

Xylitol: A Sweetener with Special Qualities

Anil Lachke

Artificial sweeteners are making deeper inroads into the area of confectioneries, health foods, sugar free products for diabetics and many other food products. There is a great structural variation among sweeteners, and it has not been possible to predict whether a particular structural feature in a molecule is responsible for the sweetness. Saccharin, cyclamates, aspartame are some of the important synthetic sweeteners which are many times sweeter than the age old sugar. However, since many of them cause serous side effects there is a need to develop safer sweetening agents. The present article describes a newer compound Xylitol that is useful as a sweetening agent.

According to Chinese wisdom, sweetness is one of the flavours necessary for maintaining balance in the body. Xylitol (*Figure 1a*) is a naturally occurring sweetener. It is a sugar alcohol present sparingly in varieties of plants, fruits and vegetables. Sugar alcohols having five or six carbon atoms occur in plants. Mannitol (*Figure 1b*) is a constituent of brown algae, and sorbitol (*Figure 1c*) is found in apple, pear and peach. Only a few

Key words

Sugar alcohol, xylitol, natural sweetener, microbial conversion.

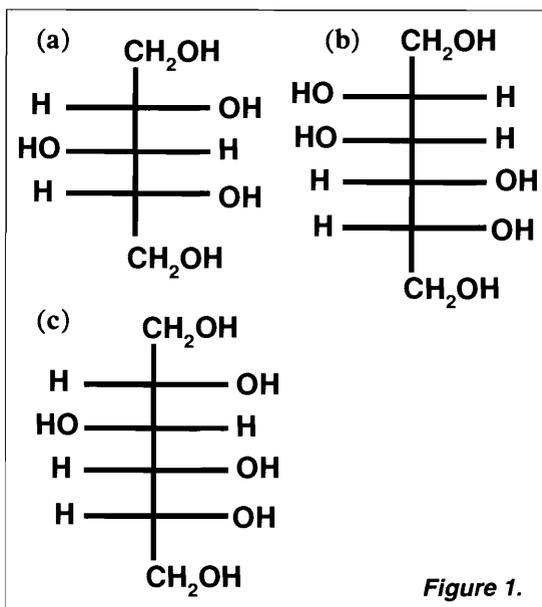


Figure 1.

berries contain xylitol in milligramme quantities (*Table 1*). In human body, xylitol is formed as a normal intermediate of glucose metabolism in amounts of about 5-15 g per day.

The immediate precursor in the production of xylitol is D-xylose – a pentose sugar. Sugar alcohols are strictly not carbohydrates. They are considered along with carbohydrates because they have a similar polyhydroxyl structure and chemical properties. Xylitol is an optically inactive five-carbon sugar alcohol.

Table 1. Amount of xylitol in some berries.

Berries	Xylitol mg/100g
Rowanberry	8.1
Blackcurrant	7.0
Raspberry	2.6
Cranberry	2.1

Sugar or sugar alcohol	Relative sweetness
Sucrose	1.4
Xylose	0.7
Xylitol	1.9
Arabinose	1.0
Arabitol	0.7
Lactose	0.7
Maltose	0.5
Galactose	0.7
Sorbitol	0.7
Fructose	2.0

Table 2. Relative sweetness of sugars and sugar alcohols (equal weight % concentration)

The relative sweetness of a few sugars and sugar alcohols is given in Table 2.

D-Xylose can be obtained in varying yields from the hydrolysis of xylose containing xylans (hemicelluloses). Agricultural waste materials such as coconut shell, corncob, wood chips and seed hulls are rich in hemicelluloses. These materials can be hydrolyzed using 1% H_2SO_4 at 100-130°C. The hydrolysate contains pentoses and products such as formic acid, acetic acid and furfural.

During World War II, Finland which suffered acute sugar shortage could successfully prepare xylitol from birch wood for use as an alternative to common sugar. Xylose is reduced to xylitol at elevated temperatures (100-150 °C) and high hydrogen pressure (50 atmosphere) in presence of catalysts like Raney nickel. Xylitol is obtained in 50-60% yield from the total

xylan content of the wood. Xylitol can also be produced as a by-product in microbial fermentation.

Many yeasts and fungi possess NADPH-linked D-xylose reductase which catalyses the reduction of D-xylose to xylitol in D-xylose metabolism. *Candida* species are excellent organisms for xylitol production studies.

Xylitol is incompletely absorbed from the digestive tract by passive diffusion. The absorbed xylitol is metabolized mainly in the liver, producing an almost identical amount of energy as is obtained from oxidation of glucose. The non-absorbed fraction reaches the large intestine, where xylitol is degraded by specific microbes to absorbable, short chain fatty acids.

Applications of Xylitol

Xylitol is used as a bulk sweetener mainly in non-carcinogenic confectionary and in oral hygiene preparations like toothpaste and mouth wash. Unlike sorbitol and mannitol, xylitol is not metabolized by *Streptococcus mutans*, a key microorganism in human dental caries. It is less frequently used in food products for diabetics, pharmaceutical preparations, throat lozenges, multivitamin tablets and cough syrups. Over 25 years of testing has confirmed that xylitol is the best sweetener for teeth. Xylitol stabilizes insulin and other hormone levels, and promotes good health. The only discomfort that some sensitive people may notice initially when

taking large amounts of xylitol is diarrhea or slight cramping. Xylitol inhibits the growth of *Streptococcus pneumoniae*. It also inhibits the attachment of both *pneumococci* and *Haemophilus influenzae* on the nasopharyngeal cells. Major cause of ear infection is *Streptococcus* sp. A group of Finland scientists has found that dietary xylitol prevents

weakening of bones in laboratory rats, and actually improves the bone density. (*Metabolism* 51.1 92-96, 2002).

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