Corn Milling, Processing and Generation of Co-Products

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Components of Yellow Dent Corn

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starch</td>
<td>61.0 %</td>
</tr>
<tr>
<td>Corn Oil</td>
<td>3.8 %</td>
</tr>
<tr>
<td>Protein</td>
<td>8.0 %</td>
</tr>
<tr>
<td>Fiber</td>
<td>11.2 %</td>
</tr>
<tr>
<td>Moisture</td>
<td>16.0 %</td>
</tr>
</tbody>
</table>
Industrial Usage of Corn Produced (MM bushel)
Corn Wet-Milling Process Overview

- Corn Cleaning
- Steep Tanks
- Germ Separation
- Grinding Mills
- Washing Screens
- Centrifugal Separators
- Starch Washing

- Starch and Nutritive Sweeteners
  - Corn Gluten Meal
  - Corn Germ Meal
  - Corn Gluten Feed
  - Cond. Fermented Extractive

- Steepwater Evaporation
- Germ Extraction
- Corn Oil

Feast Industry Co-Products
Wet-Milling Average Yield Per Bushel

- Starch: 31.5 lbs
- Gluten Feed: 12.5 lbs
- Gluten Meal: 2.5 lbs
- Corn Oil: 1.6 lbs
Condensed Corn Fermented Extractives

- Sometimes called “Corn Steep Liquor”
- Liquid Feed Ingredient
- Protein value 25% at 50% solids
- Combined with corn gluten
- Pellet binder
- Source of B-vitamins and minerals
Corn Germ Meal

- Typically analyzes 20% protein, 2% fat, and 9.5% fiber.
- Amino acid balance valuable in poultry and swine.
- Used as a carrier of liquid feed ingredients.
Corn Gluten Feed

- Combined streams
- Typically analyzes 21% protein, 2.5% fat, and 8% fiber.
- Dried in rotary dryer and pelletized
- Often sold wet
- Widely used for animal feed
Corn Gluten Meal

- Typically analyzes 60% protein, 2.5% fat and 1% fiber
- Valuable source of methionine
- Xanthophylls for “yellow” poultry
- High rumen by-pass protein for beef and dairy
Corn Dry-Milling Process Overview

1. Corn Cleaning
2. Hammermill
3. Mix Slurry
4. Liquefaction
5. Cooker
6. Fermentation
7. Centrifuge
8. Evaporator
9. Rotary Dryer
10. Ethyl Alcohol
11. Distillers Wet Grains
12. Distillers Dried Grains with Solubles
13. Cond. Distillers Solubles

Key Stages:
- alpha amylase enzyme
- CO$_2$
- whole stillage
- thin stillage
- coarse solids
- Yeast and Glucoamylase Enzyme

Feed Industry Co-products
Dry-Milling Average Yield Per Bushel

- Ethanol: 2.7 gallons
- DDGS: 18 lbs
- CO$_2$: 18 lbs
Corn Condensed Distillers Solubles

- Mostly added to dried grains
- Available as a liquid feed ingredient
- Dry matter basis 29% protein, 9% fat and 4% fiber. Typical DM 25 – 50%
- Excellent source of vitamins and minerals, phosphorous and potassium
- Can be dried to 5% moisture
- Highly palatable
Distillers Dried Grains with Solubles

- Can have other grains
- Has at least three fold the nutrients of the incoming grain
- Contains recycled microbial products
- Yeast provide increased vitamins, particularly B-complex group
Distillers Dried Grains with Solubles

- Typically analyzes 27% protein, 11% fat and 9% fiber
- Provide ruminants an excellent source of by-pass protein
- Sold in the wet form
- Successfully used in rations for beef, dairy, poultry, swine, aquaculture and pet food rations
Acknowledgments

National Corn Growers Association