

Xylitol

Xylitol (/ˈzaɪlɪtɒl/; Greek: ξύλον, xyl[on], "wood" + suffix -itol, used to denote sugar alcohols) is a sugar alcohol sweetener used as a naturally occurring sugar substitute. It is found in the fibers of many fruits and vegetables, and can be extracted from various berries, oats, and mushrooms, as well as fibrous material such as corn husks and sugar cane bagasse, and primarily birch. Xylitol is roughly as sweet as sucrose with only two-thirds the food energy, far fewer calories, and a very low glycemic index. Xylitol does not require the use of insulin to be processed by the body.

As with other sugar alcohols, with the exception of erythritol, consumption in excess of one's laxation threshold (the amount of sweetener that can be consumed before abdominal discomfort sets in) can result in temporary gastrointestinal side effects, such as bloating, flatulence, and diarrhea. Adaptation, an increase of the laxation threshold, occurs with regular intake. Xylitol has a lower laxation threshold than some sugar alcohols, but is more easily tolerated than others such as mannitol and sorbitol.

Xylitol is an organic compound with the formula $(\text{CHOH})_3(\text{CH}_2\text{OH})_2$. This achiral species is one of four isomers of pentane-1,2,3,4,5-pentol.

Production of xylitol

Xylitol was discovered almost simultaneously by German and French chemists in the late 19th century, and was first popularized in Europe as a safe sweetener for people with diabetes that would not affect insulin levels. Its dental significance was researched in Finland in the early 1970s, when scientists at Turku University showed it had significant dental benefits. Those became known as the "Turku sugar studies". Today, using hardwood or maize sources, the largest manufacturer globally is the Danish company Danisco, with several other suppliers from China and the U.S. Xylitol is produced by hydrogenation of xylose, which converts the sugar (an aldehyde) into a primary alcohol.

Properties

One gram of xylitol contains 2.4 kilocalories (Cal), as compared to one gram of sugar, which has 3.87 Cal. Xylitol has no aftertaste, and is advertised as "safe for diabetics and individuals with hyperglycemia." This tolerance is attributed to the lower effect of xylitol on a person's blood sugar, compared to that of regular sugars as it has a very low glycemic index of 7 to 13 (glucose has a GI of 100).

Dietary use worldwide

Xylitol is used around the world, mainly as a sweetener in chewing gums and pastilles. Other applications include oral hygiene products, such as toothpaste, fluoride tablets and mouthwashes. The pharmaceutical industry uses xylitol as a sweetener in its products.

Medical applications

Dental care

Xylitol is a “tooth-friendly”, nonfermentable sugar alcohol. A systematic review study on the efficacy of xylitol has indicated dental health benefits in caries prevention, showing superior performance to other polyols (polyalcohols). This is because the structure of xylitol contains a tridentate ligand, (H-C-OH)₃ that can rearrange with polyvalent cations like Ca⁺⁺. This interaction allows for Ca⁺⁺ to be transported through the gut wall barrier and through saliva may remineralize enamel before dental caries forms.

Early studies from Finland in the 1970s found that a group chewing sucrose gum had 2.92 decayed, missing, or filled (dmf) teeth compared to 1.04 in the group chewing xylitol gums. Recent research confirms a plaque-reducing effect and suggests the compound, having some chemical properties similar to sucrose, attracts and then "starves" harmful micro-organisms, allowing the mouth to remineralize damaged teeth with less interruption. (However, this same effect also interferes with yeast micro-organisms and others, so xylitol is inappropriate for making yeast-based bread, for instance.) This is because cariogenic bacteria prefer fermentable six-carbon sugars, or disacharrides such as sucrose, as opposed to the nonfermentable xylitol, whose antimicrobial properties then "starve" the bacteria, reducing their growth and reproduction. Most of these studies suggest that at least 6 grams of xylitol per day is needed for dental efficacy; for most chewing gum or breath mints this would require 12 pieces per day (op cit).

Xylitol is specific in its inhibition of the mutans streptococci group, bacteria that are significant contributors to tooth decay. Xylitol inhibits mutans streptococci in the presence of other sugars, with the exception of fructose. Daily doses of xylitol below 3.44 grams are ineffective, and doses above 10.32 grams show no additional benefit.

Saliva containing xylitol is more alkaline than saliva which contains other sugar products. After taking xylitol products, the concentration of basic amino acids in saliva may rise. When saliva is alkaline (i.e., its pH is above 7), calcium and phosphate salts in saliva start to precipitate into those parts of enamel where they are lacking.

Xylitol also inhibits the growth of *Streptococcus pneumoniae*, as well as the attachment of *Haemophilus influenzae* on the nasopharyngeal cells, making xylitol nose spray a very effective product.

Xylitol-based products are allowed by the U.S. Food and Drug Administration to make the medical claim that they do not promote dental cavities.

As a water additive for cats xylitol is effective in reducing plaque and calculus accumulation. However, there is evidence xylitol may be dangerous to dogs.

Diabetes

Possessing approximately 40% less food energy, xylitol is a low-calorie alternative to table sugar. Absorbed more slowly than sugar, it does not contribute to high blood sugar levels or the resulting hyperglycemia caused by insufficient insulin response. This characteristic has also proven beneficial for people suffering from metabolic syndrome, a common disorder that includes insulin resistance, hypertension, hypercholesterolemia, and an increased risk for blood clots.

To the dismay of health organisations world-wide, diabetes type II has become pandemic. We are now seeing it even in children and teen-agers, where previously it has been a disease of the middle-aged and older.

A quick summary of how sugar overload can lead to diabetes type II: Our bodies need our pancreas to produce insulin to clear our blood of glucose (blood sugar), and bring the glucose to our cells so the cells can convert the glucose into energy. When there's just too much glucose in the blood, the pancreas become exhausted by the constant demand for insulin. It finally breaks down, and excess sugar pollutes the bloodstream. The cells on the other hand, not getting enough glucose, become deprived of energy, and the person literally starves amidst all that food in the body. Glucose continues to accumulate, and diabetics are thus poisoned by their own blood sugar.

Xylitol may be ideal for diabetes as it is absorbed more slowly than sugar, thus not contributing to high blood sugar levels. It has a glycemic index of only 7. (GI rates carbohydrates according to their impact on blood sugar. Table sugar has a GI of 100.) This means that at a GI of 7, xylitol exhibits a slow, steady release of energy.

Furthermore, the body metabolizes xylitol without the use of, or need for insulin, and is not affected by insufficient insulin response.

Natural Alternative Sweeteners for Diabetics

Regardless of the latest recommendations on safety of artificial sweeteners, consuming fresh and natural produce is more sensible than taking the risk with products made from artificial chemical ingredients. When it comes to natural sweeteners suitable for diabetics however, these may be difficult to find in the local supermarket. You may need to source these from a health food outlet. Natural sweeteners considered by some to be the best choices for diabetics include the herbal extract Stevia, sugar alcohols like Xylitol and Erythritol, and Chicory Root Inulin.

Stevia is a natural plant-derived sweetener which has passed routine testing for safety. It will not raise blood sugar levels so it is recommended for diabetics.

Xylitol and **Erythritol** are found in the fibres of fruit and some other plants including mushrooms. They are absorbed into the blood stream more slowly than sugar and are low in carbohydrate. Rather than being stored in the body they are eliminated efficiently in the urine. However these sweeteners should be introduced slowly into the diet to allow the body to adjust to their natural laxative effect.

Chicory Root Inulin is a fibre which has beneficial probiotic properties for a healthy digestive tract and systemic cleansing. It is low in carbohydrate and does not raise blood sugar levels.

These natural alternative sweeteners may be a little more expensive to buy but, if you are a diabetic, you might wish to consider how much you think your life is worth. Once diagnosed with a life threatening disorder, or one that diminishes quality of life, would you agree to spend a few extra dollars and a little more effort each week to regain your health? If the answer is yes, then don't wait for that day to arrive before making the decision to change.

Although not a panacea for solving the diabetes problem, the introduction of xylitol into the diet as a substitute for these harmful sweeteners is a good way to satisfy one's desire for sweets without experiencing their negative effects. Whereas sucrose has a glycemic index (GI) of 60, xylitol has a GI of 7. The GI is a measure of how quickly sugar is absorbed into the blood stream during digestion, and it follows that, because of its high GI rating, high levels of consumption can lead to blood sugar spikes that can cause an excessive release of insulin. Over time, this may lead to insulin resistance in the body's cells that can result in the development of diabetes. Xylitol, on the other hand, is absorbed much more slowly, has minimal effects on blood sugar and insulin levels, and some even passes through the intestines without any absorption. According to Dr. David Williams (*Alternatives*, Vol. 13, No. 12), "Since xylitol is non-fermentable, intestinal bacteria can't digest it as it passes through the digestive tract into the intestines. Instead, it acts as a fiber, and produces beneficial short-chain fatty acids." Because xylitol is a natural product, it is nontoxic, and is also "familiar" to the body since it is produced in small quantities during normal metabolism. The body secretes enzymes that make it usable as a fuel for the production of energy.

John Peldyak, DMD, in his book, *Xylitol, Sweeten Your Smile* (1996), presents an interesting discussion about diabetes on pp. 18-20 concerning the disadvantages of sugars that are added to the diet and the advantages of xylitol as a sugar replacement. He states that an increase in sugar consumption causes "a rapid rise in blood glucose which triggers an insulin burst, followed by a rapid decrease in blood sugar, increased fatigue and more hunger." In addition, he reports the negative aspects of increased dental disease and a lack of absorption of certain trace minerals. Some advantages of replacing sugar with xylitol are a reduction of up to 40% of calories, a slow and steady release of energy, equivalent sweetness to sugar, reduction of dental disease, reduced craving for carbohydrates, and improved absorption of B-vitamins and calcium.

Osteoporosis

Xylitol also has potential as a treatment for osteoporosis. A group of Finnish researchers has found dietary xylitol prevents weakening of bones in laboratory rats, and actually improves bone density.

Ear and upper respiratory infections.

Studies have shown xylitol chewing gum can help prevent ear infections[26] (acute otitis media); the act of chewing and swallowing assists with the disposal of earwax and clearing the middle ear, while the presence of xylitol prevents the growth of bacteria in the eustachian tubes (auditory or pharyngotympanic tubes) which connect the nose and ear. When bacteria enter the

body, they adhere to the tissues using a variety of sugar complexes. The open nature of xylitol and its ability to form many different sugar-like structures appears to interfere with the ability of many bacteria to adhere. In a double-blind, randomized, controlled trial, saline solutions of xylitol significantly reduced the number of nasal coagulase-negative *Staphylococcus* bacteria. The researchers attributed the benefits to the increased effectiveness of endogenous (naturally present in the body) antimicrobial factors. In a small clinical trial nasally administered xylitol reduced ear complaints in children previously having chronic complaints, on the order of almost one a month, by more than 92%. The author also reported beneficial effects on asthma with nasal administration.

Infection

In rats, xylitol has been found to increase the activity of neutrophils, the white blood cells involved in fighting many bacteria. This effect seems to be quite broad, acting even in cases such as general sepsis.

Candida yeast

A recent report suggests consumption of xylitol may help control oral infections of *Candida* yeast; in contrast, galactose, glucose, and sucrose may increase proliferation.

Safety

Xylitol has no known toxicity in humans. In one study, the participants consumed a diet containing a monthly average of 1.5 kg of xylitol with a maximum daily intake of 430 g with no apparent ill effects. Like most sugar alcohols, it has a laxative effect because sugar alcohols are not fully broken down during digestion; albeit one-tenth the strength of sorbitol.[clarification needed] The effect depends upon the individual. In one study of 13 children, four experienced diarrhea when consuming over 65 grams per day. Studies have reported adaptation occurs after several weeks of consumption.

Dogs

Dogs that have ingested foods containing high levels of xylitol (greater than 100 milligrams of xylitol consumed per kilogram of bodyweight) have presented with low blood sugar (hypoglycemia), which can be life-threatening. Low blood sugar can result in a loss of coordination, depression, collapse and seizures in as soon as 30 minutes. Intake of very high doses of xylitol (greater than 500 – 1000 mg/kg bwt) has also been implicated in liver failure in dogs, which can be fatal.

These are points of controversy, however, as earlier World Health Organization studies using much higher doses on dogs for long periods showed no ill effect. A study published in the *Journal of Veterinary Pharmacology and Therapeutics* involved two groups of eight Pekingese dogs fed either 1 or 4 g/kg of xylitol. In addition to developing hypoglycemia, all of the dogs developed elevated levels of liver enzymes associated with liver damage. The dogs also developed reduced serum phosphorus and potassium, and increased serum calcium.

Medical Benefits of Xylitol

<http://www.xylitol.org/medical-benefits-of-xylitol>

Like sugar, except good for you

Although xylitol tastes and looks exactly like sugar, that is where the similarities end. Xylitol is like sugar, except good for you. While sugar wreaks havoc on the body, xylitol heals and repairs. It also builds immunity, protects against chronic disease and has anti-aging benefits.

Clearing the nasal passages

Research suggests significant benefits to using xylitol as a nasal spray. When infectious germs in the sinuses adhere to mucous membranes and nasal tissues, they can lead to infection and disease. The addition of precise amounts of xylitol to saline nasal spray makes it much more effective in moisturizing and clearing the nasal passages.

Since xylitol reduces the germs, pollutants and irritants from sticking to the tissue, regular use of xylitol nasal spray results in fewer respiratory infections and easier breathing. The concentration of xylitol stimulates our own defensive washing of the nose. Additionally, xylitol decreases the concentration of salt in the airway surface fluid which helps our own antibiotic substances there to be more effective—the problem with saline.

Preventing ear infections

In well controlled studies, doctors in Finland found that 8 grams of xylitol, taken orally every day, prevented about 40% of ear infections. Before bacteria can cause an infection they have to be able to attach to our body. Again, xylitol prevented the germs from sticking to the tissue.

Reducing intraocular pressure

The use of xylitol has been cited in a European patent for treating intraocular pressure – a condition that can develop into glaucoma, a serious disease that causes damage to the optic nerve. It has been reported that the use of a topical solution containing xylitol resulted in lower intraocular pressure. **Note:**

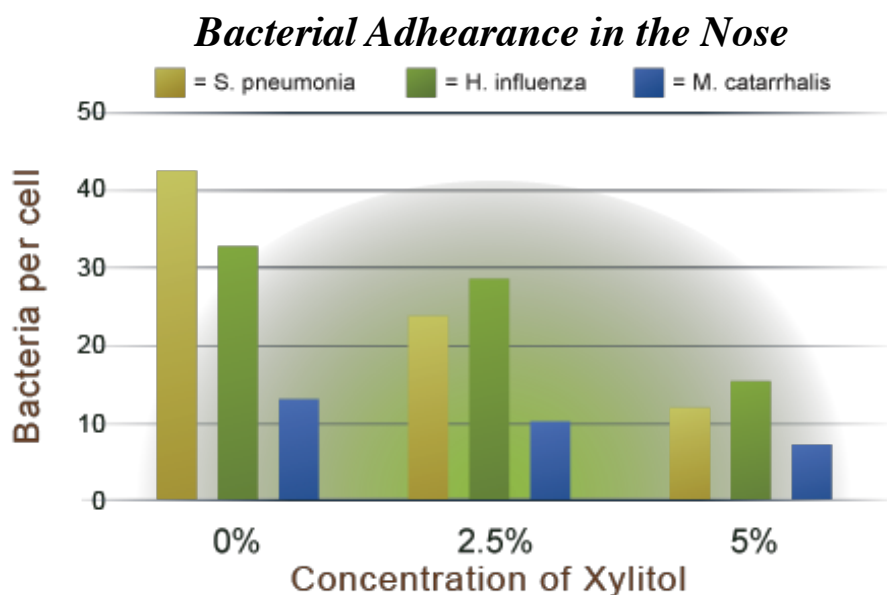
Xylitol is a food - not a drug; therefore, there are no label claims for any medical benefit on xylitol products.

Xylitol – Natural Health Benefits

Xylitol is a naturally-occurring carbohydrate (polyol) that has a 5-carbon structure – distinguishing it from other common sugars based on 6 carbons. This molecular difference is key to xylitol's benefits. While humans and other higher organisms have a metabolic pathway for using xylitol as an alternative energy source, many microorganisms (including many common pathogenic bacteria) do not. In fact, a number of studies have shown that besides being

unable to metabolize xylitol, xylitol actually interferes with bacteria's ability to adhere to body tissues (especially in the mouth and nasal passages). Furthermore, xylitol has the unique effect of diminishing bacteria's ability to produce biofilm – thereby making the bacteria more susceptible to antibiotic and natural immune system defenses.

Safety data on xylitol usage has been extensive. Initially discovered in the 1890's, xylitol wasn't the subject of intensive study until the late 1960's and early 1970's. Since then xylitol has remained a highly researched and studied ingredient. While much of the research has centered on xylitol's dental benefits, studies have also included the areas of diabetes (xylitol is metabolized in the human body independently of insulin levels); wound healing (especially due to its interference with biofilm formation); upper respiratory health (including sinusitis, prevention of otitis media, allergic rhinitis, etc.); calcium absorption; and even atopic dermatitis.



Xylitol and Diabetic Usage

Xylitol has been used in a number of countries as an effective sugar substitute – it can satisfy the sugar cravings experienced by many patients, especially newly diagnosed diabetic patients struggling to control sugar in their diets. While fully replacing regular sugar and/or glucose sources with xylitol will take some time to build up tolerance, xylitol has the advantage of avoiding "sugar spikes" and can replace sugar on a 1:1 basis – simplifying usage. Xylitol has even been used in parenteral IV applications in hospital settings as a replacement to normal glucose drips.

Xylitol and Biofilm formation/wound healing

A recent area of study that has emerged from the attempt to discover the mechanism for xylitol's efficacy in dental health, xylitol was noted for significantly reducing the ability of *Strep. mutans* bacteria to produce plaque biofilm. Subsequent studies have proven xylitol's usefulness in promoting wound-healing and interruption of bacterial colonies from producing biofilm that untreated led to antibiotic resistance and uncontrolled *Staph. aureus* infections.

Xylitol and Upper Respiratory Health

While xylitol's efficacy against *Strep. mutans* in the oral cavity has been the subject of numerous studies, there have also been several looking at xylitol's effectiveness against a closely related species, *Strep. pneumoniae*, the major pathogen in both sinusitis and otitis media. While their normal treatment is antibiotics, the research on xylitol suggests a new dimension for prevention and treatment without the concern about antibiotic resistance and the overuse or inappropriate usage of medications--it's like soap for the nose.

<http://www.xylitol.org/>

<http://store.xylitolusa.com/1lb-diabetic-delight-birch-xylitol-1lb-organic-coconut-palm-sugar/>

[Bulk Xylitol | Xylitol Sweetener](#)

<http://store.xylitolusa.com/categories/Xylitol-Sweetener/>

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[http://www.vitacost.com/productResults.aspx?x=0&y=0&ntk=products&ss=1&Ntt=Xlear
%20XyloSweet](http://www.vitacost.com/productResults.aspx?x=0&y=0&ntk=products&ss=1&Ntt=Xlear%20XyloSweet)

<http://www.amazon.com/The-Sweet-Miracle-Xylitol-All-Natural/dp/1591200385>

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<http://www.thexylitoldepot.com/>

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<http://askdrellie.blogspot.com/2006/12/xylitol-and-diabetes.html>

<http://www.sweetxylitol.net/Diabetes.html>