

Corn Syrups: Clearing up the Confusion

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Corn syrups comprise two distinct product families: “regular” corn syrups, and high-fructose corn syrup (HFCS). Much confusion has arisen about corn syrups in the past five years, largely because of the ill-considered controversy surrounding HFCS. The confusion ranges from uncertainty about the basic composition of the products to debates over sophisticated metabolism and nutrition issues.

Composition

Because they are derived from hydrolyzed corn starch, corn syrups are composed entirely of glucose: free glucose and mixtures of varying-length glucose polymers. A variety of products within the corn syrup family are made by carefully controlling acid, acid-enzyme or enzyme-enzyme hydrolysis processes. They are differentiated in functionality by assigning each a unique dextrose equivalent (DE) number, a value inversely related to average polymer chain length. By definition, regular corn syrups range from a low of 20 to above 73 DE. Spray or vacuum drum driers are used to make dried corn syrups (corn syrup solids), which function the same as liquid products when rehydrated.

HFCS contains both fructose and glucose (a key distinguishing feature from regular corn syrups), and are not characterized by DE, but rather by fructose content. The most important commercial products are HFCS-42 (42% fructose, 58% glucose) and HFCS-55 (55% fructose, 45% glucose). With pride of accomplishment, the industry named these products high-fructose corn syrup to differentiate them from regular corn syrups, which proved to be an unfortunate choice since HFCS is frequently confused with crystalline (pure) fructose. In reality, the range of 42% to 55% fructose in HFCS is widespread in nature, encompassing the fructose content of over 50 fruits, vegetables and nuts, as well as the common caloric sweeteners sucrose, fruit-juice concentrates and honey. HFCS’s fructose-glucose makeup is virtually the same as that of sucrose or sugar.

Functionality and applications

HFCS was the first glucose-fructose ingredient to successfully compete with sucrose in mainstream food and beverage applications, becoming a vital ingredient. The functionality and applications of HFCS and regular corn syrups are linked to their unique compositions:

- **Solubility**—As liquid products, corn syrups and HFCS are readily diluted with water; corn syrup solids are readily dissolved in water.
- **Hygroscopicity**—The ability of corn sweeteners to absorb moisture increases with increasing DE. This property makes corn syrups useful as moisture conditioners, food plasticizers, crystallization inhibitors and stabilizers. Since fructose binds water better than glucose, HFCS is often used as a humectant in low- or intermediate-moisture foods.

- **Texture**—Long glucose polymers present in lower-DE corn syrups give them cohesive and adhesive properties, providing chewy texture in gums; glossy appearance and syrup drainage in canned fruit; gloss and clarity in hard candies, jams and jellies; and viscosity, which increases with decreasing DE. The fructose and glucose monosaccharides in HFCS lower starch gelatinization temperatures and increase final viscosities.
- **Colligative properties**—Glucose and fructose have half the molecular weight of sucrose, a disaccharide. Size-related colligative properties are enhanced by HFCS and corn syrups of DE 53 and higher. Corn sweeteners thus control freezing point in ice cream and frozen confections, and extend shelf life by limiting microbial growth.
- **Fermentability**—Fructose and glucose in HFCS, and glucose and maltose in regular corn syrups, are readily fermentable by yeasts. Primary fermentation applications include baking, brewing and yogurt production.
- **Reducing properties**—Reducing groups on free fructose and glucose in HFCS and unbonded ends of corn syrup polymers have the ability to form pleasing cooked flavors, aromas and colors when heated with other ingredients. HFCS and higher-DE corn syrups contribute to the pleasing crust in baked goods and to caramel color and flavor.
- **Sweetness**—All corn sweeteners confer some degree of sweetness, which increases with concentration, DE, and monosaccharide and fructose content. Measured at 10% solids against a sucrose standard given the value of 100, glucose has a relative sweetness of 60, HFCS-42 has a value of 92, and HFCS-55 is 99. Contrary to erroneous claims, HFCS-55 is equally as sweet as sucrose.

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