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Topical, Annotated Xylitol References

Books


Proceedings of symposium held in Hakone, Japan August 27-29, 1967. Includes information about xylitol before major dental benefits were demonstrated.


Xylitol featured in several sections including: Sugars in foods, recent technological developments, digestion and absorption of sugars, metabolism of sugars, diabetes, therapeutic use of sugars, and sugars in the oral cavity.


The classic series of investigations which revealed the remarkable potential of xylitol.


This monograph details virtually all xylitol-related research published before 1978 on dental caries, oral microbiology, human physiology, and animal and human nutrition.


Contains interesting background “discussions” including insights into the original xylitol programs.


“*S. mutans* and *L. casei* can ferment sorbitol and mannitol (sweeteners in sugar-free gum) but are inactive towards xylitol. Xylitol is comparable to sucrose in sweetness and has been shown to be noncariogenic, possibly anticariogenic.”


“Clearly, xylitol exhibits more dental benefits than any other sweetener.

We are talking about xylitol not as a sole preventive agent but as an agent used in conjunction with available preventive services.”


Includes sections on dental considerations and xylitol in caries limitation.

General information about sugar substitution along with some specific topics such as sweeteners in children’s medications, mostly from the British and European regulatory perspective.


See chapters 8-10.


“There is no doubt that xylitol is the most expensive sweetener (about ten times more expensive than sucrose).”


Focuses on dental aspects of sugars and sweeteners with practical consumer advice on xylitol use.


“The reduction of caries prevalence in Finnish children is not likely to be fully explained exclusively in terms of fluorides and improved oral hygiene. In Finland, the widespread use of xylitol as a sweetener may have been a factor in the improvement of dental health.”


Contains sections on individual sweeteners, including xylitol, and potential mixed sweetener blends with xylitol.


Cookbook utilizes xylitol in recipes.


Provides overview for dental and upper respiratory benefits of xylitol.


Describes xylitol as a healthy sugar alternative; provides suggested uses with recipes.


“Xylitol” section by M. Bond and N. Dunning, pp. 295-317.


“The first step my preventive program involves getting rid of damaging mouth bacteria by using xylitol.”

L. Jones, *No more allergies, asthma, or sinus infections… The revolutionary approach to eliminating upper respiratory problems without drugs* Freedom Press, 2010.
“Xylitol is like soap for the nose, and a soap that can be used regularly and easily.”

**General and Review Articles**


“They (xylose and xylitol) known effects in prevention, maintenance, and therapy of a variety of pathologic conditions could prove them unique among the rest of the dietary carbohydrates. …To this end (xylose or xylitol) with other carbohydrates may be superior to the current refined dietetic sugars.”


Describes xylitol’s role in reducing demineralization and enhancing remineralization.


“Xylitol may be regarded as the best of all nutritive sugar substitutes with respect to caries prevention. It is concluded that partial sugar substitution by xylitol is a powerful tool in preventing caries and should be considered together with fluoridation and oral hygiene measures as an equally important factor in the maintenance of individual oral health.”


Xylitol has a favorable influence on all of the major factors involved in tooth decay.


There are no concerns with any harmful adaptations to long-term xylitol use.


“Chronic consumption of xylitol-sweetened chewing gum resulted in reduction of dental plaque, suppression of mutans streptococci, and reduced adhesiveness of plaque.”


Replacing sugar in foods with xylitol may lead to a reduction of dental caries.


“The literature not only supports the conclusion that xylitol is non-cariogenic but it is now strongly suggestive that xylitol is caries-inhibitory, that is, anti-cariogenic.”


“The aggregate caries increment may now be higher in the over-55 age group than in children.

The most promising dietary approach on the current scene is the use of the nonacidogenic sweetener xylitol. The evidence is accumulating that the benefits of xylitol extend beyond ‘does not promote tooth decay’ to acting as a cariostatic agent.”


“Essentially all clinical studies concerning the effect of xylitol on caries development consent to its non-cariogenicity and to the beneficial effect of substituting sucrose with xylitol in chewing gums and sweets. However, claims of anti-caries or therapeutic effects, and superiority of xylitol over other polyols are still to be confirmed by well designed and conducted studies from independent research groups.”


“Xylitol's antibacterial properties seem likely to lead to caries reductions superior to the more modest reductions with sorbitol gum.”


“Xylitol has a clear advantage over sorbitol and all other bulk and intense sweeteners. It is the only one to show both passive and active anti-caries effects.”


“Increasing interest in xylitol’s dental benefits provided the commercial incentive necessary for large-scale production” (which began in 1975 using birchwood as a source).


“These studies demonstrated a consistent decrease in dental caries, ranging from 30 to 60 percent, among subjects using sugar substitutes. The highest caries reductions were observed in subjects using xylitol.

Furthermore, since the evidence suggests a strong caries protective effect of xylitol, it would be unethical to deprive subjects of its potential benefits.”


“Although underutilized and often overlooked, xylitol use is compatible with and complementary to current oral hygiene recommendations. Xylitol is not a panacea, but is a practical and effective adjunct to “state of the art” caries prevention programs.”

Polyols are in general toothfriendly, low-glycemic, low-insulinemic, help reduce overall glycemic load, and contribute to healthy colonic environment and function.

This is the best article to find comparative glycemic discussions.


“Xylitol exhibits dental benefits which are superior to other polyols in all areas where polyols have been shown to have an effect.”


“Xylitol works very nicely in place of sugar to lightly sweeten tea and herbal teas, instantly creating an effective mouth rinse that is safe to swallow.”


“Xylitol can and does take the burden of biofilm reduction off the person with the teeth. Everyone can eat a couple pieces of candy a day, even if they cannot motivate themselves to brush and floss.”


Reduction of MS by xylitol is related to sufficient amount (6 to 10 grams per day), and with increasing frequency of administration (3 or more uses per day).


“The evidence is strong enough to support the regular use of xylitol-sweetened gum as a way to prevent caries, and it can be promoted as a public-health preventive measure.”


“Xylitol may not only be useful in caries reduction. New benefits are being discovered ranging from children with acute otitis media to elderly people with candidiasis.”


“The evidence suggests that sugar-free chewing gum has a caries-reducing effect.”


“The United States has been slow in realizing and promoting the benefits of xylitol as a supplement to brushing and flossing. Adding at least five grams of xylitol, five times daily is a good idea for everyone, not just those at risk of caries.”

“Xylitol-containing products gave elevated concentrations of xylitol in saliva and dental plaque for at least 8 minutes after intake. ...A 6g daily dose of xylitol reduced dental plaque and lactic acid production in saliva in schoolchildren after chewing for 4 weeks.”


“We conclude from our quantitative systematic review of the available research that there is consistent evidence to support the use of xylitol- and sorbitol-containing chewing gum as part of normal oral hygiene to prevent dental caries.” Xylitol gave the best results, followed by xylitol-sorbitol mixtures.


“Although research gaps exist, particularly on optimal dosing and relative polyol efficacy, there is consistent evidence to support the use of xylitol- and sorbitol-containing chewing gum as part of normal oral hygiene to prevent dental caries.”

It was noted that a sweetener blend of sorbitol and mannitol was not effective.


“Critical evaluation of the existing literature is a positive goal, but if it leads to a situation where no treatment guidelines can be given, something is wrong. This also applies to xylitol studies. ...Xylitol is a useful adjunct to traditional methods for caries control and prevention.”


“Xylitol was once only found in health food stores, however, it has become much more mainstream and is now readily available at retail outlets.”


“The scientific and clinical information available today indicates that habitual use of xylitol can be associated with significant reduction in the incidence of dental caries and with remineralization of both enamel and dentin caries lesions.”

**Acid**


Only minor subspecies of *L. salivarius* and *S. avium* were able to metabolize xylitol, and no tooth-damaging lactic acid was produced.

Xylitol had an inhibitory effect on acid production from sorbitol by MS or plaque.


“Xylitol inhibited the growth of all but one of ten strains of *S. mutans*. …However, the rate of acid production of the *S. mutans* strains was not equally affected by xylitol.”


Xylitol inhibits acid production when used alone or in mixtures with slowly fermentable carbohydrates like sorbitol or HSH.


100% xylitol-sweetened products without any added acids yield the best pH plaque response.


There was negligible acid production with aspartame, saccharine, or xylitol. Xylitol gave better results with increasing concentration.


After a sucrose rinse, xylitol gum users had oral pH that was significantly less acidic than no gum, sucrose gum or sorbitol gum chewers. Salivary stimulation was not responsible for the pH effects.


A 14-day use of xylitol gum (5 grams of xylitol per day) significantly reduced lactic acid concentration. Sorbitol gum had no effect.


Unsweetened wheat bread caused as much acid production as a sucrose solution; xylitol bread produced the least acid.

“The results indicated that wheat bread is fermentable by plaque bacteria. Addition of xylitol reduced the acid production from bread by about 30%.”


Aspartame, saccharin, acesulfame-K (high-intensity sweeteners) and xylitol were all non-acidogenic. Both sucrose and fructose were highly acidogenic.

All sugar-free gums helped reduce acid production after a sucrose sugar rinse. Xylitol gave the best response, followed by paraffin.


“Xylitol decreases the growth and acid production of mutans streptococci in the presence of various dietary sugars except fructose.”


Xylitol reduces acid production in different strains of *S. mutans* to different degrees by different biochemical mechanisms, such as disruption of glucose cell-wall transport or intracellular glycolysis.


Cell suspensions remained above pH 6 in the presence of xylitol. Glucose added to xylitol reduced the pH levels, but increased concentrations of xylitol did slow MS growth.

**Biofilm; Dental Plaque; Bacteria**


The xylitol group had a lower plaque index, 40% less plaque, and lower invertase plaque activity than the sucrose group.


Polysaccharide exposed to xylitol was more water-soluble and the structure was more amorphous and granular. This could make dental plaque looser and less adhesive.


“There was no adaptation to fermentation of xylitol after three months’ frequent consumption of the substance.”


Subjects using xylitol gum developed less plaque than those who chewed sucrose gum or a flavored gum base.

There was significantly less plaque in the xylitol group than the sucrose or plain gum base groups.


Xylitol gum chewers had less plaque and acid formation than other groups.


Xylitol caused distinct alterations in bacterial ultrastructure.


Suggests a buildup within plaque cells of xylitol metabolites inhibits glycolysis.


Demonstrates a “futile energy cycle” of MS phosphorylating, dephosphorylating and expelling xylitol, or having phosphorylated xylitol build up to toxic levels within MS cells.


Using xylitol chewing gum significantly lowered plaque weight and increased pH; sorbitol gum increased plaque weight and lowered pH.


In MS, the first step of xylitol metabolism is phosphorylation. The xylitol phosphate cannot be processed for energy by MS, so it builds up to toxic levels within the bacterial cell, or is expelled (as xylitol) back into the plaque.

In humans xylitol is first oxidized (dehydrogenated), and can be used for energy.


Uptake of xylitol by MS sets up a “futile metabolic cycle” that leads to depressed growth or even bacterial cell death.


“Our findings from three separate studies further support that administration of xylitol-containing chewing gum, in a manner consistent with practical use (3-5 times per day), can reduce plaque
accumulation (and) further underscores the importance of considering frequency of exposure to achieve an optimal result.

Both xylitol gums (stick and pellet) were superior to sorbitol gum in retarding plaque regrowth”


“The present study confirmed the SM inability to metabolize xylitol, even after a prolonged adaptative period.”


Detailed, comprehensive review of xylitol interactions with plaque bacteria.


Suggests that frequent gum chewing in itself is dentally beneficial – xylitol had no added effect on plaque deposits or acid production.


Xylitol helped to suppress the growth of *Streptococcus mutans* and *Lactobacillus rhamnosus* in a culture pulsed with glucose without pH control.


In some subjects the MS levels did not decrease after 4 weeks of xylitol use. However, the MS became more “xylitol-tolerant” which indicates that the cariogenic potential had decreased.


“Xylitol has a clear inhibitory effect on the formation of the experimental biofilms. This study shows that xylitol is not only efficient in inhibiting the acid production of cariogenic bacteria, but also in preventing the formation of a multispecies biofilm; it confirms the relevance of the use of this polyol for the prevention of oral diseases caused by dental plaque.”

“The regular consumption of xylitol lozenges modifies dental plaque, resulting in a marked reduction in the plaque acidogenicity, which could not be detected using sorbitol lozenges. Therefore, xylitol could have an additional benefit in caries prevention.”


Xylitol inhibits acid production, which helps to block selection for cariogenic bacteria.

“Xylitol can interfere with sugar transport in MS, and therefore cannot be metabolized to acid nor generate a low pH in plaque.”


“In the xylitol group, the colony counts of *S. mutans* decreased steadily over time. In addition, the adherence of the colonies in the xylitol group became weak, and the size of the colonies decreased compared to the control. The secretion of sticky substances from the surface of *S. mutans* colonies and *gfpB* gene expression also decreased in the xylitol group. These findings indicate that regular chewing of xylitol gum over a long period may lead to decreased *gfpB* expression, which can negatively affect the synthesis of extracellular polysaccharides by *S. mutans*, which could reduce the size and growth of *S. mutans* colonies and change their morphology as a result.”


Xylitol particularly inhibited the growth of *Pseudomonas aeruginosa*, one of the most important species in chronic wound biofilms.


“Both xylitol and erythritol can decrease polysaccharide-mediated cell adherence contributing to plaque accumulation through a mechanism not dependent on growth inhibition.”


Plaque counts and percentage of MS in plaque decreased in the xylitol group. MS appeared to be specifically targeted by xylitol during 4-week test period.

“By giving xylitol to operated patients, we can observe a normalization of the disturbances of glucose utilization, as well as an obviously reduced loss of nitrogen… Compared with sorbitol and fructose, xylitol utilization shows some advantages. The serum insulin values in healthy persons are not influenced by xylitol.”


Xylitol stimulates the synthesis of RNA and corticoids, which counteracts the inhibition of adrenal secretion caused by long-term steroid therapy.


Xylitol slows stomach emptying.


Xylitol delayed stomach emptying and decreased food intake.

“Our data suggest a role for xylitol as a potentially important agent in dietary control.”


“The bottom line is that xylitol is an anticatabolic sugar with potential applications to sports and athletic performance.”


“This ability of xylitol to keep blood glucose and insulin levels stable is crucial to muscle building. Recovery supplements that do not contain xylitol may well be considered obsolete.”


“All of these properties make xylitol an excellent addition to a nutritional supplement designed to help you lose body fat while maintaining or even increasing muscle.”


“The usefulness of xylitol and polydextrose as ingredients in functional foods for appetite control are as a result of their lower energy content and suppression of appetite.”

Bones


“Absorption-promoting effect of xylitol can perhaps be applied to mineral therapy.”


“These results suggest advantages in the use of xylitol in calcium supplements.”


**Candy**


Xylitol has approximately the same sweetness as sucrose sugar. Depending on the application, xylitol may seem slightly more or less sweet.

“To sweeten a cup of coffee, 13 grams of xylitol will be needed to replace 10 grams of sugar.”


“Xylitol can bring new value to sugar-free confections. The cariostatic advantage and sensorical properties of xylitol can enable confectioners to create dentally safe products with wider consumer appeal.”


Xylitol provides the highest dental benefit, sweetness and cooling effect. Xylitol can be combined with other ingredients to optimize manufacturing requirements, cost considerations, shelf stability, eating qualities and label claims.


Combining xylitol with a dimeric polyol such as maltitol or lactitol reduces the cooling effect, which would only be desirable in a mint chocolate.

“Xylitol provides several advantages as a sanding compound. In addition to enhancing the visual appeal of the product, the increased sweetness provided by xylitol helps to potentiate product flavor.”


Demonstrated that xylitol candy can be as effective as xylitol chewing gum, therefore the caries protection is not just a salivary effect from chewing.


Xylitol has some interesting properties that can result in greater stability for sensitive ingredients and thereby increased self life.


Xylitol is sweet enough to be used without the addition of artificial high-intensity sweeteners. The high cooling effect of xylitol can be used to enhance certain flavors.


Xylitol candy was used 3 times during the school day. “Xylitol seemed to have a strong preventive and a clear remineralizing effect on caries.” Relatively small amounts of xylitol cut caries rate in half.


In a six-week trial, *S. mutans/sobrinus* levels were reduced with three uses of xylitol gummy bears per day.


Study included children age 1-6 for 6 months duration. “These results suggest that a xylitol tablet may be an alternative to xylitol chewing gum for dental caries prevention.”

### Chewing Gum


“About 85% (n = 269) of the subjects who participated in the Ylivieska follow-up studies on the effect of xylitol chewing gum on dental caries during 1982–84 or 1982–85 were re-examined in 1987 for the analysis of possible long-term preventive effects. Further caries reduction was found 2 or 3 yr after the discontinuation of the use of xylitol. …In teeth erupting during the first year of the use of xylitol gum the long-term preventive effect was greater than in other teeth.”


“Those children who had used xylitol chewing gum regularly since 1982 showed significantly lower caries indices in 1988, including the proximal caries scores. The presence of MS in the proximal areas studied was significantly lower in habitual xylitol consumers.”


“The literature not only supports the conclusion that xylitol is non-cariogenic, but it is now strongly suggestive that xylitol is caries-inhibitory, that is, anti-cariogenic in human subjects, and it supplies reasonable mechanistic explanations.”


“The xylitol-consuming subjects (age 11-12) showed at the end of the study significantly smaller (p less than 0.004) salivary S. mutans counts than the control children. These effects were achieved after using up to 3 xylitol gums/day (daily xylitol dose per child was 7-10 g).”


“Xylitol chewing gum appears to have the ability to prolong the effect of chlorhexidine therapy on oral MS.” Without xylitol, pathogens quickly returned to baseline levels.

“Compliance was better in school C (xylitol gum) than in the other schools.”

Trial was conducted in Lithuania. The authors concluded that the caries preventive effect was due more to the chewing process than the ingredients in chewing gum.

C. Hayes, “Xylitol gum decreases the decayed, missing, and filled surfaces (DMFS) score over a 3-year period by an average of 1.9,” Evidence-Based Dental Practice, vol. 2, no. 1, pp. 14–15, 2002.

Statistical analysis of Machiulskiene (Lithuania trial) revealed that a caries preventive effect was indeed produced by xylitol use.


Both 55% and 100% xylitol-sweetened chewing gum use reduced MS in plaque (trial conducted in Thailand). Only the 100% xylitol gum also reduced MS in saliva.


“The evidence is strong enough to support the regular use of xylitol-sweetened gum as a way to prevent caries, and it can be promoted as a public-health preventive measure.”


In adults using chewing gum, xylitol at 6.4 to 10.3 grams per day reduced MS in plaque after 5 weeks, and in both saliva and plaque in 6 months, whereas 3.4 grams did not. It was suggested that two-thirds of the participants had been exposed to some xylitol in their diet, which could mask an effect at low levels.

“A plateau effect is suggested between 6.44 and 10.32 g xylitol/day.”


Frequency of daily xylitol exposures is important. The reduction of MS in adults increased in a linear fashion with 2, 3 and 4 uses per day. Unlike the previous dose study, there was no plateau effect, suggesting that there was still room for improvement.


“Results clearly suggest that compliance, and possibly acceptance, were superior for xylitol chewing gum.”
A. Trummler, W. Strübig, “Beeinflussung verschiedener speichelparameters nach täglicher

Xylitol gum was more effective in reducing MS than sorbitol-mannitol gum.

health interventions,” *Journal of the American Dental Association*, vol. 139, no. 5, pp. 553–
563, 2008.


Cosmetic

novel method to control the balance of skin microflora,” *Journal of Dermatological

“This study provides evidence supporting a cream containing xylitol as a useful skin-care agent for
atopic dry skin colonized by *Staphylococcus aureus*, a bacteria that can worsen atopic dermatitis
(AD).”

P. T. Mattila, P. Pelkonen, M. L.E. Knuuttila, “Effects of a long term dietary supplementation
on the collagen content and fluorescence of the skin in aged rats” *Gerontology* vol. 51, no. 3,

Dietary xylitol has been shown to increase the amounts of newly synthesized collagen, and to
decrease cross-linked collagen. Dietary xylitol supplementation may protect against some
degenerative changes during aging.

J. N. Peldyak, L. W. Bybee, E. Johnson, L.R. Misner, “Practical application of xylitol in

“Unsightly white spot lesions, fluorosis and other staining can be cosmetically improved with a
xylitol mineralizing solution (~35% xylitol plus calcium glycerophosphate.)”

Dental Caries (Tooth Decay)

A. Scheinin, “Xylitol: An update – Will it be the sugar alternative of the future?” *Oral Health*

“The real basis for the sugar-caries ratio—the frequency of sugar intake between meals in solid
form—is much more important than overall consumption.”

A. Scheinin, “Xylitol: An update – Recent studies, indications,” *Oral Health* vol. 71, no. 8,
pp. 43-46, August 1981.
“I have never seen as many cases of rampant caries as I saw in French Polynesia… Once an extraction has been performed, the patient takes the extracted tooth and, as a revenge for the pain he has suffered, smashes it with a hammer.”


“Attempts toward reduction of the use of sucrose should be aimed at products found particularly cariogenic.” Xylitol appears to reduce caries in a dose-dependent manner.


“Mere sucrose restriction without suggesting alternatives does not take into account human behavior. Complete prevention should always include the use of sucrose substitutes.

Ideal xylitol products include chewing gums, sweet snacks, dentifrices, lozenges, chewable tablets and sweetened medicines.”


“The caries-preventive effect of xylitol is both dose- and concentration-dependent.”


“The most impressive results have been achieved when a xylitol program has been added to existing prevention efforts.”


“There is sufficient evidence for clinicians to consider including xylitol-containing products in their clinical armamentarium for the prevention of dental decay in high-risk populations.”


“The consumption of xylitol-containing foods will significantly reduce the incidence of dental caries.”


“Sufficient evidence exists to support the use of xylitol to reduce caries. Clinicians and dental associations should push for clear recommendations of efficacious dose and frequency of xylitol use and for clear labeling of xylitol content in products to help consumers choose appropriately.”

“Xylitol must not represent a single preventive strategy but should be considered as an auxiliary agent mainly used when the mechanical control of dental biofilm is unsatisfactory and insufficient to avoid the development of dental caries lesions.”

Diabetes


Up to 60 grams of xylitol per day had no adverse effects on diabetic patients.


Ingestion of 50 grams of xylitol caused only a marginal increase of blood sugar.


“Xylitol produces benefits to the metabolic disorders in diabetes.”


30 grams of xylitol per day was well tolerated by children with Type 1 diabetes.


“(Fructose, xylitol, sorbitol) have been used extensively as sucrose or glucose substitutes in diabetic diets in several Western European countries and provide some theoretical advantages in dietary management.”

The review paper goes on to be somewhat dismissive of the practicality of sugar substitution with bulk sweeteners. It raises alarms about the safety of xylitol in some animals (which have been addressed subsequently), stating “If the association between xylitol and tumor induction is confirmed, it is likely that xylitol will be banned.”


“These results indicate that fructose, sorbitol, and xylitol are oxidized at a higher rate than glucose during suppression of endogenous insulin secretion, without any significant rise in glycemia.”


“No significant side effects have been demonstrated with ingestion of modest amounts of oral xylitol in normal individuals or treated diabetic patients.”

Insulin requirement after sucrose was significantly higher than after xylitol (30 grams with mixed meals). There were no side effects with 30 grams of xylitol incorporated into breakfast.

“Sucrose, in contrast, induced a greater post-prandial rise in blood glucose levels despite counter-regulation by the glucose-controlled insulin infusion system.”


70 grams of xylitol per day caused no adverse reactions.


“Xylitol offers considerable advantages as a sweetener in the diabetic diet.”


Xylitol can help in the dietary management of diabetes.


“We conclude that a patient with type II diabetes may benefit from replacing glucose and glucose equivalents with… xylitol.”


“The small glucose and insulin responses also suggest that lactitol and xylitol are suitable components of the diet for diabetic patients.”


Xylitol is partly absorbed and metabolized and is in the “very low” glycemic category.

“A low-glycemic diet may lead to lower insulin levels, to a reduced insulin demand, to improved blood glucose control and reduced blood lipid levels.”

**Dry Mouth (Xerostomia)**


Xylitol increases salivary secretion rate and decreases feeling of dry mouth.
Economics and Public Health


“There seems to be potential for positive health promotion by means of this type of xylitol campaign.”


“After 5 years, no statistically significant differences between the sealant and xylitol groups were found.”


“Following the publication of the first results, the dental circles divided into two schools: some colleagues readily accepted the “xylitol concept” while others were more reserved.”


“Distributing gum or candy to children is inherently low-tech. The xylitol research is significant because a low-cost, quickly implementable caries prevention strategy that can circumvent barriers could lessen oral health disparities in the United States.”


“In conclusion, xylitol can be presented in many forms such as chewing gums, tablets, mouthrinses, and associated to fluoride in toothpastes. Its anticariogenic power is due to the impairment of growth of cariogenic bacteria and consequent reduction in the acidity of plaque. Besides, it helps in the remineralization of initial carious lesions, is specific to S. mutans, well accepted by children and may be used with beneficial effects in all ages.”


“Steps to develop effective alternative vehicles for the delivery of xylitol particularly useful for young children and institutional settings in America are explored.”

The results from economical point of view seem to be promising if xylitol is used before and around the eruption of teeth, and maybe even better if the aim of the programme is to prevent the colonization of SM in the mouth of early childhood.”


**Field Trials**


Xylitol only replaced about half the usual candy. The xylitol group had a 73% reduction in caries, and the decay they did have was much less severe.


Preventive effect was seen with a fluoride chewing gum sweetened with xylitol and sorbitol. All children received same basic fluoride prevention.


This large trial was conducted in Belize, Central America, between 1989-1993 to compare caries rates in groups using chewing gum sweetened with sugar, sorbitol, xylitol, or sorbitol/xylitol mixture. There was also a no-gum group. The caries rates were: sugar>no gum>sorbitol>sorbitol/xylitol mix>xylitol.


This trial was conducted in the Stann Creek district of Belize, Central America, with a population high sugar consumption and high caries rates. There were 7 groups using chewing gums sweetened with sorbitol, xylitol or combinations—the best results were obtained with 100% xylitol pellet gum.


Xylitol improved periodontal health and reduced root surface caries in an elderly population.


In a series of studies, xylitol demonstrated more dental benefits than typical sugar or sorbitol sweetened products.


“Long-term use of xylitol chewing gum had an inhibitory effect on mutans streptococci in saliva and dental plaque, and on saliva lactobacilli.”


Nearly 500 children (age 11-12) in Finland participated. “Using a regimen that includes multiple measures (including xylitol) for preventing dental decay, caries increment can be significantly reduced among caries-active children living in an area where the overall level of caries experience is low.”


Some interventions such as xylitol and fluoride may have long-lasting effects which can confound results of cross-over study designs.

**Fluoride**


Xylitol and fluoride have an additive preventive effect.


Lower concentrations of fluoride and chlorhexidine can be used when combined with xylitol.


“Xylitol can augment the metabolic effects on S. mutans of low levels of fluoride.”


“Xylitol inhibited the upper part of the glycolytic pathway, while fluoride inhibited the lower part. This study indicates that fluoride and xylitol together have synergistic inhibitory effects on the acid
production of mutans streptococci and suggests that xylitol has the potential to enhance inhibitory effects of low concentrations of fluoride.”


This Russian model predicts optimal use of xylitol with fluoride combinations.


“It was concluded that xylitol and fluoride have an additive effect in the reduction of dental erosion by pure orange juice in vitro.”


“This study demonstrated that addition of xylitol, fluoride or a xylitol/fluoride combination to an acidic drink or post-treatment with fluoride or a xylitol/fluoride combination could reduce, but not prevent, enamel erosion.”

**Fungus (Yeast)**


There was a slight inhibition of growth on glucose of three oral strains of *Candida albicans* in the presence of xylitol.


Xylitol inhibited the growth of *Klebsiella aerogenes* cultured on xylose.


“The ability to convert D-xylose to ethanol under these conditions is probably common among yeasts. Growth under the same conditions on xylitol, led to only traces of ethanol.”


Buildup of intracellular xylitol catabolites caused cell swelling and weakening in *C. albicans*.


“Xylitol and glucose have different effects on the GI microflora.” Xylitol caused a shift to a simpler, more gram-positive flora. Glucose led to higher rates of candida growth and invasion.
“It (xylitol) may therefore constitute a suitable carbohydrate for use in immunocompromised patients during periods of high risk for mucositis or candidemia.”


Yeast cultured in sucrose developed more resistance than those cultured in xylitol.


“These strains (of Candida albicans) were found to be positive for glucose, galactose, maltose, saccharose, and raffinose, but they were negative for 2-keto-D-gluconate, arabinose, xylose, adonitol, xylitol, inositol, sorbitol, N-acetyl-D-glucosamine, cellobiose, and lactose assimilation tests.”


“C. albicans grown in galactose elicited maximal increase in adhesion followed by glucose and sucrose. Maltose and fructose also promoted adherence of Candida.

Xylitol significantly reduced adherence of Candida to BECs.

The dietary carbohydrates, therefore, might represent a risk factor for oral candidosis. The limitation of their consumption by substituting xylitol could be of value in the control of oral Candida colonization and infection.”


Sugar alcohols, especially erythritol, enhanced the fungicidal effect of BTC toward in vitro candidal biofilms.

Intravenous (Infusion Therapy, Parenteral Nutrition)


Mixtures of carbohydrates (including xylitol) have some advantages in IV (intravenous) nutrition over pure glucose.


“Xylitol may have special pharmacologic properties during trauma or sepsis.

Partial replacement of glucose calories with xylitol may result in an overall better utilization of nutrients.”

“Maximal glucose utilization is reduced during such states (trauma and sepsis), while the utilization of xylitol is more than doubled.”


“AFTER trauma (first 4 days) xylitol is superior to glucose with regard to oxidative metabolism and stimulation of visceral protein synthesis.” Comparable favorable long-term results were obtained with a 1:1 glucose:xylitol mixture.


“Blood glucose and insulin levels were significantly lower in the xylitol:glucose group.”


Xylitol blocked functional hepatic nitrogen clearance (FHNC) related to elevated glucagons levels.

“The mechanism whereby xylitol reduces nitrogen loss (muscle wasting) in stress metabolic conditions with hyperglucagonemia involves an effect on liver metabolism.”

**Long-Term Protection**


“Further caries reduction was found 2 or 3 years after discontinuation of xylitol.”


“Xylitol reduced the likelihood of subjects’ developing caries in the five-year time period after they chewed the last experimental gum. When teeth erupted during the second year of habitual xylitol gum-chewing, the long-term caries risk reduction was 93%.”


“The presence of MS colonization in children at the age of 2 years was significantly related to each child's age at the first caries attack in the primary dentition. In children at the age of 5 years, the dentinal caries (dmf) in the xylitol group was reduced by about 70% as compared with that in the fluoride or chlorhexidine group. We conclude that maternal use of xylitol chewing gum can prevent dental caries in their children by prohibiting the transmission of MS from mother to child.”

“The earlier demonstrated, xylitol-associated reduction in the probability of mother-child transmission of MS was still found in the children's MS counts at the age of 3 and 6 years.”


“The present study demonstrated that chewing xylitol gum for 6 months continued to inhibit the growth of mutans streptococci in adults.”

The group that used maltitol sugar-free gum had increased levels of MS in plaque.


“So, the use of xylitol induced a reduction in MS salivary levels after a short period of usage which persisted beyond its interruption.”


“Polyol-based chewing gums have a long-term effect on caries prevalence in children with a xylitol-containing gum being most effective.”

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**Medical Uses – Other**


Xylitol helps keep the antioxidant glutathione in its active (reduced) form.


Xylitol has a stimulating effect on digestive enzymes.


Xylitol can help compensate for enzyme deficiency (glucose-6-phosphate dehydrogenase deficiency) by generating NADPH. This reduces red blood cell destruction in certain hemolytic anemias.


Ribose sugar and xylitol generate energy molecules in heart muscle.

“Xylitol was administered in an attempt to normalize the functions of the sinus node and the A-V junction, and brought about a satisfactory result. It is, therefore, suggested that xylitol should be kept in mind for the treatment of cardiac arrhythmias during anesthesia.”


Xylitol used as an adjunct in gastric ulcer therapy.


Xylitol helps protect red blood cell membranes.


Added xylitol improves blood storage methods.


Single oral administration of xylitol increased the auditory threshold values of patients with Meniere’s disease.


Myoadenylate deaminase deficiency is an inherited disease (relatively common but most are not symptomatic) caused by lack of an enzyme used to recycle the energy molecule ATP. MAD is characterized by exercise intolerance, muscle weakness, cramps and soreness. One treatment is to provide the 5-carbon sugar D-ribose. In this trial, 20 grams of xylitol per day resolved the symptoms at a lower cost than ribose (xylitol is a metabolic precursor of ribose).

P. Naaber, E. Lehto, S. Salminen, M. Mikelsaar, “Inhibition of adhesion of Clostridium difficile to caco-2 cells,” FEMS Immunology and Medical Microbiology vol. 14, no. 4, pp. 205-209, 1996.

Xylitol helped to inhibit adherence of Clostridium difficile, which is potentially useful for the prevention and treatment of pseudomembranous colitis (antibiotic-associated diarrhea).


B. L. Horecker, K. Lang, Y. Takagi (eds), Springer-Verlag, Berlin, 1969.

In the small intestine, xylitol is absorbed more slowly than other sugars.


“Since the conversion to glucose proceeds smoothly with no abrupt effects in the blood glucose level and insulin secretion, xylitol instead of sucrose in the diabetic makes metabolic control easier. In starvation, diabetes and stress situations, xylitol has a normalizing effect on fat metabolism.”


Collects, reviews and discusses possible concerns with metabolic effects of high-dose xylitol, based on Australian reports of toxicity from parenteral administration. Nine studies were reported as delivered or designed at a meeting held January 24-25 in Basel, Switzerland.

In general, it was concluded that xylitol is safe for peroral human consumption, and more definitive guidelines should be developed for parenteral administration.


“In conclusion, an assessment of the effects of high-dose xylitol administration on urinary risk factors for urolithiasis indicates that the observed changes were marginal and devoid of clinical significance.”

**Mother and Baby**


Describes time-release xylitol via pacifier.

Mothers used xylitol gum from 3 to 24 months after delivery. Control groups received either fluoride or chlorhexidine varnishes on a regular schedule. MS colonization in the children was five-fold higher in the fluoride group, and three-fold higher in the Chlorhexidine group compared to the xylitol group.

Mothers who use xylitol gum are less likely to transmit harmful MS bacteria to their children.


At the age of 5 years, the caries rate was 70% lower in the xylitol than the fluoride or chlorhexidine groups.


Use of a novel “fall asleep pacifier” delivering time-release fluoride, xylitol and sorbitol significantly reduced MS colonization and caries in children.


“Maternal consumption of xylitol- and chlorhexidine/xylitol-containing chewing gums significantly reduced the mother-child transmission of salivary mutans streptococci.”

It is important to note that in this trial in Sweden, all the groups of mothers used chewing gum from child age 6 months to 18 months. The amount of xylitol was rather low, but still showed a positive benefit for the pure xylitol group. Children of high-risk mothers who used 100% xylitol gum had MS colonization rates similar to the low-risk group.


“Less caries was observed in children of mothers who chewed gums with xylitol as the single sweetener during the time of eruption of the first primary teeth compared with those who used gums containing fluoride, sorbitol and lower amounts of xylitol.”


Follow-ups at age 6 and 10 continued to show lower MS counts in the xylitol group compared with the fluoride and chlorhexidine groups, along with significantly less need for restorative dental treatment.


“Xylitol was effective as an additional caries preventive procedure in pregnant women.”

Preference for the sweet taste appears to be innate and related to growth.


This study found an association between mother food-tasting and MS colonization. The xylitol effects were not considered significant. Xylitol use was limited to 6 and 9 months.


Xylitol syrup squirted on teeth (8 grams at least twice per day) was effective in reducing early childhood caries by up to 70%.


Xylitol syrup is likely to be effective in populations with high caries rates.


Maternal gum chewing began in the sixth month of pregnancy and ended 13 months later. The children of mothers in the xylitol group had significantly less colonization or at least delayed colonization by MS than the control group.

“In summary, xylitol gum chewing… starting at pregnancy, significantly reduced mother-child transmission of MS in this Japanese population.”


“The ten-year follow-up suggested that the results of the Ylivieska (Finland) mother-child study had not been temporary and that the prevention of MS transmission (with xylitol) in assumed high-risk families can be economically reasonable.”

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**Nose and Ear; Upper Respiratory**


Xylitol markedly inhibited the growth of alpha-hemolytic streptococci.

“With the increasing appearance of antimicrobial resistance, alternatives are needed to prevent bacterial diseases. We found xylitol to be a promising new product, effective in syrup and chewing gums, for preventing acute otitis media (AOM) in children.”


Xylitol chewing gum reduced the occurrence of otitis media by 40%.


Xylitol reduces the adherence of *Streptococcus pneumoniae* and *Hemophilus influenzae* to epithelial cells.


“Xylitol may be of value in enhancing the innate antimicrobial defense at the airway surface.”


Xylitol solutions of 5 to 7.5 grams were well tolerated by toddlers aged 6 to 36 months.


Only about half of the pediatricians surveyed knew about medical uses of xylitol. “Future research should focus on prevention and the use of xylitol as a possible prophylaxis regimen for Acute Otitis Media in patients.”

**Orthodontics**

Xylitol helps prevent damage to teeth and gums during fixed orthodontic treatment.


100% xylitol-sweetened gum yielded the best results in reducing plaque and MS in young patients wearing fixed orthodontic appliances (braces).


Xylitol in tablets was used at a low dose of 1.7 or 3.4 g/day for 18 weeks. There were no changes in MS counts in plaque or saliva.

“The lactic acid formation rates decreased slightly (approximately 10%) in the two xylitol groups compared with baseline.”


“The use of a xylitol lozenge after a sucrose challenge can be an advisable practice for fixed orthodontic patients to prevent future dental caries.”

Periodontal (Gum) Disease


There was less inflammation with xylitol users.


There was less gingival bleeding with xylitol.


“The inflammatory potential of dental plaque may be reduced during xylitol consumption as compared to sucrose consumption.”

Xylitol plaque was less irritating for macrophages and bones than sucrose plaque.


Sucrose rinse was the most irritating for bone.


“The total carbohydrate content was significantly lower in plaque obtained from the xylitol and cyclamate groups than in plaque obtained from the sucrose group. Rinsing with xylitol solution resulted in a higher plaque calcium level than with the two other sweeteners.”


Xylitol plaque was less inflammatory than sucrose plaque.


Along with reductions in occurrence of root surface caries, xylitol use also improved gingival health.

S. J. Han, S. Y. Jeong, Y. J. Nam, K. H. Yang, H. S. Lim, J. Chung, “Xylitol inhibits inflammatory cytokine expression induced by lipopolysaccharide from Porphyromonas gingivalis,” *Clinical and Diagnostic Laboratory Immunology*, vol. 12, no. 11, pp. 1285–1291, 2005.

“Taken together, these findings suggest that xylitol may have good clinical effect not only for caries but also for periodontitis by its inhibitory effect on the LPS-induced inflammatory cytokine expression.” This Korean study also showed that xylitol inhibits the growth of *P. gingivalis*, an important periodontal pathogen.


Plaque and Gingival Index scores were significantly improved with the three uses of xylitol candy during school days.

“These overall findings of beneficial effects of xylitol-based protocols on periodontal parameters corroborate our findings.

We have demonstrated that a combined treatment consisting of xylitol gum/chlorhexidine- and fluoride- varnish was moderately superior on periodontal parameters of mothers. Similar results were found for (their) infants.”


Use of probiotic/xylitol tablets for 2 and 4 weeks showed improvement in halitosis and gingival bleeding upon probing.


Participants, at least 60 years old, who chewed xylitol gum twice a day for 6 months demonstrated significant improvements in Plaque and Gingival Index scores over the control group.

**Regulatory and Endorsements**


“These ‘cariostatic” effects make xylitol the best sugar substitute for chewing gum, children’s medications, and, perhaps, a variety of other sweetened products.”


“Public policy recommendations regarding dental benefits of such (xylitol) products should be allowed and manufacturers permitted to make scientifically-supported promotional health claims in package labeling and media advertising.”


Typical approved statement: “The Finnish Dental Association recommends the use of xylitol.”


“The American Academy of Pediatric Dentistry (AAPD) recognizes the benefits of caries preventive strategies involving sugar substitutes, particularly xylitol, on the oral health of infants, children, adolescents, and persons with special health care needs.”
Remineralization


More than twice as many xylitol as sucrose molecules diffuse through dental enamel.


“Whereas the more soluble Ca(II) compounds (like CaSO\textsubscript{4}) exerted measurable complexation with xylitol, no such complexation was found with hydroxyapatite and enamel powder. … Through the retarding effect on calcium phosphate precipitation, alditols may favorably govern remineralization of carious lesions.”


Mineral loss in enamel was about three times higher with sucrose than xylitol.


Chewing sorbitol or sorbitol/xylitol gum for 20 minutes after meals and snacks stimulated remineralization by salivary means.


Exposure to xylitol (20 grams per day in candy) resulted in pronounced rehardening.


This 25-day study suggested a concentration response with xylitol.

“The pH drop in plaque, measured in vivo after a 1-min mouthrinse with a 10% sorbitol solution, was least pronounced after the 70% xylitol gum and most pronounced after the 70% sorbitol gum period.”

These observations are from the chewing gums field trials carried out in Belize.

“The usage of 100 per cent xylitol pellet-shaped gum was more frequently associated with arrest of dentine caries than other treatments. … High-xylitol chewing gum usage can retard or arrest even rampant caries.”


Primary teeth with dentin caries that remineralized during xylitol use were examined by electron microscope and for microhardness. “The rehardened surface layer (normally <0.1 mm in thickness) was significantly harder than sound dentin and nearly as hard as sound enamel.”


“When remineralizing solution containing xylitol is used, xylitol may act as Ca2+ ion carrier and may maintain constant Ca2+ ion content by introducing Ca2+ ions from the surface layer to the middle and deep demineralized layers, thereby enhancing total remineralization. The present study demonstrates that remineralization occurs over the entire demineralized layers via the utilization of xylitol.”


“Remineralization near the surface layer advanced because of crystal formation resulting from fluoride action. Xylitol additives working as calcium-ion carriers possibly promoted remineralization in the intermediate and deep layers.”


“It was found that among sugar alcohols and calcium compounds tested, the combination of xylitol and calcium hydrogenphosphate strongly enhanced the remineralization of demineralized layers.”


Xylitol chewing gum is even more effective with the addition of calcium and seaweed extract.

“Xylitol gum containing G. furcata extract and calcium hydrogenphosphate amplified the remineralization throughout all demineralized layers. Furthermore, the effect of this gum stronger than that of maltitol gum.”


“Xylitol can induce remineralization of deeper layers of demineralized enamel by facilitating Ca\(^{2+}\) movement and accessibility.”


Xylitol gum enhanced the remineralization of initial caries-like enamel lesions


“Remineralization becomes all the more remarkable in the presence of xylitol. Xylitol strongly stimulated saliva-induced remineralization in deep layers.”


Adding calcium to xylitol gum increased the remineralizing effect.


“Chewing xylitol gum containing funoran and calcium hydrogenphosphate has a significant effect on the remineralization of initial caries-like lesions of the teeth.”

**Safety**


Even premature babies are fully capable of metabolizing xylitol.


Adaptation up to 200 grams per day in divided doses is possible.


Absorption decreases with increasing dosage. Blood chemistries were all normal.

“Xylitol, with adaptation, is well-tolerated and safe to levels of at least 90 grams per day, with no subjective or objective adverse findings.”


“In our own experiments, 100 grams (per day, after adaptation) was well-tolerated without much difficulty.”


“Recent metabolic studies have further indicated the safety of perorally administered xylitol at the present dosage levels. Comprehensive blood and urinary analysis on human subjects have revealed no untoward side effects.”


“The subjects’ body weights and blood values remained normal throughout the whole, more than 5-year period involving the regular consumption of substantial amounts of xylitol.”


Even in small children there are usually no side effects with the amount of xylitol needed for dental protection.


The safety profile of xylitol was reviewed and found similar to the milk sugar lactose. Any adverse effects in animals were species-specific and not significant for humans.


The only adverse reports were transient gastrointestinal discomfort with xylitol over-consumption.


“The accumulated scientific evidence demonstrates that xylitol meets the safety and efficacy prerequisites for use in caries prevention programs.”
Special Properties


Sweetness of xylitol is similar to sucrose. Fructose is sweeter; glucose less sweet.


Polyols stabilize proteins against heat denaturation.


Xylitol inhibits several important food-spoilage organisms.

M. Brin, Discussion in Foods, Nutrition and Dental Health Vol 1 Pathotox, Park Forest South, Il, 1981.

“There may be some inadvertent health and nutritional benefits from the presence of xylitol in the diet.”


Dietary xylitol helped prevent B-vitamin deficiencies.


“Alditol (such as xylitol) do not function as demineralizing agents of the teeth, however. Through the retarding effect on calcium phosphate precipitation, alditols may favorably govern remineralization of carious lesions.”


Xylitol inhibits aggregation of calcium-proteinates.


“Aldo- and ketosugars and disaccharides (maltose, sucrose, lactose) generally enhanced precipitation, whereas all polyols (xylitol, D-sorbitol, mannitol, and maltitol) retarded the formation of turbidity in saliva. Xylitol inhibited formation of precipitates also in the presence of D-xylose, dextrins, and starch.”

“The results indicate that xylitol can be used as a carrier in tablets of solid dispersions, when a fast drug release is desired.”


“There is a relatively strong hydration of xylitol. This polyol adopts a single linear conformation and, from the point of view of the hydration dynamics, it should be classified as positively hydrated.”


“Xylitol is being used as a highly valued ingredient with some interesting and useful properties in food and pharmaceutical products. It can be produced from xylose-rich (hemicellulose fraction of lignocellulose) resources by chemical or biotechnological method.”

### Special Situations


Over a period of 60 days, 20 grams of xylitol per day (as tablets with meals) improved plaque index, gingival bleeding scores, and overall oral hygiene.


College students surveyed gave almost unanimous, unconditional support for a program of including xylitol gum routinely with school-based meals.

K. Masalin, “Caries-reducing effects of xylitol-containing chewing gum and tablets in confectionery workers in Finland,” *Community Dental Health* vol. 9, pp. 3-10, 1992.

“An ordinary commercial xylitol-containing chewing-gum can be used to decrease caries risk factors in confectionery workers.”


“Xylitol should always be used immediately after exposure to sugar or other carbohydrates.”


After 3 months twice daily use of fluoride toothpaste in a preschool setting, more children in the xylitol group had reduced MS scores (toothpaste had 9.7% added xylitol).

From 1977 use of xylitol gum in Finland has increased dramatically: among teenage girls, from 1% to 81%, with 61% reporting regular daily use.

“The increase in use of xylitol gum is an example of the positive effect of health education given by a comprehensive, preventively oriented system of dental health care in association with commercial interests.”


Xylitol was more effective than sorbitol in reducing the incidence of root surface caries. Xylitol use also stimulated saliva, improved gingival health, and even help reduced cravings for cigarettes in several smokers.


“Chewing gum containing xylitol as the sweetener has resulted in reduced risk of root surface caries. It may effectively reduce plaque, the virulence of plaque, the acidity of plaque after a sucrose challenge, and gingivitis.”


“These results suggest that snack foods developed with xylitol are generally well accepted by children.” Most children aged 3 to 6 years found at least 5 of 6 snack foods sweetened with xylitol acceptable or very good.


“Children's acceptance and compliance for chewing was excellent. Children chewed the gum at designated times and none of the children swallowed the gum. Teachers' acceptance of the chewing program was low.”


“This study supports the suggestion that chewing xylitol gum may reduce salivary S. mutans levels. Xylitol chewing gum may provide a feasible caries prevention method for preschool children.”

“The results suggest that xylitol-containing saliva stimulants may be more effective than sorbitol-containing products in controlling some caries-associated parameters in people who are mentally disabled.”


“Oral health status in the xylitol group was a little bit better than in the control group. The use of xylitol can therefore be recommended, especially if the personnel do not have the possibility to supervise the brushing.”


“The U.S. Army Dental Command's Health Promotion Program is constantly seeking additional prevention measures to enhance the oral health of America’s Army. The Dental Command has created the "Look for Xylitol First" initiative aimed at training all members of the dental care team on the positive benefits of xylitol and to teach patients how to be smart consumers and evaluate products for their xylitol content.”


“Habitual use of relatively small daily quantities of polyol-containing chewing gum by young children may be regarded as an important additional caries-preventive procedure in a combined day-care centre and home setting. Especially xylitol-containing chewing gum may significantly reduce the growth of mutans streptococci and dental plaque which may be associated with dental caries.”


“The purpose of this paper is to review information for the inclusion of xylitol in primary preventive regimens as an adjunct for the prevention of oral diseases for special needs patients.”


“Milk sweetened with xylitol is well accepted by Peruvian children ages 4-7 years.” Xylitol in milk was preferred over plain milk or milk with sorbitol.


“Xylitol delivered by gum or lozenge appears to be effective clinically in reducing cariogenic bacteria and caries levels, but novel systems that deliver therapeutic amounts when needed would be a major advance, especially for young children.”

Tooth decay rates were cut in half by relatively small amounts of xylitol in hard candy.


“It is prudent for clinicians to advise all patients approaching declining age to start using xylitol products as a preventive. Use of these products may be the answer everyone has been waiting for.”


Xylitol gum was used 4 times a day for 3 months by children 3 to 4 years old. “Xylitol gum consumption is effective in avoiding increased plaque mutans streptococci in young children.”

**Sweeteners (Other)**


“Xylitol has first been used for parenteral nutrition and subsequently as a sweetener in diets for diabetics.”


“(Gastrointestinal) tolerance to maltitol is very low. My volunteers said that maltitol did the most terrible things to them and they would not take part in any more tests.”


A mixture of sucrose and xylitol in chewing gum was not effective in reducing plaque.


Xylitol is found in a wide variety of fruits and vegetables, but in small quantities.


The best rehardening properties were for saliva substitutes with xylitol.


“More research is needed to assess the ability of mixtures of xylitol with sorbitol, maltitol, other sugar alcohols and intense sweeteners to prevent oral plaque diseases.”
Xylitol (is) an exceptionally effective caries-reducing instrument provided that xylitol is not mixed in foods containing large amounts of sucrose.”


Acid and polysaccharide production were reduced with xylitol.

“The amounts of polysaccharide synthesized by the microorganisms in the incubations decreased in the order: glucose>sucrose>sorbitol>mannitol>lactitol>xylitol.”


“Frequent use of sorbitol may present a small cariogenic risk in people with low salivary flow.”


“The central role of sucrose in promoting dental caries is beyond reasonable dispute. Other fermentable sugars such as glucose, fructose, corn syrups, and high fructose corn syrups, are also cariogenic.

Most sugar alcohols (sorbitol, mannitol, lactitol, maltitol and hydrogenated starch hydrolysate (HSH) are fermented at much slower rates by oral flora than sucrose; however, with long-term use the oral microflora will adapt and they are then more acidogenic. Xylitol is an exception in that it is not fermented at all by normal oral flora and produces no caries.”


An expensive ingredient like xylitol is often blended with less costly bulking agents along with intense sweeteners. Xylitol is sometimes used in small amounts to potentiate flavor in sugar-free applications.


“The final conclusion has always been that consumption of sugars is a risk factor for caries. The previously mentioned characteristics of sorbitol and xylitol make sorbitol a very low caries-promoting sugar alcohol, and xylitol either a non- or even anticarious ingredient in foods.”


Catalogs common sugar alcohols -- their occurrence, uses and selected properties.

Caries risk is related to the frequency of carbohydrate consumption. “The use of chewing gum and other xylitol-containing products have resulted in defined reduction in caries and represent interesting alternatives for high-caries-risk populations.”


Not all sugar alcohols share the same characteristics. The uncommon 5-carbon structure of xylitol may help explain some unique health benefits.


“Xylitol—a 5-carbon sugar that oral microflora cannot metabolize—has additional anticariogenic effects attributable to antimicrobial action, stimulation of saliva resulting in increased buffer activity and an increase in pH, and enhanced remineralization.”


“Erythritol and xylitol may exert similar effects on some risk factors of dental caries, although the biochemical mechanism of the effects may differ.”


“Unlike sorbitol, which can be metabolized slowly by some oral bacteria, xylitol has a bacteriostatic effect on mutans streptococci. It also has been reported to reduce mutans streptococci levels in plaque and saliva, block mother-to-child transmission of mutans streptococci and alter the acidogenic potential of plaque to subsequent sugar challenges. Xylitol-containing chewing gum and mints can be recommended as an adjunct to other preventive intervention strategies if cost considerations do not outweigh effectiveness.”

**Toothpaste and Oral Care Products**

The authors did not pay attention to the possible role of xylitol (2.5% as a flavoring agent) as a contributor to enhanced remineralization of one of the rinses.


“The reduction of dental plaque and caries is achieved regardless of how the xylitol is administered. The only prerequisite is to get the xylitol into contact with the teeth.”


“Significant reduction of MS was found in subjects using the xylitol/glycerol dentifrice.”


“Children with no detectable approximal caries at baseline, who used the MFP toothpaste with the xylitol-sorbitol mixture, showed a lower (p < 0.05) caries increment as compared with children who used the MFP toothpaste with sorbitol alone.”


Fluoride toothpaste with added 10% xylitol provided a significantly greater anticaries benefit than similar fluoride toothpaste without xylitol.


Xylitol treatment (14 days) provoked an increase in oral glucose clearance, which was proportional to its concentration in the mouthrinse formula, up to 40% with 1% xylitol concentration.

The most pronounced pH drop for the sugar substitutes was found when rinsing with palatinose, and the least with xylitol. MS counts and plaque index scores decreased after xylitol.


“All thus, this study demonstrated 1) that the addition of 10% xylitol to an enzyme-containing dentifrice without sodium lauryl sulfate has an inhibitory effect on MS counts in saliva and dental plaque, and 2) that the inhibitory effect seems to be dose-dependent.”


Toothpaste containing 36% xylitol (Squigle Enamel Saver®) was superior to regular, (non-xylitol) fluoride toothpaste with respect to bleeding index, gingival index and plaque index in a group of 78 periodontal patients.


“The addition of 10% xylitol to a triclosan-containing dentifrice reduces the number of MS in saliva and dental plaque.”


“Adding xylitol to fluoride toothpaste enhanced the remineralizing effect.”


“Xylitol varnish can be regarded as a promising vehicle for increasing xylitol release along time.”

WWW.