



2015 updated draft

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FACTSHEET ON GLUCOSE FRUCTOSE SYRUPS, ISOGLUCOSE AND HIGH FRUCTOSE CORN SYRUP

1. Understanding the terms:

Terms like glucose fructose syrups, isoglucose and High Fructose Corn Syrups (HFCS) are often confused and used interchangeably. This section aims to clarify the differences (read more)

Glucose is a simple sugar found naturally in many foods. Glucose performs a unique and vital role as an energy source for the brain which cannot use other types of energy¹.

Fructose is also a simple sugar found in many foods. It is the sweetest of all naturally occurring sugars. High levels of fructose are, for example, typically found in fruits notably tree fruits (oranges, apples etc), berries, melons and some root vegetables such as sweet potatoes, parsnips and onions.

Sucrose, or table sugar, is made up of glucose and fructose linked together in a 1:1 ratio (ie, 50% glucose, 50% fructose).

Glucose Fructose Syrup (GFS) is a liquid sweetener used in the manufacturing of foods and beverages. It is composed of different sugars, mainly glucose and fructose, with varying compositions, with a fructose content ranging from 5 to 50%. If the fructose content exceeds 50%, the product becomes a **Fructose-Glucose Syrup**.

In Europe, Glucose-Fructose syrups and Fructose-Glucose syrups with a fructose content of more than 10% are referred to as **isoglucose**² in EU legislation.

¹ European Food Information Council (EUFIC) (2012) Carbohydrates. Available at <http://www.eufic.org/article/en/expid/basics-carbohydrates/>

² For a definition of isoglucose please see COUNCIL REGULATION (EC) No 1234/2007 of 22 October 2007 establishing a common organisation of agricultural markets and on specific provisions for certain agricultural products (Single CMO Regulation) – definition on page 89

In the United States, this type of product is produced from maize starch most commonly either with a 42% or a 55% fructose content and is called **High Fructose Corn Syrup (HFCS)**.

2. How Glucose Fructose Syrups are produced

In the EU, Glucose Fructose Syrups³ are made typically from wheat or maize starch. The starch molecule is a long chain of glucose cells. By first liberating free glucose molecules through a process called 'hydrolisation' and then changing some of these glucose molecules into fructose in a process called 'isomerisation' (link to infographic).

3. The uses of Glucose Fructose syrups (GFS)

Glucose Fructose Syrups are found in many food and drinks, not only for their sweetening characteristics, but also for their other specific properties (read more)

In the EU, GFS is mainly found in confectionery, beverages, jams and preserves, baked goods, cereal products, yogurts and other dairy products, condiments and canned and packed goods. It is not only used for its sweetening properties but also for its other properties, for example as a texturiser and preservative. GFS also, for example, prevents crystallisation in confectionery and prevents sweets from sticking to their wrappers.

Outside of the EU, and notably in the US, GFS (notably HFCS as it is termed there), because, unlike sucrose, is a liquid, it is particularly well suited to and also used widely in soft drinks.

4. Differences between the EU and the US situation

The extent and type of GFS use varies significantly from one region to the next. This is partly because of different legislative approaches and partly due to different consumer preferences, for example between the US and the EU (read more)

³ For a legal definition of glucose fructose syrup please see Council Directive 2001/111/EC, of 20 December 2001, relating to certain sugars intended for human consumption, OJ L10, 12 January 2002, p. 53

The use of GFS in soft drinks in the EU has been limited because soft drinks need a fructose content of at least 42% to achieve their desired level of sweetness and GFS with such a high level of fructose is not available in the EU in sufficient quantities. This is because in the EU, the production of isoglucose (glucose fructose syrups with more than 10% of fructose) is limited by the EU sugar regime to 5% of total EU sugar production. Its use is therefore more limited than elsewhere in the world. In the EU, soft drinks are therefore sweetened primarily using sucrose, which has a fructose content of 50%.

In the US, no production limits exist on GFS, and HFCS today constitutes up to 40% of US sugars consumption. Its main application is in soft drinksⁱ.

The EU sugar regime is due to end in October 2017, meaning that, from that date, there will no longer exist EU production quotas on either sucrose or isoglucose. This is expected to result in a possible change in isoglucose production in the EU. The extent of this change is extremely difficult to predict and subject to as yet unknown outside factors but industry estimates suggest an increase in EU isoglucose production from its current level of approx. 720,000 tonnes a year to at least 2 million tonnes a year over time (representing approximately 15% of total EU sugar consumption).

5. The nutritional properties of GFS and HFCS

GFS, other starches and sucrose contain the same number of calories, 4kcal/g (read more).

Human beings derive their energy from carbohydrates, proteins and fats. EFSA (European Food Safety Authority) published guidelines suggesting that carbohydrates should constitute 45-60% of total energy intake for both adults and childrenⁱⁱ.

GFS is a sugar and one source of carbohydrates. Other carbohydrate sources include starch, found predominantly in starchy foods like bread, potatoes and pasta and sucrose, an important ingredient in many food products that are commonly found in the diet.

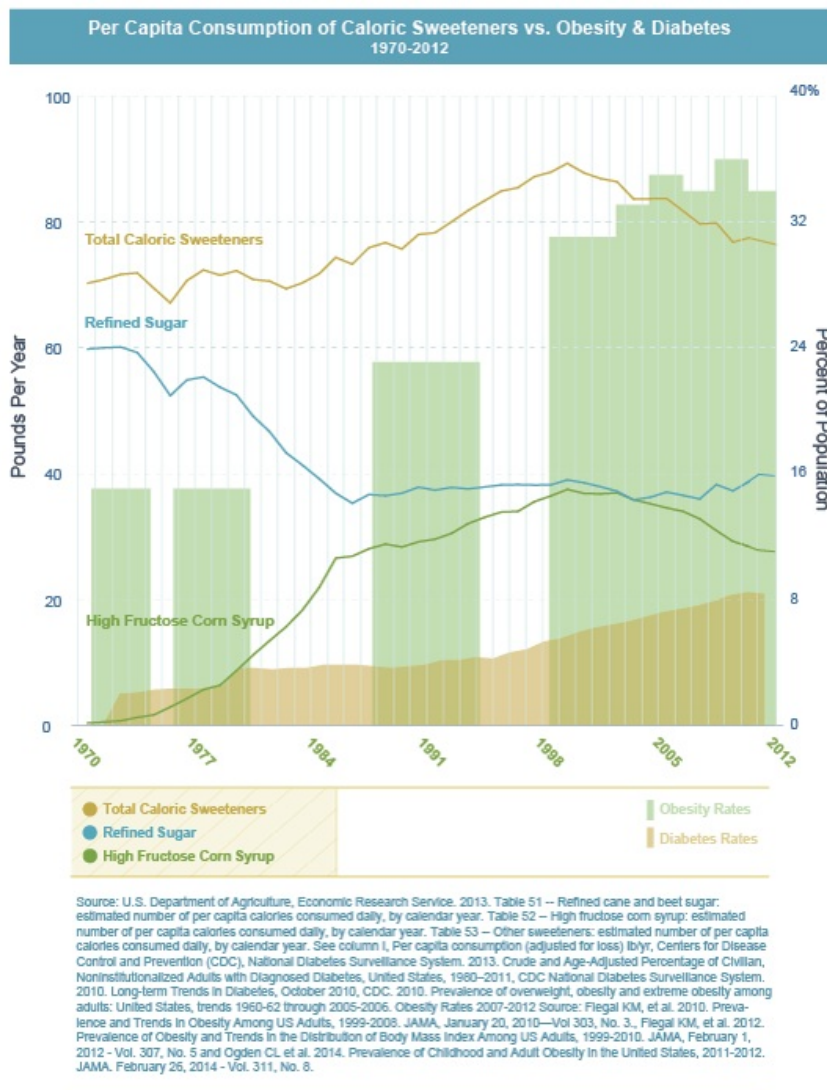
GFS, other starches, and sucrose all contain the same number of calories, 4Kcal /gⁱⁱⁱ.

6. HFCS consumption and obesity

No causal relationship between increased HFCS consumption and increased obesity rates has been demonstrated. The reality is that HFCS consumption has been decreasing since 1999 but obesity rates have continued to increase (read

more)

As a result of the popularity of GFS in the US, at levels with a similar fructose level to sucrose (i.e HFCS), there has been extensive research in that country comparing the health and nutritional characteristics of HFCS with sucrose. Though causality was never established, the evidence initially suggested a correlation between increasing HFCS consumption and rising US obesity and diabetes rates^{iv}. This suggested correlation has been thoroughly reviewed and subsequently strongly questioned primarily because whilst US HFCS consumption has been falling since 1999, obesity and diabetes rates in that country have continued to increase.



^{iv} The Effects of Sucrose, Fructose, and High-Fructose Corn Syrup Meals on Plasma Glucose and Insulin in Non-insulin-dependent Diabetic Subjects

The American Medical Association clearly stated in June 2008 that ‘high fructose syrup does not appear to contribute to obesity more than other caloric sweeteners’.

Furthermore, data from other countries showed no correlation between HFCS and obesity prevalence rates.

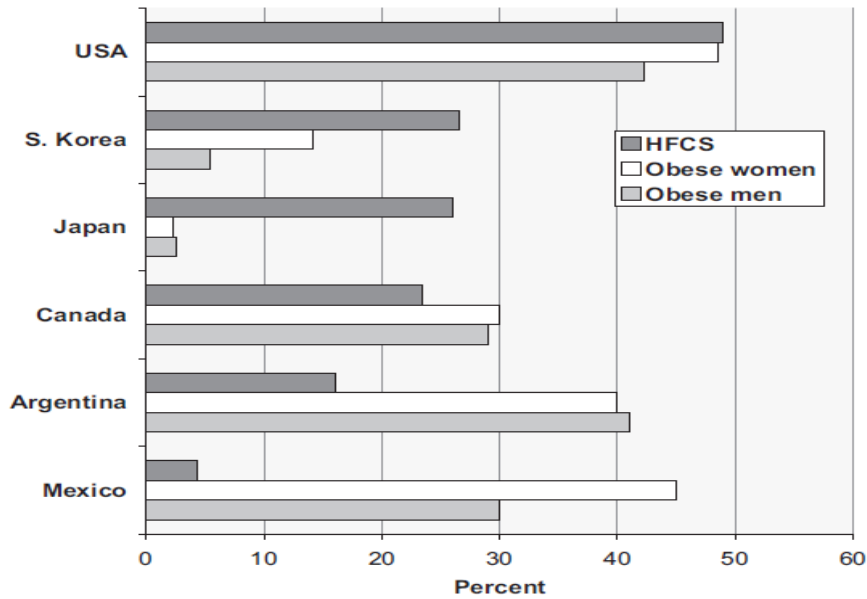
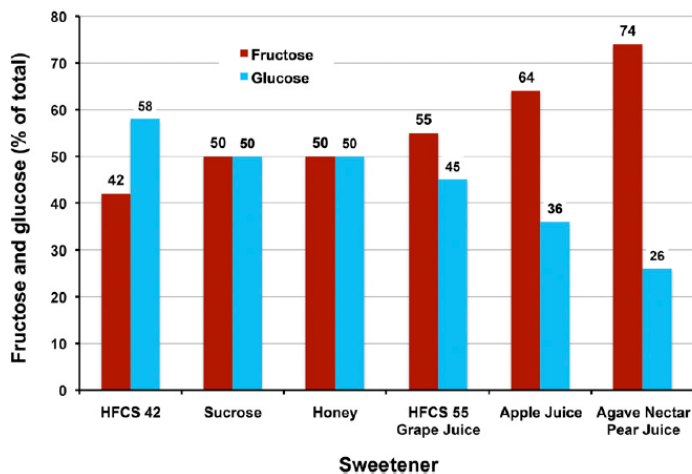


FIGURE 4. World Health Organization obesity rates (BMI ≥ 30 kg/m², age ≥ 30 y) versus high-fructose corn syrup [(HFCS); share of (sucrose + HFCS)] in selected countries for 2005 (32, 33).

7. HFCS compared to sucrose

Sucrose and HFCS contain very similar levels of fructose and glucose and have the same calorific value (read more).

HFCS is typically produced in the US with a fructose level of either 42% or 55%. The fructose level in sucrose or honey is 50%, i.e. equivalent to HFCS as illustrated in the chart below:



The Academy of Nutrition and Dietetics in 2012 noted that 'High Fructose Corn Syrup is nutritionally equivalent to sucrose. Both sweeteners contain the same number of calories (4 per gram) and consist of about equal parts of fructose and glucose. Once absorbed into the blood stream, the two sweeteners are indistinguishable' ^{vi}.

8. Fructose compared to other sugars

Studies comparing beverages with different levels of fructose have not demonstrated any differential effects on feelings of fullness between fructose and other sugars^{vii} (read more).

Evidence demonstrates that fructose and glucose, the main constituents of both HFCS and sucrose are indeed metabolised in different ways in the body ^{viii}.

However, studies comparing beverages with different levels of fructose have not demonstrated any differential effects on feelings of fullness between fructose and other sugars^{ix}. More generally, when fructose or fructose-containing sweeteners are used as an alternative to other carbohydrates in diets providing similar calories, no adverse effect on body weight is observed^x. To cite *Sievenpiper J L, de Souza R J, Mirrahimi A, Me Y, Carleton A J, et al.*, 'Fructose, if consumed in high doses can contribute to increasing bodyweight but such effect would be due to excessive caloric intake rather than to the consumption of fructose itself'^{xi}.

Recent research published in Europe supports these conclusions, to cite Tappy et al :

"Through multiple misconceptions about fructose and fructose-containing sugars, a causal role of their intake has been proposed in the aetiology of the global obesity epidemic. However, current evidence on the metabolic effects of fructose, as consumed by the majority of populations, is insufficient to demonstrate such a role in metabolic diseases and the global obesity epidemic."^{xii}

Most recently, in June 2014 the UK SACN draft report on "Carbohydrates and health" stated that:

"The body absorbs free fructose and glucose, or the same sugars derived from sucrose and HFCS, in exactly the same way. Therefore, it appears unlikely that fructose, as consumed as a component of HFCS, causes metabolic abnormalities or promotes weight gain more than other sugars consumed in an isocaloric diet (Klurfeld, 2013)" and concluded after reviewing existing studies and meta-analysis that: "Therefore on balance, it is considered that there is insufficient evidence to demonstrate that fructose intake, as consumed in the diet, leads to adverse health outcomes independent of any effects related to its presence as part of total and free sugars"^{xiii}.

9. The causes of obesity

The increasing rates of obesity, both in the US and Europe, and indeed elsewhere in the world are, as nutritionists, health experts and researchers generally agree, primarily the result of an imbalance between calories consumed and calories burned. The solution to reducing obesity is promoting a balanced diet and sufficient physical activity^{xiv}.

List of references

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<http://www.corn.org/wp-content/uploads/2009/12/CRAR2010.pdf>
- ⁱⁱ EFSA (2010). "Scientific opinion on dietary reference values for CHO and dietary fibres." EFSA Journal 8(3): 1462 [77 pp].
- ⁱⁱⁱ Textbook knowledge, supported by Food insight which says "HFCS and table sugar contain the same number of calories – 4 calories per gram or 16 calories per teaspoon."
http://www.foodinsight.org/Content/6/HFCS_v7.pdf
- ^{iv} Bray, G.A., S.J. Nielsen, and B.M. Popkin, Consumption of high-fructose syrup in beverages may play a role in the epidemic of obesity. American Journal of Clinical Nutrition, 2004. 79: p. 537-543.
- ^v The Health Effects of High Fructose Syrup, Report 3 of The Council on Science and Public Health (A-08), The American Medical Association
- ^{vi} Acad Nutr Diet 2012: 112: 739-758
- ^{vii} Soenen E, Westerp-Plantenga WS (2007) No differences in satiety or energy intake after high-fructose corn syrup, sucrose, or milk preloads. Am J Clin Nutr 86:1586-94
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- ^x EFSA (2011). "Scientific opinion on the substitution of health claims related to fructose and reduction of postprandial glycaemic responses pursuant to article 13(1) of regulation (EC) No 1924/2006." EFSA Journal 9(6): 2223 [15 pp].
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^{xi} Sievenpiper J L, de Souza R J, Mirrahimi A, Me Y, Carleton A J, et al. (2012) Effect of fructose on body weight in controlled feeding trials. *Ann. Intern. Med.* 185(6): 291 – 304.

^{xii} V.J. van Buul, L. Tappy and F.J.P.H. Brouns, *Nutrition Research Reviews*, 2014, Misconceptions about fructose-containing sugars and their role in the obesity epidemic.

Klurfeld D, Foreyt J, Angelopoulos T, Rippe J. "Lack of Evidence for High Fructose Corn Syrup as the Cause of the Obesity Epidemic." (Accepted, *International Journal of Obesity*, advance online publication, doi:10.1038/ijo.2012.157, 18 September 2012.)

^{xiv} WHO (2003). *Diet, Nutrition and the prevention of chronic diseases: Technical report 916.*