FACULTY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY

HIGH FRUCTOSE CORN SYRUP

- High fructose corn syrup (HFCS) also called glucose- fructose, isoglucose and glucose-fructose syrup

- Sweetener made from corn starch that has been processed by glucose isomerase to convert some of its glucose into fructose.

- HFCS was first marketed in the early 1970s by the Clinton Corn Processing Company .

- As a sweetener, HFCS is often compared to granulated sugar

- Advantages of HFCS over granulated sugar include being easier to handle, and being less expensive in some countries.

Uses of HFCS

Food

- In U.S. HFCS is among the sweeteners that mostly replaced sucrose (table sugar) in the food industry.

- Factors include production quotas of domestic sugar, import tariff on foreign sugar, and subsidies of U.S. corn, raising the price of sucrose and lowering that of HFCS, making it cheapest for many sweetener applications

- The relative sweetness of HFCS 55, used most commonly in soft drinks, is comparable to sucrose

- HFCS (and/or standard corn syrup) is the primary ingredient in most brands of commercial "pancake syrup", as a less expensive substitute for maple syrup

- Because of its similar sugar profile and lower price, HFCS has been used illegally to "stretch" honey

- Assays to detect adulteration with HFCS use differential scanning calorimetry and other advanced testing methods

Beekeeping

- In apiculture in the United States, HFCS became a sucrose replacement for some honey bees starting in the late 1970s.

- When HFCS is heated to about 45 °C (113 °F), hydroxymethylfurfural can form from the breakdown of fructose, and is toxic to bees

Production Process

- Corn is milled to produce corn starch.

- An "acid-enzyme" process is used in which the corn starch solution is acidified to begin breaking up the existing carbohydrates

- Then enzymes are added to further metabolize the starch and convert the resulting sugars to fructose.

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- The first enzyme added is alpha-amylase which breaks the long chains down into shorter sugar chains oligosaccharides

- Glucoamylase is mixed in and converts them to glucose

- The resulting solution is filtered to remove protein

- Then using activated carbon, and then demineralized using Ion-exchange resins

- The purified solution is then run over immobilized xylose isomerase

- which turns the sugars to ~50–52% glucose with some unconverted oligosaccharides, and 42% fructose (HFCS 42), and again demineralized and again purified using activated carbon

- Some is processed into HFCS 90 by liquid chromatography, then mixed with HFCS 42 to form HFCS 55.

- The enzymes used in the process are made by microbial fermentation

Composition and varieties

- HFCS 42 (≈42% fructose if water were removed) is used in beverages, processed foods, cereals, and baked goods.

- HFCS 55 is mostly used in soft drinks.

- HFCS 65 is used in soft drinks dispensed by Coca-Cola Freestyle machines.

- HFCS 90 has some niche uses but is mainly mixed with HFCS 42 to make HFCS 55.

Health

Obesity and metabolic disorders

- Sugars became a health concern among the American public in the early 1970s with the publication of John Yudkin's book, Pure, White and Deadly

- The book claimed that simple sugars, an increasingly large part of the Western diet, were dangerous.

- In the 1980s and 1990s, Gerald Reaven and Sheldon Reiser of the USDA published papers discussing the dangers of dietary fructose from consumption of sucrose and of HFCS, especially with regard to heart disease, diabetes, and obesity.

•Clinical Nutrition that suggested that the altered metabolism of fructose when compared to glucose may be a factor in increasing obesity rates

▪ Compared to glucose, fructose may be more readily converted to fat and the sugar causes less of a rise in insulin and leptin, both of which increase feelings of satiety

▪Fructose, in contrast to glucose, was shown to potently stimulate lipogenesis (creation of fatty acids, for conversion to fat)