

# Refined Corn Products

## Definitions

### Starch, Unmodified (Native)

One of nature's preeminent renewable resources and a mainstay of our food and industrial economy, starch is a complex carbohydrate composed of chains of glucose molecules. Basic consumer necessities such as paper and textiles are examples of its use in major industrial applications, where it is used in sizing, surface coating and adhesives. Cornstarch serves as the raw material from which a host of products are made, including baby powder, laundry spray starch and cooking starch. It is also found in other common household items such as matches, batteries, diapers and a wide variety of food products.

### Starch, Modified

Modified starch is starch that has been treated to provide specific physical and functional attributes in a variety of food and industrial applications. Many of today's instant and ready-to-eat foods are produced using modified starches, enabling them to maintain improved textural characteristics during freezing, thawing and heating.

### Dextrins

Dextrins are a roasted form of starch and are used for their adhesive and thickening properties. Dextrins' adhesive properties make them key components in corrugated board and paper bags. They are also found in a variety of food items such as baked goods, prepared mixes, frozen desserts and other dairy products.

### Cyclodextrins

Cyclodextrins, which are produced through enzymatic treatment of starch, have the physical shape of a hollow cone. The interior cavity can encapsulate ingredients such as vitamins, flavors, fragrances and drugs, which makes them useful in a variety of pharmaceutical products, nutritionally enhanced foods and beverages. They can even be used to remove cholesterol from milk and eggs.

### Maltodextrins

Maltodextrins are made from starch that has been treated with acids and/or enzymes to produce low conversion syrups that are usually spray dried to create free-flowing powders. They are used for their bulking benefits and as complex carbohydrates in many applications. Maltodextrins provide energy, texture and moisture, and they help evenly disperse ingredients in items such as protein bars, meal replacement drinks and dried soups.

### Corn Syrups

Corn syrups are made from starch that has been partially reduced in size by a combination of low pH and naturally-occurring enzymes to produce syrups that are primarily glucose polymers of varying lengths. They have low to mild sweetness and are used for thickening, texture, clarity and sheen in food applications such as cereal bars, ice cream, salad dressings and canned fruits.

### Glucose (Dextrose)

Glucose (also called dextrose) is made by treating corn syrup with naturally-occurring enzymes to break the glucose polymers down to their basic building blocks. Glucose is a monosaccharide sugar notable for its mild sweetness, texture, bulking ability and white color. It is used in a variety of food and confectionery applications, including baked goods, fruit fillings, tomato sauces, meat products, chewing gum and chocolates as well as for making solutions for intravenous injections. Glucose serves as the source material for high fructose corn syrup (HFCS) production and comprises half its composition (fructose is the other half). It is increasingly used in fermentations as a source of energy for microorganisms producing vitamins, amino and organic acids, antibiotics, ethanol, food colorants, renewable substitutes for petrochemical feedstocks and a host of other materials.

### High Fructose Corn Syrup (HFCS)

HFCS is a natural, nutritive, versatile sweetener offering many benefits. It is very similar to sucrose (table sugar) and honey in composition, sweetness, calories and metabolism. HFCS is composed of either 42% or 55% fructose, with the remaining sugars being primarily glucose and small amounts of higher sugars. HFCS provides energy, sweetness and moisture, and it enhances flavor and stability. It is found in numerous consumer foods and beverages due to its valued physical and functional attributes, including bran cereals, yogurts, dairy beverages, sauces, canned fruits, baked goods and condiments.

## Definitions cont.

### Crystalline Fructose

Crystalline fructose is made by separating the fructose from glucose in high fructose corn syrup. It is provided in crystalline form and used primarily as a replacement for sucrose in dry mix, baking and snack food applications.

### Corn Oil

Corn oil is made from the oil-rich germ of the corn kernel. It is used mainly in cooking oil, salad oil and margarine. High in mono and poly unsaturated fats, corn oil is a top choice for reducing saturated fat and trans fat in numerous food products.

### Corn Gluten Feed

Corn gluten feed is the protein and fiber co-product of corn processing. It is used primarily for dairy and cattle feed.

### Corn Gluten Meal

Corn gluten meal is a high protein co-product of corn processing. It is used for poultry feed, pet food and other applications.

### Germ Meal/Germ

Germ meal is the co-product of corn germ after oil has been extracted. It is used for its fiber and residual fat in feed for poultry and swine.

### Steepwater

Steepwater is the water in which corn has been soaked (steeped) during the initial stages of the corn refining process. It contains extracted protein, amino acids and important nutrients and is used as a concentrated liquid protein supplement for cattle.

### Ethanol

Ethanol is a pure alcohol produced by fermenting glucose derived from corn starch. It is a renewable alternative to petroleum-based fuels and is used as an oxygenate (octane enhancer) when blended with gasoline for automotive use. It is also used increasingly in pharmaceutical and cosmetic formulations.

### Organic acids

Organic acids are acids like citric and lactic acids that are derived from the fermentation of glucose. Citric acid is used for its tart flavor in confectionery and beverages and serves as a preservative in many food products. Lactic acid is also used for its flavor and preservative qualities. It also can be converted to polylactic acid, which can be made into biodegradable plastic.

### Amino acids

The amino acids lysine, threonine and tryptophan are derived from the fermentation of glucose. These amino acids, the building blocks of protein, are used as animal feed supplements.

### Polyols

Polyols are a group of low-calorie sweeteners derived from the hydrogenation of various corn sweeteners. They have fewer calories than sucrose, do not promote tooth decay and elicit a low glycemic response, which makes them important ingredients in foods and beverages formulated for diabetics and oral care products like toothpaste and reduced-calorie gum.

### Xanthan Gum

Xanthan gum is derived from the fermentation of glucose. It provides stability, retains moisture, enhances flavors and improves texture in items such as dressings, sauces and dairy foods.



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# Tapping the Treasure

The sight of tasseled corn swaying gently in the wind is a familiar scene in summer in many regions of the country. In fact, corn is the most abundant crop produced in the United States today. It accounts for more planted acres and has a higher value than any other commodity.

While consumers are most familiar with sweet corn and popcorn, the majority of corn grown in the United States is field corn — also called yellow dent corn. Yellow dent corn is prized for its starchy composition and serves either as livestock feed or as raw material for the host of food ingredients and industrial products described within the pages of *Tapping the Treasure*.

With the advent of new manufacturing technologies and the successful commercialization of innovative products, the demand for refined corn has become a significant segment of the corn economy.

Contained within the fibrous cover of the kernel — the hull — is a treasure of raw materials from which thousands of food and industrial products can be made. These products add tremendous value to yellow dent corn.

Corn refiners use #2 yellow dent corn, which is removed from the cob during harvesting. An average bushel of yellow dent corn weighs 56 pounds. Approximately 70% of the kernel is starch (from the endosperm), about 10% is protein (predominantly gluten), 4% is oil (extracted from the germ) and 2% is fiber (from the hull). It is the goal of the corn refining process to separate each component and then further refine it into specific products. Each of the components — and the specific products made from them — is worth far more than the raw grain.

Corn sweeteners and ethanol are the largest segments of products made by the corn wet milling industry. Americans now consume more sweeteners made from corn than from any other source. High fructose corn syrup (HFCS) has replaced about half the sucrose used by the food and beverage industry in the United States, and has thereby provided increased functional benefits to U.S. consumers.

Ethanol is used as an octane enhancer in gasoline. It has continued to gain recognition as a cleaner burning additive than traditional, petroleum-based products. It is not surprising that ethanol constitutes one of the largest uses of refined corn.

Starch is the third largest product family from refined corn. Corn processors provide Americans with over 90 percent of their starch, and in a wondrous variety of forms and functional properties.

Corn refiners are rapidly becoming the largest — and most innovative — fermentation industry in the world. For decades, they have used fermentation processes to convert glucose into organic acids (e.g., citric and lactic) and amino acids. In recent years, the fermented product line has expanded into areas including sugar alcohols, vitamins, pigments and corn-derived alternatives to petrochemicals.

Corn oils and feedstuffs — corn gluten meal and corn gluten feed — are isolated from various parts of the refining process and are important commercial products in their own right.

Thus, the treasure of corn is tapped through innovative, evolving technology, which provides considerable added value to corn. Browse the thousands of applications listed within and see for yourself why corn is part of our daily lives.



