# ARTIFICIAL SWEETENERS

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**at current levels are safe, but...**

# THEY MAINTAIN OUR TASTE PREFERENCE FOR SWEET FOODS

&

# CAN INCREASE SUBJECTIVE HUNGER AND HENCE ENERGY INTAKE

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# FOREWORD

There is much concern by consumers over the use of sweeteners, particularly artificial sweeteners such as aspartame in our food and there is great debate over whether the disadvantages of using sugar, such as tooth decay and obesity, are less important as the chance of getting cancer from sweeteners.

This briefing contains reviews of evidence from UK and European Scientific Committees that say there is no evidence that sweeteners at their present rate of consumption do not increase the risk of cancer or other non-communicable diseases.

However, recent research has pointed to the possibility that artificial sweeteners present in food and drink maintain our penchant for sweet-tasting foods, and the absence of calorific content may lead individuals to consume other product that may be high in sugar.

This briefing details a variety of common sweeteners and concludes with an evidence-based position statement on the use of artificial sweeteners in everyday food and drink.

Helen Turner

## Introduction

Whether you believe that sweeteners are a dangerous substance or a viable alternative to sugar, there is no avoiding them. Sweeteners can be found in soft drinks, processed foods, cakes, chewing gum and even toothpaste.

But much like any alternative; sweeteners have met some resistance, being linked to cancer, increased risk of stroke and high blood pressure amongst others.

None of these claims have stuck and sales of sugar-free products have been increasing for decades inferring the consumer acceptability of sweeteners.

There are several natural and artificial sweeteners that are used in food and drink across the world.

This document will establish an evidence-based position by identifying and exploring the sweeteners that are used in the UK, discuss whether there are any harmful effects and the future role they may play in our diet as we attempt as a nation to reduce our sugar consumption.

## Intensive Sweeteners

As their name implies, intense sweeteners are many times sweeter than sugar. Examples include saccharin, aspartame and acesulfame K (ace-K) which are up to 200 times sweeter than sucrose (normal table sugar).

Sucralose and neotame have been more recently approved and are about 600 and 7000 times sweeter than sugar respectively. Blends of sweeteners (e.g. ace-K/aspartame) can also be used particularly in soft drinks to achieve particular taste profiles. Their use can result in a different 'mouth feel' to sugar.

### Aspartame (e.g. Nutrasweet)

Aspartame is made by joining two protein components, aspartic acid and phenylalanine, and a small amount of methanol. Aspartic acid and phenylalanine are the building blocks of protein and are found naturally in all protein-containing foods, including meats, grains and dairy products. Methanol is found naturally in the body and in many foods, such as fruit and vegetable juices.

The EFSA's main conclusion is that aspartame and its breakdown products are safe for human consumption at current levels of exposure. Members of the Panel on Food Additives and Nutrient Sources added to Food (ANS) Panel have concluded that the current Acceptable Daily Intake (ADI) of 40 mg/kg of body weight per day is protective for the general population.

Consumption surveys confirm that intakes of low calorie sweeteners are well below the respective ADI values in all population groups.

This is equivalent to 80 sachets (one sachet equals 40mg) every day for life or 14 cans of soft drink every day [1].

There have been more studies on the intakes of this sweetener than any other food additive. Studies have been performed in most countries around the world including the UK [2]. In all cases the average intakes of all sweeteners by all groups (including children and diabetics) are well below the relevant ADI value.

In patients suffering from the medical condition phenylketonuria (PKU), the ADI is not applicable, as they require strict adherence to a diet low in phenylalanine (an amino acid found in proteins).

With respect to pregnancy, the panel noted that there was no risk to the developing foetus from exposure to phenylalanine derived from aspartame at the current ADI (except for women suffering from PKU) [3].

Following a thorough review of evidence provided by both animal and human studies, the European Food Safety Authority (EFSA) has ruled out a potential risk of aspartame causing damage to genes and inducing cancer.

EFSA's experts also concluded that aspartame does not harm the brain, the nervous system or affect behaviour or cognitive function in children or adults [2].

However, PKU is rare—it is estimated to affect 1 in every 10,000 babies born in the UK.

The opinion makes clear that the breakdown products of aspartame (phenylalanine, methanol and aspartic acid) are also naturally present in other foods. The contribution of breakdown products of aspartame to the overall dietary exposure to these substances is low.

## Neotame

Neotame is an artificial sweetener made by NutraSweet that is between 7,000 and 13,000 times sweeter than sugar and approximately 30 to 60 times greater than that of aspartame, depending upon the food application. In the European Union, it is known by the E number E961. It is extremely potent, rapidly metabolised, completely eliminated and does not appear to accumulate in the body.

It is chemically similar to the artificial sweetener aspartame, but is used at vastly lower levels and is more stable. It reduces the production of phenylalanine during metabolism of the chemical and thus it is safe for consumption by those who suffer from phenylketonuria.

Over 100 scientific studies were done to establish the safety of neotame. A comprehensive battery of safety studies in animals and humans demonstrated no adverse effects from neotame.

People of all ages, including pregnant or breastfeeding women, teens and children, and people with diabetes can enjoy products sweetened with neotame while maintaining a healthier diet. The EFSA Panel established an ADI of 0-2mg/kg of body weight per day.

## Saccharin (e.g. Sweet 'n Low)

Most additives are not thought to affect cancer risk. Colours, flavours and sweeteners are constantly investigated by researchers and if any are thought to be a real risk, they are withdrawn. Sometimes there is a scare about a particular additive.

Some years ago, saccharin was claimed to be a carcinogen. Researchers had found that when it was fed to rats in huge quantities, the rates of cancer in the rats increased. We are very unlikely to eat that much saccharin and so it is unlikely to cause cancer in people, but far fewer foods contain it now than did just a few years ago.

## Acesulfame Potassium

This non-nutritive artificial sweetener is approximately 200 times sweeter than sugar at low concentrations but tends to become bitter at higher levels. It is normally used in sweetener blends to produce a more sugar-like taste than that of any of the low-calorie sweeteners alone.

The ingredient also helps the blend retain its sweetness during baking or heat processing.

Acesulfame potassium helps blends sustain their sweetness over time, thereby increasing the shelf life of products. This sweetener is not metabolised or stored in the body. After it is consumed, it is quickly absorbed by the body and then rapidly excreted.

Acesulfame potassium has been approved for use in 90 countries including the United Kingdom, Germany, Australia and Canada. It has been reviewed and found safe by the Joint Expert Committee on Food Additives of the World Health Organisation and the Scientific Committee for Food of the European Union.

Acesulfame potassium has been thoroughly tested in several long-term animal studies. The tests, which used amounts of the ingredient that are far higher than a person would normally consume, clearly found no evidence of cancer or tumours [4].

The ADI has been set at 15mg/kg of body weight per day. For a 60kg person, this corresponds to 900mg of acesulfame potassium every day for a lifetime or approximately 200 grams (one-half pound) of sugar equivalent each day. At current average usage levels in beverages, for example, this amount would correspond roughly to two gallons of beverage daily.

## Sucralose (Splenda)

Sucralose is the only low-calorie sweetener made from sugar. It is about 600 times sweeter than sugar and can be used like sugar in a broad range of foods. Sucralose can be used in place of sugar to eliminate or reduce calories in a wide variety of products, including beverages, baked goods, desserts, dairy products, canned fruits, syrups and condiments.

Sucralose (for example Splenda) was discovered in 1976. More than 100 scientific studies conducted over a 20-year period have conclusively determined that sucralose is safe for everyone to consume. Sucralose was approved by the joint FAO/WHO Expert Committee on Food Additives (JECFA) in 1990 and by prominent regulatory authorities throughout the world, and has been consumed by millions of people internationally since 1991.

Sucralose is derived from sugar through a patented, multistep process that selectively substitutes three chlorine atoms for three hydrogen-oxygen groups on the sugar molecule. The tightly bound chlorine atoms create a molecular structure that is exceptionally stable and is approximately 600 times sweeter than sugar.

Although sucralose is made from sugar, the body does not recognise it as sugar or another carbohydrate. The sucralose molecule passes through the body unchanged, it is not metabolised, and is eliminated after consumption.

Studies have shown that the amount of sucralose which might be consumed by individuals, even if consumed every day throughout a person's lifetime, would still be considered safe by a wide margin by U.S. and international health authorities. The ADI for sucralose is 5mg/kg of body weight per day.

Numerous studies have shown that sucralose can be safely consumed by people with diabetes.

Sucralose is not recognised by the body as sugar or as a carbohydrate. It is not metabolised by the body for energy and does not affect blood glucose levels. Sucralose has no effect on blood glucose utilisation, carbohydrate metabolism or insulin production.

Sucralose can be used by everyone, including pregnant women and breastfeeding mothers and children.

### Rebiana (Truvia)

Rebiana is the trade name for high-purity rebaudioside A, a Steviol glycoside which when used as a non-nutritive sweetener is 200 times sweeter than sugar. Steviol glycosides are high intensity sweeteners, 250-300 times sweeter than sugar. They are isolated and purified from the leaves of the stevia plant (Stevia rebaudiana Bertoni), where it is present at levels up to 13%.

Stevioside is another steviol glycoside and along with rebeaudioside A is converted in the gastrointestinal tract to steviol, which is subsequently converted to glucuronide which is not further metabolised but efficiently excreted [5].

EU Regulation 1131/2011, which came into force on 2 December 2011, permits steviol glycosides to be used in certain specified foods at permitted maximum levels (expressed as steviol equivalents).

Stevia is now used in some soft drinks in the UK, enabling production of lower calorie alternatives by blending sugar and stevia to reduce calories by up to a third.

Stevia extracts can have a bitter taste and therefore several commercially available stevia based sweeteners blend in other sweeteners to improve their taste and may include: dextrose, maltodextrin, sucrose (sugar) natural flavourings and sugar alcohols.

### Bulk Sweeteners

Sugar alcohols are not non-nutritive sweeteners, they contain 2.6 calories per gram (roughly half of which are digested), but they do not cause tooth decay like table sugar.

Although they are generally less sweet and caloric than sugar, eating large amounts (particularly of mannitol) can cause bloating and diarrhoea. They're often used in sugar-free foods marketed to diabetics, because they contain fewer carbohydrates than table sugar.

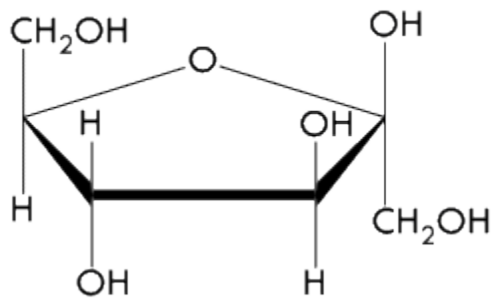
They do contain some carbohydrates, so eating them in excess may increase blood sugar. They can also be found in sugar free chewing gum, sugar free sweets and cough syrups.

### Culinary Syrups

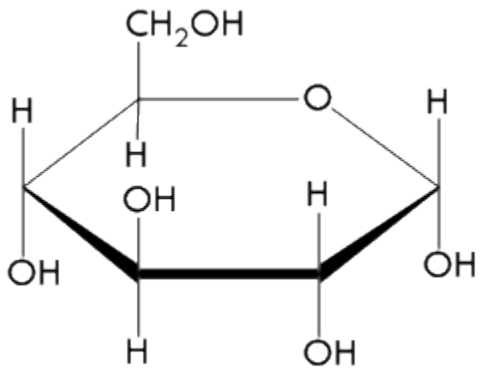
Syrups are found in many food and drinks, for their sweetening characteristics, but also because they contain a large amount of dissolved sugars but show little tendency for crystallisation, producing a better 'mouth-feel' and preventing sweets from sticking to their wrappers.

### Glucose-Fructose Syrups (GFS)

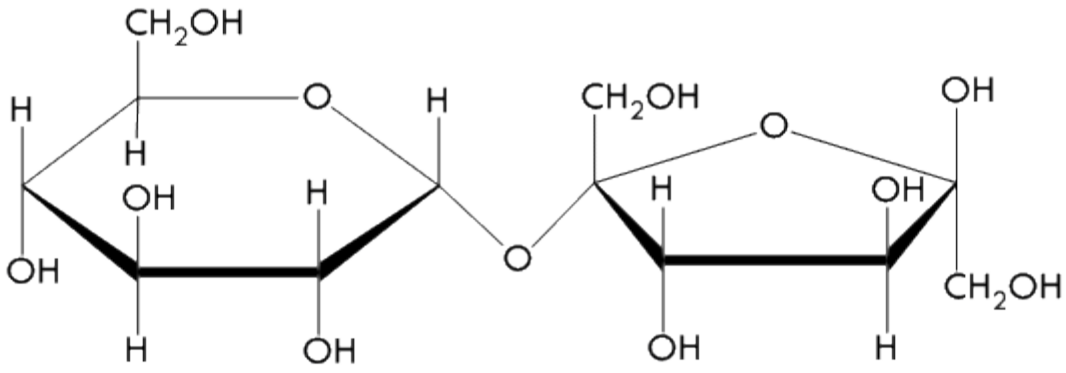
Glucose-Fructose syrup (GFS) is a liquid sweetener used in the manufacturing of foods and beverages. It is composed of different sugars, mainly glucose and fructose, with varying compositions, with a fructose content ranging from 5—50%. If the fructose content exceeds 50%, the products becomes Fructose-Glucose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




Fructose—a monosaccharide and is the primary sugar found in fruit. It too doesn't have to be broken down by the body and is processed in the liver.




Glucose—is a monosaccharide and is a carbohydrate in its simplest form. It doesn't have to be broken down and is immediately absorbed into the bloodstream. Glucose enters cells with the help of the hormone insulin.




Sucrose—sometimes known as normal or table sugar, is a disaccharide, made up of one glucose molecule and one fructose molecule. When eaten, sucrose is broken down by enzymes to produce glucose and fructose which are then absorbed into the bloodstream.

*Fructose, Glucose and Sucrose – three different types of sugar, all used in the production of soft drinks.*

These syrups are made typically from wheat or maize starch, by first making glucose syrup, then through a process called 'hydrolisation', which involves freeing glucose molecules. With the use of enzymes, some of these glucose molecules are then changed into fructose.

## High Fructose Corn Syrup (HFCS)

In the United States, this type of product is produced from the wet milling of corn. Maize starch is converted to a syrup that is nearly all glucose.

Enzymes are then applied, reorganising the atoms in the glucose molecules to produce a 42% fructose syrup called HFCS-42.

Further refinement produces a 90% HFCS which is blended with HFCS-42 to make a third syrup, HFCS-55.

### Use in Food Production

GFS is mainly found in confectionary, beverages, jams and preserves, baked goods, cereal products, yoghurts and other dairy products, condiments and canned and packaged goods such as McVitie's HobNobs, McVitie's Jaffa Cakes, Carte D'Or ice cream and Mr. Kipling Bakewell Slices. It often appears in ingredients lists as 'glucose-fructose syrup', 'high fructose corn syrup' or HFCS.

Its use 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 GFS that contain 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. In the US, no production limit exists on GFS, and HFCS today constitutes up to 50% of US sugar consumption. Its main application is in soft drinks.

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,' a view supported by the American Dietetic Association who 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.

### Consumption of high fructose corn syrup (HFCS) per person per year

The low consumption of HFCS in the UK was reported in a paper published in 2012 in *Global Public Health* entitled:

High Fructose Corn Syrup and diabetes prevalence: A global perspective [6].

It found that diabetes rates were 20% higher in countries that consumed high rates of HFCS compared to those who consumed little. The U.S had the greatest consumption, amounting to 25kg per person per year compared to 0.5kg per person per year in the UK.

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# POSITION STATEMENT

The body of scientific evidence indicates that artificial sweeteners consumed at current levels are safe.

According to PHE [7] and the SACN report on carbohydrates and health [8], consumption of sugar-sweetened drinks compared to non-sugar sweetened drinks, results in greater weight gain and increases in body mass index in children and adolescents due to increased energy consumption.

However, there is some emerging evidence to suggest that artificial sweeteners may not aid weight loss; individuals may compensate for the energy deficit when consuming non-calorie drinks.

Further evidence suggests that the palatability of both sugar-sweetened beverages and artificially sweetened drinks increases subjective hunger and hence energy intake—this requires further study [9].

In an attempt to lower the propensity for sweet food and drink to meet the new SACN guidelines, switching to 'diet drinks' might be a step in the right direction and part of an incremental process of change.

By switching to drinks such as water and low fat milks we can reduce our overall energy intake from sugar whilst simultaneously altering our taste preference.

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