

It Begins with a Kernel...

A corn kernel is made up of four major components: starch, fiber, protein and oil. Corn can be processed in different ways to tap into these components and use them in all kinds of products. A typical grocery store will contain 4,000 products that list corn ingredients on the label but many other products also depend on corn, from paper goods and cardboard packaging to all the meat, milk, eggs, poultry, and other protein products that come from corn-fed animals.

Masa

Perhaps the oldest method of corn processing is the masa process developed in the Americas long before the time of Columbus. It involves boiling corn kernels in a lime solution, then soaking, washing, drying and grinding the corn into masa flour. Masa flour is used to make tortillas, snack foods, taco shells, tostados and traditional foods.

Dry Milling for Grits, Corn meal, Corn Flour

The most common dry milling process begins by cleaning the corn and tempering it to 20% moisture, then removing the oil-containing germ and most of the fiber. The remainder, mostly starch and protein, is dried, sifted and ground into many different sizes of grits, corn meal, and corn flour. The germ and fiber are processed to make crude corn oil, hominy feed, bran products, corn meal, and more grits, meals and flours. In addition to food uses, dry milled corn products have industrial applications in insulation, fiber board, plywood, particle board, as binders in various products, and in livestock feed and pet foods.

Grits are used in:	Corn meal goes into:	Corn cones/flour is used in:
Brewing beer Corn flakes Other breakfast cereals Snack foods	Bakery mixes Cereals Corn bread Corn meal mixes Corn muffins Fritters Hush puppies Pancake mixes Snacks Spoon bread	Baby foods Bakery mixes Breadings, coatings and batters Cereals Dusting for pizzas English muffins Fermentation processes Meat products Pancakes, muffins, doughnuts

Wet Milling for Starch, Corn Sweeteners, Fermentation Products

Wet milling (refining) involves soaking the corn, then grinding it and separating its components. Throughout the process, the corn flows in a stream of water (which gives the process its name). Most of the fiber and protein go into animal feed; the oil is a premium heart-healthy oil for humans. The starch, highly purified to remove other components, can be treated in different ways to modify its performance or to break it into

simple sugars. The resulting corn sweeteners can be fermented to transform them into yet more valuable products.

Wet milling one bushel of corn produces...

- 1.6 pounds of crude corn oil, plus
- 13.5 pounds of corn gluten feed, plus
- 2.6 pounds of corn gluten meal, plus
- 31.5 pounds of starch.

The starch can be further modified to produce
 33 pounds of corn sweeteners or
 2.7 gallons of ethanol

Ethanol, Livestock Feed, and CO2

Corn-based ethanol can be made through either a dry or a wet milling process. In either case, about a third of the grain ends up as livestock feed: distillers grains if it comes from the dry process or corn gluten feed and corn gluten meal if it comes from the wet process. Ethanol plants also capture carbon dioxide from the process and sell it for use as dry ice or in carbonated beverages.

Examples of wet milled corn uses:

Industrial Starch Uses:	Industrial Sweetener Uses:	Industrial Fermentation Products:
Paper, recycled paper	Acetic acid	Acetic and amino acids
Cardboard	Charcoal briquettes	Blankets and bedding
Textiles	Dyes and inks	Carpet tile
Glues and adhesives	Enzymes	Cosmetics
Batteries	Insecticides	Electroplating and galvanizing
Bookbinding	Laminated building materials	Food packaging
Cleaners, detergents	Matches	Disposable cold drink cups, plates and cutlery
Coatings on paper, wood and metal	Metal plating	Industrial chemicals
Color carrier for printing	Organic solvents	Leather tanning
Crayons and Chalk	Paper	Mannitol
Dyes	Plasticizing agents	Organic solvents
Fireworks	Rayon	Paper
Industrial filters and water recovery	Shampoo	Plastics
Lubricants	Shoe polish	Plasticizers
Ore and oil refining	Textiles	Soaps and cleaners
Paints	Theatrical makeup	Sports and active wear
Plastics		Textiles
Rubber tires		
Surgical dressings		
Wallboard and wallpaper		

Food and Drug Starch Uses:	Food and Drug Sweetener Uses:	Food and Drug Fermentation Products:
Aspirin Baby food Baked goods Baking powder Cake, cookie, dessert mixes Candies Cereals Coffee whitener Dried soups Drugs Gravy mixes Instant breakfast foods Instant pudding mix Instant teae Salad dressings Spray cooking oil Powdered mixes Powdered sugar Precooked frozen foods Salt Seasoning mixes Yeast	Alcoholic beverages and brewing Baby foods Bacon Baked goods Caramel color Carbonated and fruit beverages Canned fruits, fruit fillings Cereals Cheese spreads Chewing gum Condiments Confections, chocolate Drugs Food coloring Frosting and icing Frozen and dried eggs Hams Hot dogs, bologna Ice cream, sherbets, and frozen puddings Jams, jellies, preserves Marshmallows Peanut butter Pet food Pickles and relishes Sausage Snack foods (pretzels, potato chips, corn chips) Soups Spices Tomato sauces Vegetables Vinegar Worcestershire sauce Yeast	Antibiotics Bakery products Citric acid Drugs Enzymes Food acids Pharmaceuticals Wine