CPD questions

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FEATURE

There is a lot of confusion among the general

public around sugar, sweeteners, 'no added sugar', 'naturally occurring sugars', 'free sugars' and sugar alternatives such as Xylitol. We commissioned **Elaine Gardner**¹ of the British Dietetic Association [the other BDA!] to sort fact from fiction and provide advice that you can share with your patients on the effects of sugars and alternative sugars on general and oral health

1 Xylitol

What is it? A polyol (sugar alcohol) that looks and tastes like sugar (can be used in equal measurement).

Found in? Available to purchase in granular form and in a range of specialist food products like honey, jams and chocolate. Medications and oral health products (mouth rinses, toothpaste, lozenges) can contain xylitol. It is found naturally in very small amounts in some fruits like berries, but the most common source of xylitol is from sugar-free chewing gum.

Effect on general health: Xylitol has a lesser effect on blood sugar levels than sugar, due to its slow absorption rate (low glycaemic index of 7). It can be useful as an alternative to reduce sugar consumption for people with diabetes as it does not raise blood glucose or insulin levels.

¹ Registered Dietitian, British Dietetic Association

The unbearable sweetness of sugar (and sugar alternatives)

It has a reduced caloric value which can be helpful in weight control. One spoon of sugar contains 16 calories versus ten calories from xylitol. This is a small saving, but not very much.

Xylitol is slowly and only partially absorbed in the intestine and too much can cause water retention, resulting in diarrhoea. It is not recommended to consume more than 50 g xylitol per day.

Oral health impact: Xylitol is not metabolised by bacteria in the mouth and so it does not contribute to tooth decay. It also helps remineralise tooth enamel.

Chewing sugar free gum stimulates the flow of saliva through the chewing action; stimulated saliva helps to reduce acidity in the mouth by washing away plaque acids and contributes to their neutralisation by providing an important buffer, bicarbonate. Stimulation of saliva flow through the use of sugar-free gum results in a 10-12 fold increase over a resting saliva rate, which helps wash away debris of food particles and sugars from the mouth and restore optimum pH levels in the mouth faster than without sugar-free gum.

Saliva also has an important role in the maintenance of tooth mineralisation as it provides the calcium and phosphate ions used to repair damaged enamel and it encourages the remineralisation of early caries.

Chewing gum sweetened with xylitol also helps reduce oral *Streptococcus mutans* levels, a key pathogen responsible for dental caries.

of xylitol vehicles to address public health needs. *Adv Dent Res* 2009; **21**: 10.1177/0895937409335623.

2. Söderling E. Controversies around xylitol. *Eur J Dent* 2009; **3**: 81-82.

2 Agave nectar

What is it? A sweet syrup traditionally produced from a cactus-like plant. New methods of processing mean that it now bears little resemblance to the traditional product that, anecdotally, had health benefits. The product, including those claiming to be 'raw', is now a highly-refined syrup high in fructose. It is very similar to high fructose corn syrup, which is commonly found in carbonated drinks.

Found in? Available to purchase in a light or dark syrup, from health food shops and supermarkets.

Effect on general health: Agave is commonly marketed as a slow-release carbohydrate with a low glycaemic index. This is true as it contains mainly fructose and only low amounts of glucose. Although fructose doesn't raise blood sugar levels in the short-term, it can contribute to insulin resistance when consumed in large amounts. This can

Oral health impact: Fructose like sucrose is detrimental to oral health. Bacteria on tooth surfaces metabolise fructose to form acid, resulting

Xylitol

Agave nectar

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'SUGAR-FREE CHEWING GUMS USING XYLITOL ARE A CONVENIENT, SIMPLE AND EFFECTIVE MEANS OF IMPROVING DENTAL HEALTH THROUGH THE STIMULATION OF SALIVA WHEN USED REGULARLY'

Advice for patients: Xylitol is a useful alternative to sugar but moderation in the quantity consumed is important.

Sugar-free chewing gums using xylitol are a convenient, simple and effective means of improving dental health through the stimulation of saliva when used regularly throughout the day.

Further reading

1. Milgrom P, Ly K, Rothen M. Research findings on xylitol and the development

cause major increases in long-term blood sugar and insulin levels, strongly raising the risk of metabolic syndrome and type 2 diabetes.

The liver metabolises fructose, but when overloaded it starts turning the fructose into fat globules, which raise blood triglycerides. Having a high level of triglycerides in your blood can increase your risk of heart disease.

Agave contains more calories than sugar (60 vs 48 calories), but as it is sweeter you should use less.

in a fall in plaque pH and demineralisation. When the pH rises again to above 5.5 due to the dissipation of acid after about 20-30 minutes, enamel can be reformed and repaired with calcium and phosphate released from the saliva.

Advice for patients: The promotion of agave nectar as a natural and healthy product is unfounded. Its cost is much higher than sugar and there are no advantages in using it instead of sugar.

Further reading

1. Stanhope K L, Schwarz J M, Havel P J. Adverse metabolic effects of dietary fructose: results from the recent epidemiological, clinical, and mechanistic studies. *Curr Opin Lipidol* 2013; **24**: 198-206.

3 Stevia¹ (steviol glycosides)

What is it? A sweetener, extracted from the stevia plant. It is 250-300 times sweeter than sugar.

Found in? It can be purchased in granular, tablet and liquid form from supermarkets. Stevia is approved for use in numerous products, for example: sugar-free soft drinks, jams, flavoured milks, yoghurts, cakes, desserts, chocolates and beer. When used as a table-top sweetener, stevia can be mixed with other artificial sweeteners to improve their texture and aftertaste.

Stevia can also be found in combination with sugar to reduce the sugar (and calorie) content of products without losing sweetness. For example, Coca-Cola Life and Sprite use stevia. Tate and Lyle produce 'Sugar with Stevia' that is approximately half the calories of pure sugar.

The stability of stevia under high temperatures means it can be useful for cooking.

Effect on general health: Stevia has no calories, no carbohydrates, a glycaemic index of 0 and does not raise blood sugar levels. It is safe to use by diabetics and is also suitable for children, pregnant women and those with allergies.

For those trying to reduce weight it is a useful tool to help cut calories. Replacing six teaspoons of sugar with stevia sweetener provides a 100 kcal reduction.

Some products, however, do also contain sugar alongside stevia (see above) so it is important to read ingredient labels carefully to find out whether the product is sugar-free or simply 'reduced'.

Oral health impact: Stevia is tooth friendly as it does not contain any fermentable carbohydrate.

In a study by Brambilla *et al.*,² 20 volunteers rinsed for one minute with sucrose or stevia

extract solutions, and plaque pH was measured. After five, ten, 15 and 30 minutes, the sucrose rinse produced a statistically significantly lower pH value compared to the stevia extracts, meaning that more acid was formed with sucrose. The authors conclude that stevia extracts can be considered non-acidogenic and therefore appropriate to support dental health.

Advice for patients: An excellent alternative to sugar, but it's important to check ingredient labels to ensure the sweetness is from only stevia and it is not mixed with a percentage of sugar.

1. Boileau A, Fry J C, Murray R. A new calorie-free sugar substitute from the leaf of the stevia plant arrives in the UK. *Nutr Bull* 2012; **37**: 47-50.
2. Brambilla E, Cagetti M G, Ionescu A, Campus G, Lingström P. An in vitro and in vivo comparison of the effect of stevia rebaudiana extracts on different caries-related variables: a randomized controlled trial pilot study. *Caries Res*; **48**: 19-23.

4 Dates (and other dried fruits)

What is it? Fruit that has been dried to remove water and so concentrates the sugars already present in the fruit.

Fruits such as raisins, dates, prunes and apricots are dried in the sun or in heated wind tunnel dryers.

Many fruits such as cranberries, blueberries, mango and pineapple are infused with a sucrose syrup or apple juice and then heated or dried, which further increases their sugar content.

Found in? Available in most shops and supermarkets. The fruit retains much of its original flavour and is widely used by the confectionery, baking, and sweets industries. As ingredients, dried fruits and their juices, purées and pastes impart sweetness and texture and are also often used in home baking.

The raw food trend has seen an increase in the number of products such as cereal bars that contain high proportions of dried fruits. For example products in the Nakd range can contain 49% dates, and 17% raisins with nuts and flavourings.

Effect on general health: Dried fruits are a good source of iron and fibre in the diet. The glycaemic index (GI) of traditional dried fruit is low to moderate (29-62) and the insulin response is proportional to their GI. However, as the sugar content of fruit (mainly fructose) is concentrated when the fruit is dried, they do contain, weight for weight, more sugar than fresh (64 g sugar per 100 g raisins). The key is

Stevia

Dates

Agave is a sweetener to avoid as it has negative implications on health outcomes (both general and oral). If used, patients should be advised to maintain optimum oral hygiene through toothbrushing twice daily with fluoridated toothpaste and plaque control measures.

portion size - a portion of dried fruit is around 30 g (one tablespoon of raisins, three dried apricots). It is, however, easy to overeat dried fruit and so the sugar and calories can add up.

Sulphur dioxide is used in some dried fruits, such as dried apricots, to protect their colour and flavour. Sulphur dioxide, while harmless to healthy individuals, can induce asthma when ingested by sensitive people.

Oral health impact: Dried fruit contains large amounts of fermentable carbohydrate (mainly glucose and fructose) which is detrimental to oral health. The current recommendation from NHS England is to consume dried fruit with a meal and never as a snack due to its 'sticky' nature. This has been challenged in a review by Sadler¹ which suggests that the evidence base is weak and there are positive attributes for dental health, such as the need to chew dried fruits which encourages salivary flow, and the presence of anti-microbial compounds. It must be noted that the review was funded by the California Prune Board.

Advice for patients A good product but should be eaten in moderation. While more work is establishing the extent of the effects of eating dried fruit on teeth, dried fruits and products containing them are best enjoyed as part of a meal, not as a between meal snack. Oral hygiene needs to be maintained.

1. Sadler M J. Dried fruit and dental health. *Int J Food Sci Nutr* 2016; **67**: 944-959.

5 Honey
What is it? Honey is produced by bees.

Found in? Available in most shops and supermarkets. The texture and flavour depends on which flowers the bees collect nectar from, but its composition is relatively standard.

Effect on general health:

Honey is a sugar and is a mix of glucose and fructose. Although it has a lower glycaemic index than sugar, it is still calorie-containing and has a similar impact on blood sugar levels. For diabetics or those trying to manage blood sugar levels there is no advantage in substituting honey for sugar. It is included in the category of 'free sugars' (alongside table sugar).

Honey is reputed to contain a wide range of minor constituents that act as antioxidants and

it also contains anti-bacterial agents. This is why Manuka honey from New Zealand is supposed to be beneficial, but there is insufficient evidence currently to substantiate its use in practical applications. While it certainly has bactericidal properties, the transfer to improvements in clinical conditions is limited. Additionally, table honeys that we buy generally possess lower antibacterial activity than the Medical Grade Honey that is used in research.

Honey (and any products containing it) should never be given to babies under one year. Occasionally honey contains the bacteria that causes infant botulism, which is life threatening.

that Manuka honey is antimicrobial towards some oral bacteria but *Streptococcus mutans*, a key pathogen responsible for dental caries, is most resistant. The authors state that Manuka honey should not be used in the treatment of periodontal disease due to the high concentrations of fermentable carbohydrates and the direct demineralising effect.

Syrup

Honey

Oral health impact:
Honey is composed of fermentable carbohydrate which is cariogenic.¹

A recent study examined the antibacterial activity of Manuka honey against plaque-associated bacteria *in vitro* in order to evaluate the potential application as an adjunct to periodontal treatment.² It found

Advice for patients: Honey is just another form of sugar and should be consumed in moderation. Oral hygiene needs to be maintained.

1. Bowen W H, Lawrence R A. Comparison of the cariogenicity of cola, honey, cow milk, human milk, and sucrose. *Pediatrics* 2005; **116**: 921-926.

2. Safi S H, Tompkins G R, Duncan W J. Periodontal application of Manuka honey: antimicrobial and demineralising effects in vitro. *Int J Dent* 2017; **2017**: 9874535.

6 Syrup

What is it? A variety of different sugary liquids such as maple syrup, black treacle (molasses), golden syrup, date syrup and pomegranate molasses can fall under this heading. These are produced as by-products of the sugar industry (black treacle, golden syrup), from natural sources (maple syrup is the sap of the maple tree) or

food stores. Some products like maple syrup can be expensive, so cheaper imitations are made out of flavoured high fructose corn syrup (the sweetness commonly used in processed foods and drinks).

The different syrups are used instead of sugar for the different flavours they bring to products like cakes (eg black treacle in gingerbread), biscuits (eg golden syrup in flapjacks) and desserts (eg maple syrup and pancakes). Some products can also be used as a dressing on salad and vegetables, to sweeten stews, to drizzle over yoghurt or porridge, or used in marinades or dips.

approximately a third sucrose. As a result, if eaten in excess they have the same problems as sugar, ie obesity, diabetes.

Date syrup contains concentrated date sugar (mainly fructose) with the pulp (fibre content) removed. It has been suggested that it has antibacterial effects (similar to honey), but the evidence to date is from laboratory experiments and there have been no trials in humans.

There are claims regarding the benefits of the fruit/tree based syrups due to their antioxidant content, but these are based on the actual fruits and there is no robust evidence base concerning the benefits of the syrups.

Oral health impact: They are all harmful to teeth due to the high levels of fermentable carbohydrates.

Advice for patients: Syrups should be used sparingly for flavour. Oral hygiene needs to be maintained.

7 Yacon syrup (nectar)

What is it? Made from the roots of the Yacon plant, it has a caramel taste and is about half as sweet as honey.

Found in? Available from health food stores and online.

Effect on general health:

Yacon syrup is composed of fructo-oligosaccharides (FOS), inulin and a small amount of glucose and fructose.

FOS is a soluble fibre virtually undigested by the human digestive system and by forming a gel, it provides beneficial bulk helping the movement of waste through the intestine.

Both FOS and inulin are prebiotics which means they provide a food source for the fermentation of beneficial bacteria in the gut. These friendly bacteria play a significant role in regulating the immune system, inhibiting the growth of disease-causing bacteria, digesting food and producing valuable vitamins.

Yacon syrup provides only about one third the calories of sugar, but as it is less sweet potentially more may be used. It has a very low glycaemic index, so beneficial in the regulation of blood sugar and insulin levels.

In the popular press it has been claimed to be a new 'miracle food' in weight loss treatment due to its lower calorie content, as

Yacon syrup

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made from fruits (dates, pomegranate juice).

Syrup shots used to produce a wide range of flavoured coffee drinks, teas and smoothies, commonly seen in coffee shops in the UK, are most often sugar (sucrose) syrup with added flavourings, although some sugar-free versions are becoming available.

Found in? Available in many shops and health

Effect on general health: Some syrups contain iron (black treacle, date syrup) but as they have a strong taste and concentrated sweetness only small amounts are used. This makes their contribution as a source of iron in the diet very limited.

All syrups contain a mixture of glucose, fructose and sucrose in varying proportions, with golden syrup and treacle containing

well as its bulky nature making people feel fuller and satisfied. It also increases bowel transit time and increases defecation frequency, which may also play a role. Human trials are so far very limited and evidence is scarce.

If Yacon syrup is taken in excess it can lead to abdominal pain, gas, bloating and diarrhoea. Maximum recommended daily consumption of Yacon syrup is about 20 g per day.

The quantity of beneficial constituents obtained by using Yacon syrup is limited by the amount consumed which means there may be minimal health benefits in everyday use.

Oral health impact: There have been no specific studies on Yacon syrup and oral health in humans. FOS are not cariogenic, but Yacon syrup also contains small amounts of the fermentable carbohydrates glucose and fructose.

There have also been reports of some of the FOS from Yacon being converted to fructose during food processing and when exposed to high temperatures (such as when baking). This increases the potential for cariogenicity.

Advice for patients: The adverse bowel effects of Yacon syrup limits its potential benefits. Although evidence is limited, it seems prudent to advise patients to pay full attention to oral hygiene if they are using the product.

Further reading

1. Caetano B F, de Moura N A, Almeida A P, Dias M C, Sivieri K, Barbisan L F. Yacon (*Smilax glabra*) as a food supplement: health-promoting benefits of fructooligosaccharides. *Nutrients* 2016; **8**: pii: E436.

8 Coconut (palm) sugar

What is it? It is made from the sap of the coconut palm tree and looks like brown, granulated sugar. Palm Sugar is similar but made from a different type of palm tree.

Jaggery is a concentrate of date, sugar cane juice and/or palm sap without separation of the molasses. It has a fudge-like consistency and is used extensively by the Asian population (particularly those from India) to sweeten foods, breads and sweets.

All these products are similar and are mainly composed of sucrose (table sugar) with smaller quantities of glucose and fructose. Coconut sugar can contain 70-80% sucrose and jaggery about 50% sucrose.

Found in? Available from shops, health food stores and online.

Effect on general health: Coconut

palm sugar (and palm sugar and jaggery) is essentially a fairly pure form of sugar and like ordinary sugar it can contribute to obesity, diabetes and heart disease.

Coconut sugar undergoes little processing so it retains some of the natural vitamins, minerals (notably iron, zinc, calcium and potassium), fibre (inulin) and antioxidants. The nutrients in coconut sugar are likely to have a minimal effect unless you eat large amounts, when any benefit will be outweighed by all the sugar you're eating.

Coconut sugar has the same number of calories as table sugar (16 calories per teaspoon).

Oral health impact: All these products contain high levels of fermentable carbohydrates so are cariogenic.

Advice for patients:

Treat these products in the same way as table sugar and use sparingly. Oral hygiene needs to be maintained as they are harmful to teeth.

9 Lactose (milk sugar)

What is it? The sugar found in animal milks and dairy products. It has 20% the sweetness of table sugar.

Found in? As a powder, it is available from health food stores and online. In the pharmaceutical industry, lactose is a filler when forming tablets. It is also used widely by the food manufacturing industry and in home brewing. Lactose is most commonly consumed within milk and dairy products.

The quantity of lactose in animal milks remains similar at about 4.7% lactose, whether the milk is from a cow, goat or sheep and whether it is semi-skimmed or skimmed. Flavoured milks (such as strawberry, chocolate) can have sugar additions.

Effect on general health: If you are lactose intolerant, you cannot digest milk sugars because the body cannot produce the enzymes needed to digest lactose. There are now a number of lactose-free milks available.

Oral health impact: Lactose is a non-fermentable sugar so is not cariogenic and is not harmful to teeth. Milk and the associated dairy foods also tend to be high in protein, calcium and phosphates which help neutralise the effects of acid production which is beneficial to oral health.

Coconut (palm) sugar

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Dairy products without added sugar or a small piece of cheese can be advised as snacks or as after-meal desserts for positive oral health. It is noted, however, that eating a piece of cheese may not be a practical solution and that this may have a detrimental impact on overall dietary intakes, especially if eaten frequently.

Dairy based foods such as fruit yoghurts may also have free sugars added to sweeten them. On average, three teaspoons of free sugars can be added to a small pot (125 g) of yoghurt. Likewise flavoured milks can contain over 5% sucrose and as such have cariogenic potential.

Advice for patients: Plain milk and dairy based choices with no added sugars, such as

'THE POPULATION COULD BE ENCOURAGED TO CONSUME FEWER "SWEET SNACKS AND DRINKS", RATHER THAN SIMPLY REPLACING THOSE CONTAINING SUGAR WITH THOSE CONTAINING ARTIFICIAL SWEETENERS'

10 Sucralose

What is it? Sucralose is an artificial sweetener. Although the name Sucralose ends in -ose, it is not a sugar like fructose or sucrose, so the name is rather misleading. It is a modified form of ordinary sugar (sucrose). It is also known under the E number E955.

Sucralose

Found in? It is commonly found in granular, liquid or mini-tablet form and sold under the trade name of 'Splenda' or as the individual yellow packets of Canderel (not other versions of Canderel as they contain different sweeteners).

Sucralose-based products are in a broad range of lower-calorie foods, including table top sweeteners, fizzy drinks, chewing gum, baking mixes, breakfast cereals and salad dressings.

Effect on general health: Sucralose itself contains no calories but because it is very sweet (approximately 600 times as sweet as sugar), sucralose in the granulated format is often mixed with other sweetening ingredients such as maltodextrin. This dilutes its intense sweetness and provides volume and texture. These, however, are not calorie-free, so a teaspoon contains about 2-4 calories. This is about 20% of the calories of sugar which the granulated product is intended to replace.

The claim that 'Sucralose has less of an impact on blood glucose than sugar' has been validated by the European Food Safety Authority.¹

Oral health impact: Sucralose has no effect on tooth decay (again validated by EFSA¹). Any other sweetening ingredients included in the Sucralose-based table top sweeteners are not harmful to teeth. Sucralose is commonly found in oral health products, such as chewing gum.

Advice for patients: Sucralose is one of many artificial sweeteners that can be used as an alternative to sugar. These can be useful for weight reduction and for helping diabetics reduce their sugar intakes. Sucralose is not cariogenic, but, as always, good oral hygiene should be maintained.

As part of a healthy diet, the population as a whole could also be encouraged to consider consuming fewer 'sweet snacks and drinks', rather than simply replacing those containing sugar with those containing artificial sweeteners.

1. European Food Safety Authority (EFSA). Scientific Opinion on the substantiation of health claims related to the sugar replacers xylitol, sorbitol, mannitol, maltitol, lactitol, isomalt, erythritol, D-tagatose, isomaltulose, sucralose and polydextrose and maintenance of tooth mineralisation by decreasing tooth demineralisation and reduction of post-prandial glycaemic responses pursuant to Article 13(1) of Regulation (EC) No 1924/2006. *EFSA J* 2011; **9**: 2076. Available from: <http://onlinelibrary.wiley.com/doi/10.2903/j.efsa.2011.2076/epdf> (accessed September 2017).

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Lactose (milk sugar)

natural yoghurt, are the best options to choose. While lactose is not harmful to teeth, patients are often unaware of the additional sugars added to dairy products that can impact on oral health. Oral hygiene should always be maintained.

Further reading

1. Al-Jobair A, Khounghanian R. Evaluating the cariogenic potential of flavored milk: an experimental study using rat model. *J Contemp Dent Pract* 2015; **16**: 42-47.
2. Telgi R L, Yadav V, Telgi C R, Boppana N. In vivo dental plaque pH after consumption of dairy products. *Gen Dent* 2013; **61**: 56-59.