UNIVERSITY OF MINNESOTA

Dairy Extension
Department of Animal Science
101 Haecker Hall
1364 Eckles Ave.
St. Paul, Minnesota 55108

(612) 373-1014



# Dairy Update

## FEEDING WET-MILLED CORN BYPRODUCTS TO DAIRY COWS

August, 1983
Issue 66

J. G. Linn, Extension Dairy Specialist, and
D. E. Otterby, Professor of Animal Science

The wet process of milling corn results in endproducts of starches, sugars, syrup and oil for human consumption. Several byproducts resulting from this process can be good feedstuffs for dairy cows. The major feed byproducts produced are: corn gluten meal, corn gluten feed, corn germ meal and condensed fermented corn extracts or steep corn liquor. The latter two byproducts are normally not directly available as a livestock feed. Corn gluten feed, either wet or dry, and corn gluten meal are the major feed byproducts available for dairy cattle feeding.

### BYPRODUCT DEFINITIONS

Corn gluten feed - Approximately 9 to 12 pounds of corn gluten feed are produced for every bushel of corn wet-milled. Corn gluten feed is that part of the corn kernel remaining after most of the starch and germ (oil) and some gluten (protein) have been removed. Fermented corn extracts and/or corn germ meal may or may not be added to corn gluten feed before being sold for feeding.

Corn gluten meal - Approximately 2 to 3 pounds of corn gluten meal are produced from the wet-milling of 1 bushel of corn. Corn gluten meal is the dried residue after removal of even larger portions of starch and germ and the separation of the bran (or fiber) from the kernel. It may contain fermented corn extracts and/or germ meal. Two corn gluten meals are usually available, 41 percent and 60 percent crude protein.

Corn germ meal - The ground corn germ from which oil and most of the solubles have been removed during the steeping process. The amounts produced are limited and therefore, not normally available for feeding directly.

Condensed corn fermented extract - The product remaining after some of the water from the sulfuric acid steeping liquid has been removed and fermented naturally by action of lactic acid producing micro-organisms.

## NUTRIENT COMPOSITION OF BYPRODUCTS

The nutrient contents of all 4 byproducts compared to soybean meal and corn are listed in table 1. Corn gluten feed can be considered as a medium energy, medium protein feed. Corn gluten meal is a high protein, medium energy feed. The other 2 byproducts, germ meal and condensed fermented extracts, are fair energy and are medium to good protein sources.

Table 1. Nutrient Content of Wet-Milled Corn Byproducts Compared to Soybean Meal and Corn[a].

| Nutrient | Corn gluten feed | Corn gluten meal[b] | Corn germ meal | Condensed corn fermented extract | Soybean meal | corn |
|---|---|---|---|---|---|---|
| Dry matter, % | 90[c] | 90 | 90 | 50 | 90 | 88 |
| Crude protein, % | 25[d] | 66 | 22 | 43 | 50 | 10 |
| Crude fiber, % | 9 | 3 | 13 | 0 | 7 | 2 |
| Net energy, Mcal lb | | | | | | |
| Lactation | .88 | .88 | | | .84 | .92 |
| Maintenance | .87 | .90 | | | .86 | .98 |
| Gain | .58 | .60 | | | .57 | .64 |
| TDN, % | 82 | 84 | 78 | 75 | 81 | 88 |
| Calcium, % | .33 | .18 | .33 | .26 | .36 | .03 |
| Phosphorus, % | .86 | .51 | .56 | 3.39 | .75 | .31 |
| Magnesium, % | .32 | .05 | .18 | 1.89 | .30 | .13 |
| Potassium, % | .67 | .03 | .33 | 4.34 | 2.21 | .35 |
| Sulfur, % | .24 | .44 | .36 | 1.04 | .49 | .14 |
| Manganese, ppm | 26 | 8 | 4 | 45 | 31 | 6 |
| Copper, ppm | 53 | 31 | 5 | 28 | 41 | 4 |
| Zinc, ppm | 52 | 29 | 111 | 124 | 48 | 21 |

[a]All nutrient values except dry matter are on a 100% dry basis.

[b]Composition listed is for 60% crude protein corn gluten meal.

[c]Wet corn gluten feed will be 40 to 50% dry matter.

[d]Crude protein content may vary depending upon source.

## FEEDING VALUE OF CORN GLUTEN MEAL

Corn gluten meal has been used for several years commercially and in research trials as a protein source. Not only is it high in protein content but the protein is of low rumen degradability or highly bypassed (table 2). Also, the amino acid profile of corn gluten meal complements that of soybean meal. However, the actual profile of amino acids leaving the rumen may be quite different than that of the initial feedstuff. The feeding of corn gluten meal has been shown to increase the amounts of amino acids presented to and absorbed in the small intestine, but the few research trials on production have shown variable responses. Thus, the cost of protein sources and their derived benefits in milk production must be considered.

Table 2. Rumen Degradability and Essential Amino Acid Composition of Corn Gluten Meal, Corn Gluten Feed and Soybean Meal[a].

| Item | Corn gluten meal | Corn gluten feed | Soybean meal |
|---|---|---|---|
| Crude protein, % | 66 | 25 | 50 |
| Rumen degradability, % | 45 | *** | 72 |
| Essential amino acid content, % of dry matter | | | |
| Methionine | 2.1 | .6 | .7 |
| Phenylalanine | 4.2 | .9 | 1.2 |
| Histidine | 1.3 | .8 | 2.5 |
| Lysine | 1.1 | .7 | 3.2 |
| Valine | 3.0 | 1.2 | 2.4 |
| Leucine | 10.4 | 2.2 | 3.8 |
| Isoleucine | 2.6 | .7 | 2.8 |
| Tryptophan | .3 | .1 | .8 |
| Threonine | 2.2 | 1.0 | 1.9 |
| Arginine | 2.1 | 1.1 | 3.8 |

[a]All values are on a 100% dry matter basis.
***Variable depending upon if feed is fed wet or dry.

## FEEDING VALUE OF CORN GLUTEN FEED

Dried corn gluten feed has been used as a protein source similar to that of corn gluten meal. The exact protein degradability will vary depending upon processing and drying but is estimated to be similar to soybean meal (table 2). Because of the lower protein content, the amino acid content of corn gluten feed is less than corn gluten meal and does not complement soybean meal as well as corn gluten meal.

Feeding information on wet corn gluten feed is limited. University of Illinois researchers recently compared various amount of wet corn gluten feed in diets for lactating dairy cows. All diets contained (dry matter basis) 50 percent corn silage and either 0, 20, 30 or 40 percent wet corn gluten feed. The remaining portion of the diet was a corn, soybean meal and mineral grain mix. All diets contained 15.8 percent crude protein, .6 percent calcium and .45 percent phosphorus. Feed intake and milk production declined with increasing amounts of wet corn gluten feed (table 3). However, fat tests increased with increasing amounts of wet corn gluten feed.

Table 3. Feeding Value of Wet Corn Gluten Feed for Dairy Cows[a].

| Item | Wet corn gluten feed (% of ration DM) 0 | 20 | 30 | 40 |
|---|---|---|---|---|
| Dry matter intake, lb/day | 52.7 | 51.3 | 48.9 | 47.3 |
| Dry matter digestibility, % | 74.1 | 71.5 | 68.9 | 69.3 |
| Milk, lb/day | 67.1 | 65.7 | 61.7 | 61.9 |
| Milk fat, % | 2.9 | 3.0 | 3.2 | 3.2 |
| Milk protein, % | 3.2 | 3.1 | 3.1 | 3.1 |
| 4% fat milk, lb/day | 55.8 | 55.5 | 53.9 | 54.6 |

[a]Univ. of Illinois

The feeding value of wet compared to dry corn gluten feed was evaluated at the University of Guelph. Diets contained (dry matter basis) corn silage (33 percent), alfalfa hay (17 percent), dry or wet corn gluten feed (0 or 26 percent) plus a corn, soybean, mineral and vitamin grain mix. All diets contained 16 percent crude protein and were fed to cows in early lactation. Cows fed the wet corn gluten feed diet consumed less dry matter, produced less actual milk but equal 4 percent fat milk compared to cows fed the control or dried corn gluten feed diets (table 4).

Table 4. Feeding Value of Wet and Dry Corn Gluten Feed for Dairy Cows[a].

| Item | Diet Control | Dry gluten feed | Wet gluten feed |
|---|---|---|---|
| Dry matter intake, lb/day | 38.4 | 42.3 | 36.4 |
| Milk, lb/day | 57.6 | 59.3 | 53.4 |
| Milk fat, % | 3.0 | 3.3 | 3.6 |
| 4% fat milk, lb/day | 49.4 | 53.1 | 50.3 |

[a]Univ. of Guelph.

PRICING CORN GLUTEN FEED

The dollar value of corn gluten feed should be based on corn and soybean meal prices since these two ingredients are the most like the ones to be replaced in rations. Price comparisons can be determined as follows:

1. 15% crude protein corn gluten feed (90% dry matter)
   100 lb of 15% gluten feed is equivalent to 18 lb of soybean meal plus 82 lb of corn.

   Soybean meal - $240/ton = $.12/lb
   Corn price - $3.15/bushel = $.056/lb
   18 lb Soybean meal x $.12/lb = 2.16
   82 lb Corn x $.056/lb = 4.59
   $6.75/100 lb or
   $135/ton

   If gluten feed is 45% dry matter, the value per ton of wet gluten feed is

$$\frac{\$135/\text{ton}}{90\%\ \text{dry matter}} \times 45\%\ \text{dry matter} = \$67.50\ \text{ton}.$$

2. 20% crude protein corn gluten feed (90% dry matter)
   100 lb of 20% gluten feed is equivalent to 30 lb of soybean meal plus 70 lb of corn.

   30 lb of soybean meal x \$.12/lb = \$3.60
   70 lb corn x \$.056/lb = 3.92
   7.52/100 lb or
   \$150.40/ton

SUMMARY AND RECOMMENDATIONS

All 4 wet milled corn byproducts (corn gluten meal, corn gluten feed, corn germ meal and condensed fermented corn extract) contain adequate nutrients for consideration as dairy feeds. Corn germ meal, because of limited quantities produced, and condensed fermented corn extract, because of high water content are probably not feasible feed byproducts by themselves but can be blended with other feeds and used satisfactorily. Corn gluten meal has been found to be a good source of bypass protein and appears to complement soybean meal in amino acid content. An exact replacement figure has not been determined, but probably corn gluten meal can be used to supply up to 50 percent of the protein supplement if economics are favorable. The nutrients in corn gluten feed appear to be utilized as well as those in corn and soybean meal for milk production. Wet or dry corn gluten feed can probably make up 25 to 30 percent of the ration dry matter without affecting production. Economics of the byproducts should be the major determinant in their use and rations need to be balanced for all nutrients for maximum milk production efficiency.