

MECHANISMS OF THE ANTICARIOGENIC ACTION OF XYLITOL IN CHILDREN WITH NON-CARIOUS LESIONS OF DENTAL HARD TISSUES

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Abstract. This paper reviews current understanding of the mechanisms underlying the anticariogenic action of xylitol, with particular attention to its relevance for children with non-cariious lesions of dental hard tissues. Based on a content analysis of scientific papers and reviews indexed in major domestic and international databases, the mechanisms of xylitol action are shown to be multifactorial and mutually reinforcing, including direct inhibition of *Streptococcus mutans* growth, disruption of biofilm structure and microbial metabolic activity, and stimulation of salivary flow. A key feature of xylitol is its inability to be fermented by cariogenic bacteria into organic acids, which helps maintain plaque pH above the critical demineralisation threshold and supports conditions favourable for remineralisation of dental hard tissues. Interaction of xylitol with the bacterial phosphotransferase system disrupts normal carbohydrate metabolism in *Streptococcus mutans*, leading to futile energy expenditure and a progressive decline in cell viability. The regular use of xylitol containing products, including toothpastes, mouth rinses, chewing gum, and confectionery, is shown to provide a sustained reduction in caries risk, which is of particular importance in children with non-cariious lesions of dental hard tissues and in those with xerostomia related to mouth breathing associated with pathology of the Pirogov Waldeyer lymphoid pharyngeal ring. It is concluded that the multifactorial mechanisms of xylitol action justify its inclusion, alongside fluorides and calcium containing compounds, in caries prevention regimens for children, together with controlled restriction of dietary sucrose.

Keywords: xylitol, *Streptococcus mutans*, dental biofilm, caries prevention, non-cariious lesions, remineralization, salivation, phosphotransferase system.

Aim. To study the current understanding of the mechanisms of the anticariogenic effect of xylitol, with particular reference to its significance for children with non-cariious lesions of dental hard tissues.

Materials and Methods. A content analysis of scientific papers and domestic and foreign medical sources indexed in the largest databases, including Cochrane Library, e-Library, MEDLINE, PubMed, ScienceDirect, and Scopus, was carried out using the following keywords: mechanism of action of xylitol, toothpastes and chewing gum containing xylitol, *Streptococcus mutans*, and caries prevention in children.

Results. Current experimental and clinical data indicate that the anticariogenic effect of xylitol is realised through a combination of complementary mechanisms, including

inhibition of *Streptococcus mutans* growth, disorganisation of dental biofilm structure accompanied by a decrease in the metabolic activity of the microbial community, and increased salivation.

One of the fundamentally important aspects of xylitol action is its inability to be metabolised into acids by cariogenic bacteria. Unlike fermentable carbohydrates, xylitol is not converted by *Streptococcus mutans* into organic acids, chiefly lactic acid, which helps maintain the acid base index, or pH, of the oral environment above the critical demineralisation threshold of approximately 5.5. This property of xylitol ensures pH stability and creates conditions favourable for the remineralisation of dental hard tissues. When xylitol enters bacterial cells through the phosphotransferase system, normal metabolic processing is disrupted, resulting in an unproductive expenditure of the bacterial cell's energy reserves. As a consequence, the metabolic activity of the microbial cell declines sharply, ultimately leading to cell death.

A further mechanism involves suppression of *Streptococcus mutans* proliferation and disruption of the formation and structural organisation of dental biofilm. Regular use of xylitol containing products, such as toothpastes with a xylitol concentration of up to 25%, mouth rinses, chewing gum, candies, and lollipops, provides a long term reduction in caries risk in children, which is particularly relevant for patients with non-cariious lesions of dental hard tissues. An important supportive mechanism is the stimulation of salivation associated with chewing xylitol containing gum, which activates the buffering systems of saliva and creates optimal conditions for remineralisation. Through these combined effects, xylitol contributes to stabilisation of dental plaque pH and of the overall composition of the oral microbiota.

In children with predominantly oral breathing caused by pathology of the Pirogov Waldeyer lymphoid pharyngeal ring, and the associated xerostomia that frequently accompanies this condition, the use of toothpastes containing both xylitol and alginate has been shown to help increase the level of hydration of the oral mucosa, providing an additional benefit in this vulnerable group of patients.

Conclusions. The multifactorial mechanisms of xylitol action, namely its non-fermentability by cariogenic bacteria, its disruptive effect on bacterial metabolism, adhesion, and biofilm formation, and its stimulation of salivation, together justify the inclusion of xylitol as an additional component of caries prevention products for children with non-cariious lesions of dental hard tissues. Its use is recommended in combination with fluorides and calcium containing compounds, together with mandatory and controlled restriction of dietary sucrose in children.

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