

Sugars & sweeteners

A technical paper on supplementation

Introduction

Sugar has a remarkable power on humans. It tends to give a feeling of comfort and may reduce pain in infants and children. Milk-sugar present in breastmilk, is one of the first things people are exposed to and embeds a long-lasting memory of security and comfort.¹⁻³

Sugar is also known for its preservative effects and improves tastiness (palatability) of many products, which is well recognized by the food industry. For decades sugar has been added to foods and drinks to improve shelf-life and taste. This has led to an enormous increase of unaware sugar consumption (Figure 1). It has been estimated that the global sugar consumption will be more than 35kg per person annually (Figure 2) which is approximately 96g per day.⁴⁻⁶ This amount is far more than the recommended 25g per day by health institutes^{7,8} and has a direct risk potential on health. Today, there is a large body of evidence that confirms that sugar is not that 'sweet' and that overconsumption increases the risk for overweight, diabetes, and dental diseases.⁹⁻¹¹

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Figure 1: Sugar intake increase since 1700.¹²

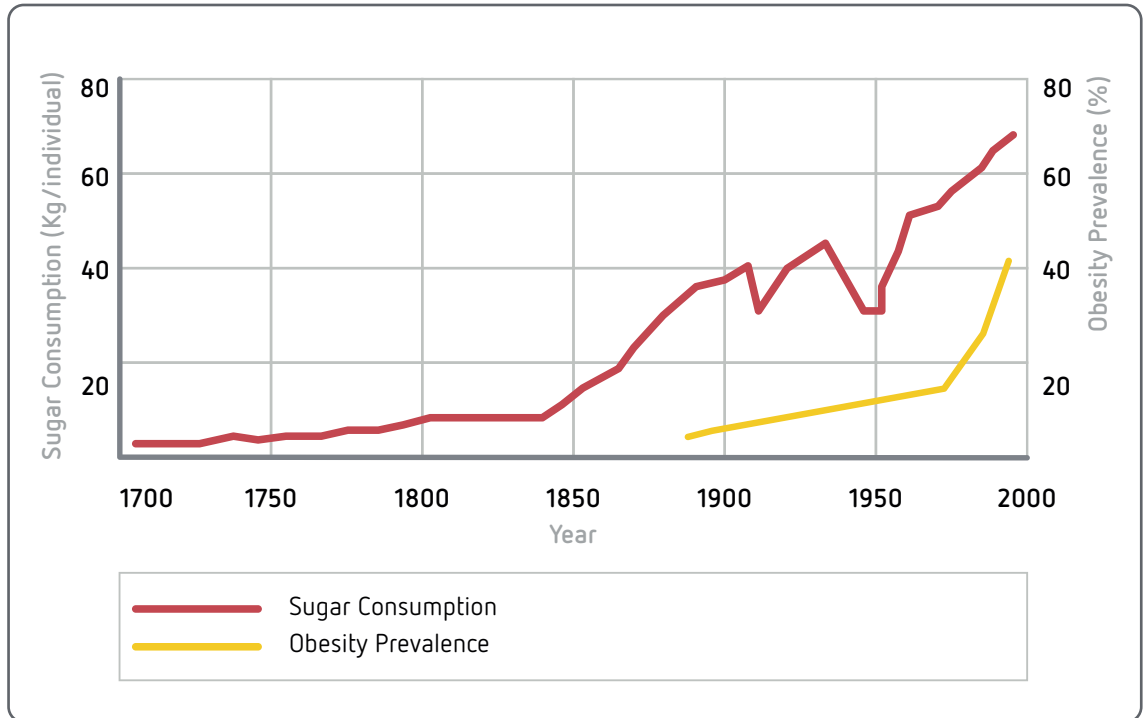
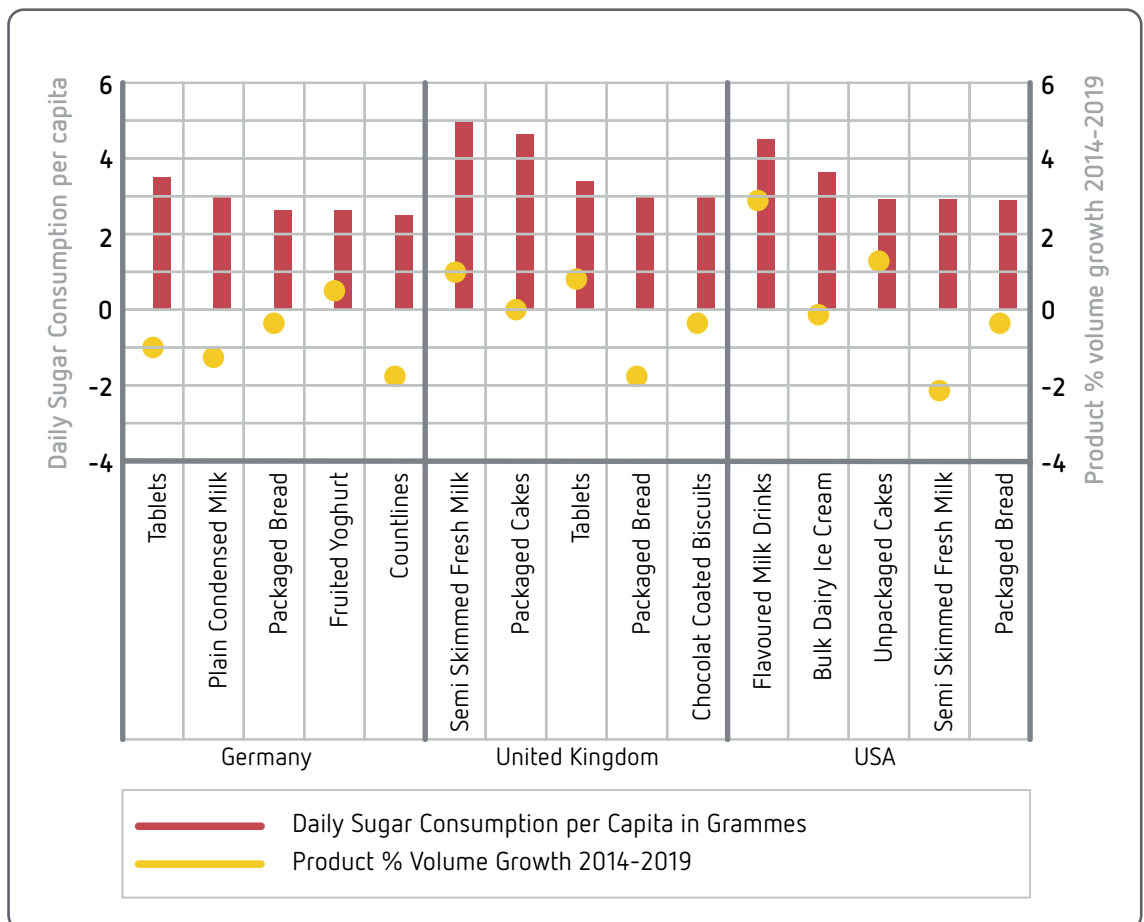


Figure 2: Global sugar consumption per capita per year.^{5,6}



2 HEALTH RISKS OF SUGAR OVERCONSUMPTION

Overconsumption of sugar is often due to the unawareness of consumers since most of the added sugar is 'hidden' in foods and drinks. The recommended daily allowance (RDA) of sugar is 130 g/day, which is about 8 teaspoons.¹³ However, due to the excessive addition of sugar in food products and drinks, the average daily intake increased by 35% the past years.^{5,6,14} Researchers demonstrated that overconsumption of sugar significantly increases the risk for various diseases:^{7,11,15-18}

- Hypertension
- Cardiomyopathy
- Dyslipidaemia
- Diabetes type II
- Kidney and liver disorders
- Obesity

Importantly to note is that sugar has an effect on the brain similar to tobacco and alcohol addiction.^{19,20} Sugar tends to give feelings of comfort because it stimulates the release of dopamine which is also known as a feel-good neurotransmitter produced in the brain. Frequent sugar consumption may change the dopamine receptors causing a need for more sugar. Research demonstrated that the increased need for sugar is one of the main factors of overweight and obesity in every age category.^{7,18,19,21}

Because of the growing evidence that sugar overconsumption is negatively associated with health, the World Health Organization (WHO), European Food Safety Association (EFSA) the Food and Drug Administration of the United States of America (USFDA) provided guidelines and recommendations how to reduce sugar intake with 5% to 10% per person per day.^{4,13,22} These recommendations urged the food industry to reduce the amount of added sugar to their products and to replace it with healthier alternatives.



The unawareness of consumers that most of the added sugar is 'hidden' in foods and drinks.

3 SUGAR VS SWEETNERS

3.1 What is sugar?

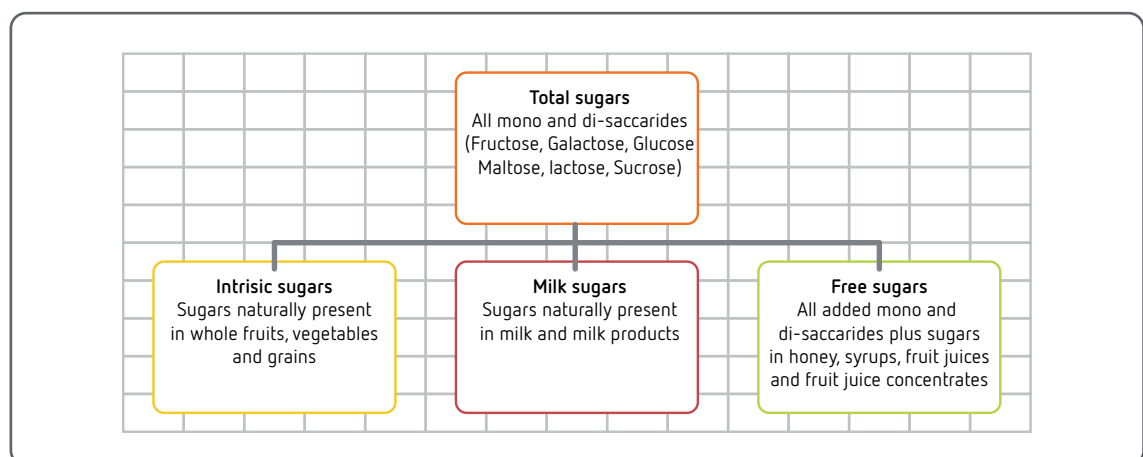
White table sugar or sucrose is a carbohydrate found in plant sources. It is a disaccharide formed by glucose and fructose. Sucrose has a glycaemic index (GI) of 65 which means that it rapidly increases blood sugar and insulin levels.²³⁻²⁵ Frequent fluctuations of insulin levels increase the risk for various diseases including type 2 diabetes mellitus and cardiovascular diseases.^{26,27} Sucrose is considered a non-essential nutrient that provides 3.9 kilocalories per gram of energy and added to foods and drinks, it easily increases the calorie amount.^{7,15,16} Besides sucrose there are 2 other main sugar forms commonly added to foods and drinks:²⁸

- Fructose (from fruits)
- Glucose (original form of carbohydrates)

Fructose is present in fruits and replaced sucrose for a large part because of its sweetening power, low production costs and lower GI of 19.²⁸

Glucose is a simple sugar and the breakdown-product of sucrose and fructose. It is the essence of sugar forms and provides energy particularly for the brain.²⁵

Figure 3: Different sugar forms²⁵



3.2 What are sweeteners

Sweeteners can replace sucrose as a healthier alternative. There are two types of sweeteners: natural and artificial sweeteners.

1) Natural sweeteners are sugars forms that occur mainly in fruits and vegetables. The chemical structure of natural sweeteners is different compared with sucrose and fructose. Xylitol and sorbitol for instance, are classified as sugar-alcohols, also known as polyols.²⁹

These sweeteners are frequently combined to mimic the sweetness of sucrose.²⁸

Besides polyols, stevia can also be used as natural sweetener. The sweetness of stevia comes from steviol glycosides which has more than 100 times the sweetness of table sugar.³⁰

The most common natural sweeteners are:²⁹

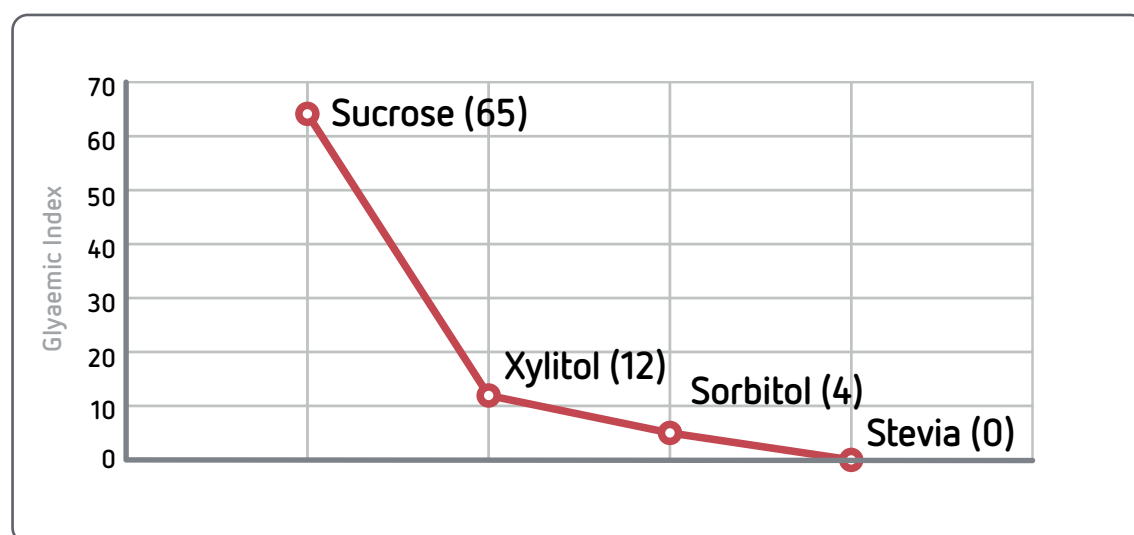
- Xylitol
- Sorbitol
- Stevia
- Mannitol
- Erythritol
- Maltitol

2) Artificial sweeteners are manufactured sweeteners that provide a sweet taste to mimic the taste of sucrose. The most common artificial sweetener is sucralose.

3.3 Differences between sugar and sweeteners

Sweeteners have many health benefits compared with sucrose and the main advantage is the low GI resulting in less insulin fluctuations and thus a reduced risk for type 2 diabetes.²⁷

Figure 4: Glycaemic index versus different sweeteners



Natural sweeteners also contribute to:

- Dental health
- Satiety
- Healthy microflora
- Shelf-life of products (antimicrobial)

In contrast, sucrose consumption may:

- Cause tooth decay
- Increase craving for (sweet) foods
- Disrupt the microflora resulting in overgrowth of yeasts and bacteria

3.4 Safety of sweeteners

The safety of sweeteners (natural and artificial) is strictly regulated. Sweeteners permitted for food additives are subjected to a comprehensive examination to determine their safety before being accepted for human use.³¹

National authorities, the EU's Scientific Committee on Food and the Joint Food and Agriculture Organization (FAO)/WHO Expert Committee on Food Additives, provide information about the safety and the maximum permitted doses of approved sweeteners.³¹⁻³³

Some sweeteners may have a laxative effect when consumed in extreme high doses. However, research suggested daily doses below 50g are unlikely to cause undesirable effects.^{34,35}

3.5 E-Number

Though E-numbers are sometimes judged as unhealthy or unsafe, these are actually identification codes given by the EU Commission to permit additives used in foods and drinks after a thorough safety investigation.³⁶

4 COMMON NATURAL SWEETENERS

4.1 Xylitol

Xylitol naturally occurs in almost all plants and acts as an antioxidant. It is roughly as sweet as sucrose and has a cooling effect in the mouth. Xylitol may prevent the incidence of dental diseases by: ^{29,37-39}

- Reducing plaque and dental cavities by 80%
- Promoting remineralization of tooth enamel
- Increasing saliva production
- Reducing infections in the mouth

Xylitol has a low GI of 12 and it has no effect on blood glucose and insulin levels which makes it advantageous in products for diabetic patients and in diet products. It also increases satiety that may reduce bingeing. ³⁹

Moreover, xylitol has prebiotic properties that may help to promote the growth of beneficial bacteria (microflora) in the colon. In particular, it promotes the growth of *bifidobacteria* and *lactobacilli* that both are significantly related to an improved immunity. ⁴⁰ It may also act as a preservative against unwanted bacteria and certain yeasts. ^{41,42}

With respect to safety, a single dose of 50g is well tolerated and does not cause side effects such as bloating or diarrhoea. ^{34,38,43} The Scientific Committee for food of the EU approved xylitol as a safe additive in food and beverages and gave it the E-number E967. ⁴⁴

4.2 Sorbitol

Sorbitol or D-glucitol, naturally occurs in fruits. It is often combined with other sweeteners because it is approximately 40% less sweet than sucrose. It has a GI of 4 which makes it ideal for diabetic food products. ²⁹

Sorbitol has similar health benefits as xylitol; it has a positive effect on teeth, does not affect blood glucose and insulin levels, and promotes the microflora in the colon. ^{29,32} A single dose of 50g is well tolerated and does not cause laxative effects. ³⁴ Sorbitol is approved as a sweetener by the Scientific Committee for food of the EU since 1984 and carries the E-number E420. ³²

4.3 Stevia

Stevia or stevioside, is found in the leaves of the stevia plant (*Stevia rebaudiana* Bertoni). It has an intense sweet taste which is almost 200 to 300 times sweeter than sucrose. Stevia has no effect on blood glucose and insulin levels because it has a GI of 0. Stevia may also have antimicrobial properties and might reduce hypertension. ^{30,45}

The WHO's Joint Experts Committee on Food Additives approved stevia as a sweetener for foods. The EFSA established a recommended daily intake of 4mg/kg body weight. ^{21,33} Stevia has been approved as a sweetener in food and beverages by the Scientific Committee for food of the EU since 2011 and received the E-number E960. ^{33,46}

5 ADDED SUGAR IN DIETARY SUPPLEMENTS

Dietary supplements are intended to complement the normal diet with functional ingredients that benefit health. Sugar (sucrose or fructose) and flavours are generally added to improve the tastiness (palatability) of the final product, because some of the active nutrients in dietary supplements have a bitter or distinct taste. Some supplements, such as gummies, contain more than 15 grams of sugar. The addition of sugar (sucrose) to dietary supplements seems a contradiction in the health-benefit purpose of dietary supplements.

Children are the most difficult group to pursue to voluntarily consume dietary supplements. Supplements for children are generally designed to mimic all sorts of candy, e.g. gummy forms, and contain often a low amount of active ingredients and added sugars to improve palatability and acceptance.^{7,17,18}

Natural sweeteners are a much healthier alternative for table sugar. Sweeteners do not excessively affect blood glucose and insulin levels and do not cause food cravings. They have a similar sweetness as sugar without the negative effects on (dental) health.

The addition of sugar (sucrose) to dietary supplements seems a contradiction in the health-benefit purpose of dietary supplements.

Stevia is one of the natural substitutes for sugar



6 PATENTED CONCORDIX® TECHNOLOGY

Vitux AS uses the innovative ConCordix® technology for the development of dietary supplements.

This patented technology provides customized dietary supplements that combines both water- and oil-based ingredients are combined in one Smart Chew. The supplements are sugar-free and sweetened with a combination of xylitol, sorbitol and stevia, and have exceptional taste masking properties.

The uniqueness of the technology lies within the design of the supplements: a gelatin matrix with an emulsion of water and oil. This allows both water- and oil- soluble active ingredients to be embedded in the delivery unit, which is an exceptional feature and offers a wide array of possibilities.

The compliance and acceptance of ConCordix formulated dietary supplements is high across all age groups. The gelatin creates a chewable supplement that is soft and easy to ingest without the necessity of water and enhances bioavailability of active ingredients.

6.1 Unique palatability and sugar-free

The unique palatability and exceptional taste masking properties are possible due to a combination of tasty aromas and sweeteners as xylitol, sorbitol and stevia. Several clinical studies have shown the tastiness of ConCordix formulated supplements in products for nutritional and pharmaceutical purposes.^{47,48}

Ibuprofen is known for its bitter taste when a hard tablet is chewed or when a powder formulation is not well dissolved. A group of adults received ibuprofen embedded in ConCordix and were instructed to chew the supplement 3 to 6 times before swallowing. Repeated chewing did not release the bitter taste of ibuprofen and clearly confirmed the unique taste masking.^{47,50}

Fish-oil has many health benefits but has a distinct taste and smell. Children who received either a ConCordix formulated fish-oil or placebo supplement for 3 months, reported that the supplements had a comparable taste with that of candy and the acceptance-rate was high.⁴⁹

6.2 Exceptional stability

A well-known challenge during the development of dietary supplements is that active ingredients may have a poor stability. This potentially affects the functional properties and taste of the final product. Supplements formulated with ConCordix have a low water activity, optimized pH and a unique air-tight packaging that provides long-term stability for up to 24 months.⁴⁷

Exceptional stability results in:

- Reduced risk for degradation of ingredients
- Reduced risk for ingredient interactions
- Reduced risk of formation of oxidation products
- Improved shelf life
- Improved taste

7 CONCLUSION

Overconsumption of sugar has considerably increased the past decades, with associated health risks including type 2 diabetes and obesity. This has led to the development of guidelines and recommendations from authorities on a global scale to reduce the amount of sugar in foods and drinks.

A healthy alternative to replace sugars is to use (natural) sweeteners. Sweeteners have a similar taste as sugar without imposing the health benefits of functional ingredients in dietary supplements. They do not affect blood glucose and insulin levels or induce food cravings that can lead to overweight. Sweeteners as xylitol and sorbitol may even protect teeth and support the gut microflora.

In contrast to most other dietary supplements, ConCordix Smart Chews are completely sugar free and only contain natural ingredients.

8 COMPANY PROFILE

Vitux AS is a Norwegian based company that provides dietary supplements for private label manufacturers. Vitux AS offers custom-made and sugar-free products made with the patented, innovative ConCordix technology.

At Vitux AS we try to make health easy. Vitux AS uses state-of-the-art BRC certified manufacturing methods. Only natural ingredients with high quality standards are used to produce turnkey products and customized dietary supplements. We provide a tailor-made solution that fits your needs. A team of experts will assist you to produce a tailor-made product based on your needs. Feel free to get more information about our unique ConCordix chewable Smart Chews and visit our website: www.concordix.com or contact one of our experts.

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