried Grains Solubles	Distillers Dried Grains	Cond. Distillers Solubles	Wet Distillers Grains
Dry Matter	90	90	30	30 - 50
Protein	27.8 - 30.4	30	24 - 28.5	30 - 32
Fat	8.9 - 10.7	8.4	9 - 14.5	8.5 - 12.5
Fiber	6.9 - 10.1	14.4	4	--
ADF	18 - 21	18	2 - 7	14 - 22
NDF	44 - 46	44	10 - 23	30 - 50
TDN	85 - 90	77	75 - 120	70 - 110
NEm	0.99	0.89	1.05 - 1.15	0.9 - 1.1
NEg	0.68	0.67	0.85 - 0.93	0.7 - 0.8
Ca	0.17 - 0.26	0.11	0.03 - 0.17	0.02 - 0.03
P	0.78 - 0.83	0.41	1.3 - 1.45	0.5 - 0.8
K	0.49 - 1.08	0.18	1.75 - 2.25	0.5 - 1
Mg	0.2 - 0.33	0.08	0.65 - 0.9	0.2 - 0.3
Na	0.3 - 0.63	1	0.3 - 20	0.1 - 0.2
S	0.37 - 0.44	0.48	0.37 - 0.95	0.5 - 0.7
Fe	258 - 358	222	227 - 600	90 - 180
Cu	10 - 64	49	17 - 83	6 - 7
Zn	67 - 89	--	103	40 - 60
Mn	28 - 27.6	--	34	8 - 16

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