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ZEROSE® ERYTHRITOL

The natural* zero calorie sweetener
from a trusted supplier.



BEGIN ►

*FDA has not defined natural. Contact Cargill for source and processing information.

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Cargill Advantage

Why Cargill?

- **Trusted ingredient expert with a broad portfolio of products and services**
- **Deep R&D resources with expertise in regulatory, applications and product development**
- **Proprietary marketing data and unique insights to help create innovative product solutions**
- **Reliable and sustainable US supply chain**

As a customer-focused supplier of ingredients for the food, beverage, dietary supplement and pharma/personal care industries, Cargill is uniquely positioned to help customers develop exciting new solutions for their customers and consumers.



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Overview

What is Zeros® Erythritol?

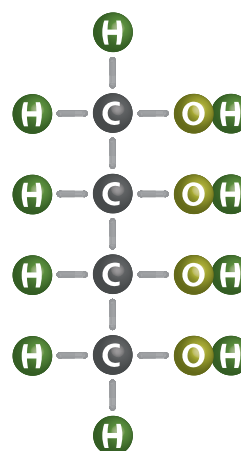
Zeros® erythritol is a natural*, zero calorie bulk sweetener, with a taste and functionality similar to sucrose. With zero calorie content, Zeros® erythritol offers a solution for both health and indulgence. In addition, erythritol has the highest digestive tolerance compared to other polyol sweeteners. It excels in food and beverage applications promoting reduced sugar and weight management. It is also non-cariogenic, and does not promote tooth decay, making it an excellent ingredient for products positioned to promote oral health. Zeros® erythritol will appeal to product formulators looking to create excellent taste, satisfying mouthfeel and an appeal to the healthy lifestyle market.

How is it made?

Zeros® erythritol is a low molecular weight polyol, comprised of four carbon atoms. It appears as a white crystalline, odorless product which rapidly dissolves in water (up to 60 g/100 ml at 30°C) to give a brilliantly clear, low viscosity, colorless solution.

Zeros® erythritol is the first polyol to be industrially manufactured by a fermentation process. The starting material is a simple sugar-rich substrate which is fermented using a yeast to yield erythritol. The product is then crystalized to 99.5% purity from the filtered and concentrated fermentation broth.

* FDA has not defined natural. Contact Cargill for source & processing information.



Regulatory Status

Erythritol received a “No objection letter” from the FDA on September 11, 2001 as an ingredient in food and beverages; additional uses are self-determined as GRAS. In Canada, it was approved for use as a food additive in November 2004. In Mexico, it is authorized for use at GMP levels. Brazil received approval effective March, 2008; it is included in the ANVISA Sweeteners list.

Claims

The labeling, substantiation and decision making of all claims for your products is your responsibility. We recommend you consult regulatory and legal advisors familiar with all applicable laws, rules and regulations prior to making labeling and claims decisions, including decisions regarding natural claims.



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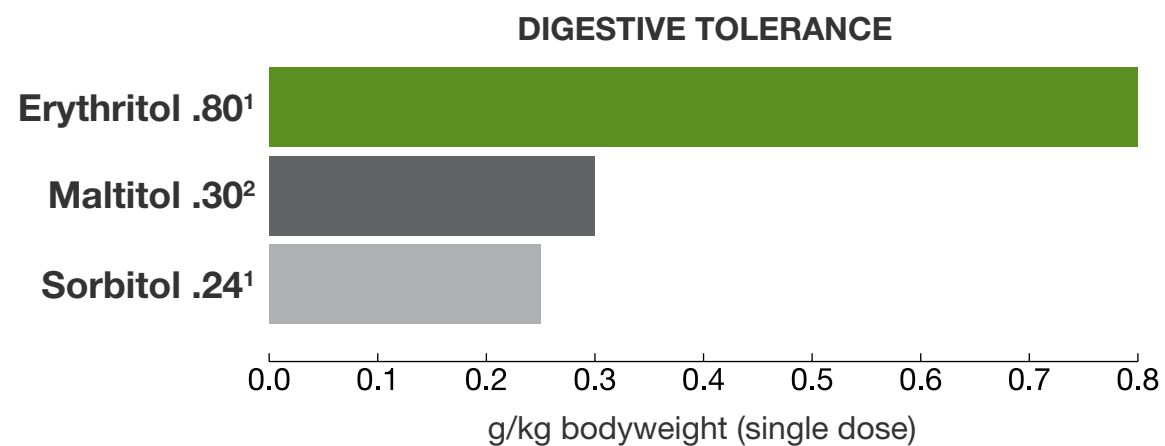
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Nutritional Benefits

- **Zero calorie**
- **High digestive tolerance**
 - Clinical studies show that erythritol has better digestive tolerance when compared to other polyols
- **Suitable for people with diabetes**
 - Does not raise blood glucose or insulin levels
- **Non-cariogenic**

With the growing demands to reduce overall sugar consumption, the food industry is seeking ways to respond to consumer demand for foods that help meet their dietary and weight loss goals. This means developing foods that are sugar-free, lower calorie and low in glycemic carbohydrates while also trying to achieve the desired texture, flavor and stability of traditional products.



Sources: 1 Oku et al (1996)
2 Koizumi et al (1983)



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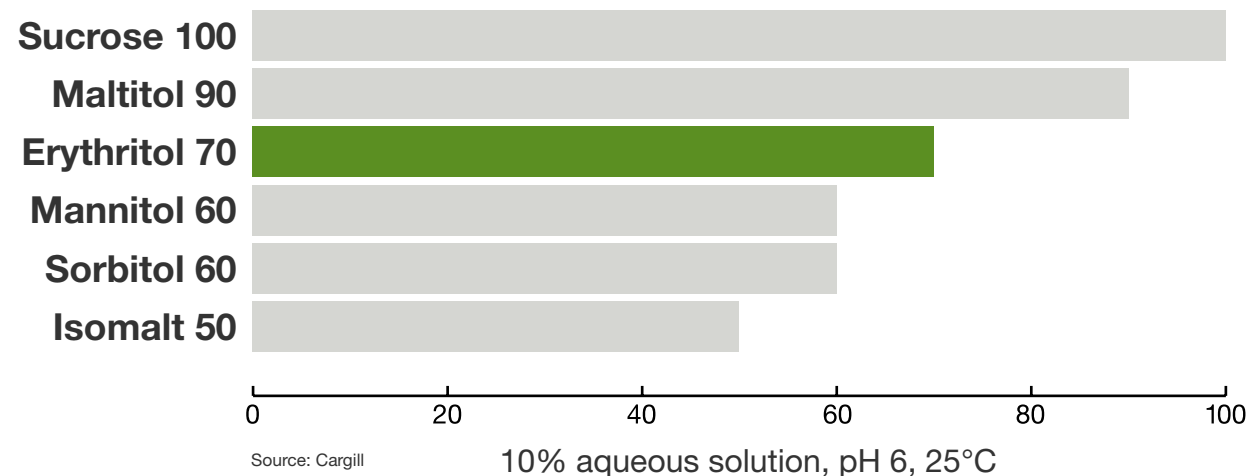
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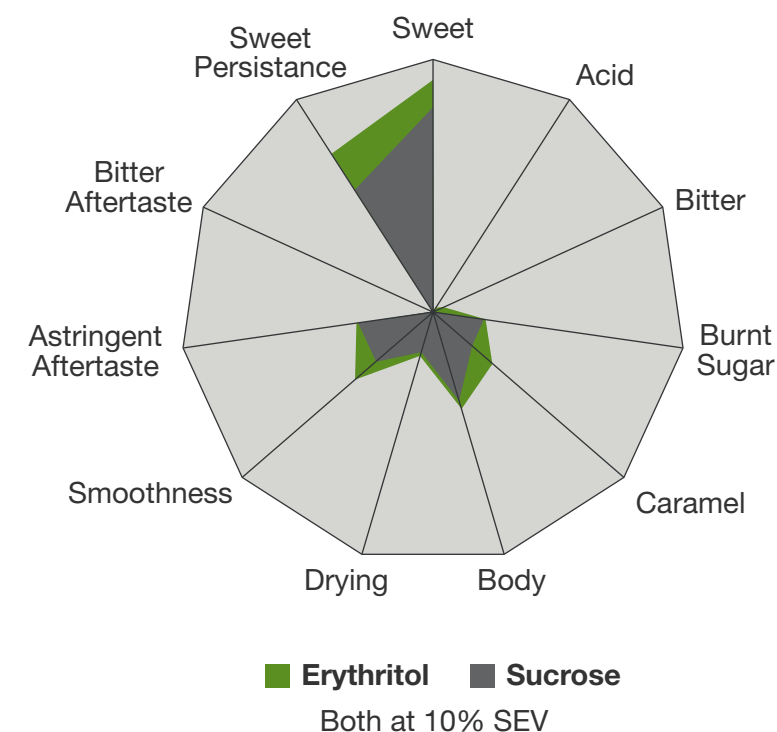
Functional Benefits

- Clean, sweet taste similar to sucrose
- Natural
- Adds smoothness and body
- Masks off-flavors
- Cool mouthfeel (high negative heat of solution)
- Synergy with intense sweeteners
- Extends storage stability
- High processing (acid and heat) stability
- Low hygroscopicity
- High speed of crystallization

RELATIVE SWEETNESS



TASTE COMPARISON OF ERYTHRITOL TO SUGAR



Source: Psychophysical Characteristics of Erythritol,
Leatherhead Food RA, UK



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Confectionery

- **Clean sweet taste**
- **Fine crystal structure**
- **Non-hygroscopic**
- **Attractive cooling effect**

In gum: Zeros® erythritol can improve the flavor profile, and its cooling effect gives a unique and enjoyable chewing experience.

In sugar-free chocolate: Sweetener blends with Zeros® erythritol, as a bulk sweetener, yield calorie reduction with excellent gloss, texture, snap and melting characteristics. It masks aftertastes of intense sweeteners and is useful in sugar-restricted diet.



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Food

- **Great sugar-like taste in combination with intense sweeteners**
- **Excellent heat and acid stability**
- **Improved shelf life**
- **Excellent water activity management**
- **Enhanced bulk and body**
- **Optimal freezing point depression**

When compared to sucrose in baking, Zerose® erythritol exhibits different melting behavior, a more compact dough, less color formations, better moisture control and softer baked products.

The use of Zerose® erythritol as a bulking agent can support sugar replacement strategies and allow for lower calorie profiles in many dairy products and frozen desserts such as pudding, yogurt, smoothies, ice cream or sorbet.



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Beverage

- Sugar-like taste
- Works well with high intensity sweeteners
- Enhanced body and mouthfeel
- Optimal freezing point depression
- Excellent heat and acidity characteristics

Zerose® erythritol is ideal for diet soft drinks, flavored waters and milks, sports drinks, smoothies, iced teas, frozen beverages and soy-based beverages.



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Tabletop Sweeteners



- **Sugar-like taste when used in combination with intense sweeteners**
- **Non-hygroscopicity**

Make spoonable sweeteners or cubes with taste and texture very similar to sucrose by combining Zerose® erythritol and intense sweeteners for enhanced taste profile and reduced calories.



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Oral Care

- Not fermented by oral bacteria
- Clinically shown to reduce plaque and the risk of dental caries better than other polyols
- Well tolerated (highest digestive tolerance of all polyols)
- Certified “toothfriendly”
- Attractive cooling effect
- Works well with other polyols and high intensity sweeteners

Dental caries is a disease caused by oral bacteria that convert carbohydrates into organic acids and dental plaque, resulting in damage to the teeth. Unlike sugar, erythritol is not fermented by oral bacteria, and therefore does not promote dental caries.

In oral care applications, Zeroses® erythritol acts as a salivary stimulant and provides masking properties for astringent and bitter tastes. It also has demonstrated non-cariogenic properties. Its sugar-like taste and cooling effect makes it a great option for oral care products like toothpastes and rinses.

Zeroses® erythritol is certified as “toothfriendly” by Toothfriendly International.



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Pharmaceutical

- **Inert excipient; excellent carrier in capsules**
- **Excellent flowability and stability in powders**
- **Attractive cooling effect**

As a non-caloric excipient, Zerose® erythritol can be used in a wide range of solid and liquid dosage formulations including granulated powders, lozenges and syrups. Sugar-free lozenges crystallize easily, producing a hard, crunchy texture and refreshing, cooling effect.



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DENTAL STUDY

Dental Study Overview

A newly published clinical study shows evidence that erythritol demonstrated significant caries, dental plaque and *Streptococcus mutans* reduction versus sorbitol and xylitol.

In a three-year clinical study,* the dental effects of erythritol, xylitol and sorbitol were compared among elementary school-age children. The results showed that while each polyol sweetener had dental benefits, erythritol outperformed xylitol and sorbitol in the following ways:

- The amount of dental plaque was lower in the erythritol group.
- The number of dentine caries on teeth were lower in the erythritol group.
- Counts of *Streptococcus mutans* in saliva and upper dental plaque were lower in the erythritol group.

Methodology

In a double-blind, parallel, randomized, controlled three-year study, 485 primary school children in Tartu, Estonia, were given 2.5g polyol tablets three times per day during school days (200 days per year). The study tested the efficacy of long-term daily intake of erythritol and xylitol candies as compared to sorbitol (control) candies. The subjects were examined annually to collect the following data:

- Dentin caries development
- Plaque weight
- Oral counts of *Streptococcus mutans* and *Lactobacilli*

Enamel and dentine caries lesions were determined with ICDAS (International Caries Detection and Assessment System) criteria by four calibrated dentists.



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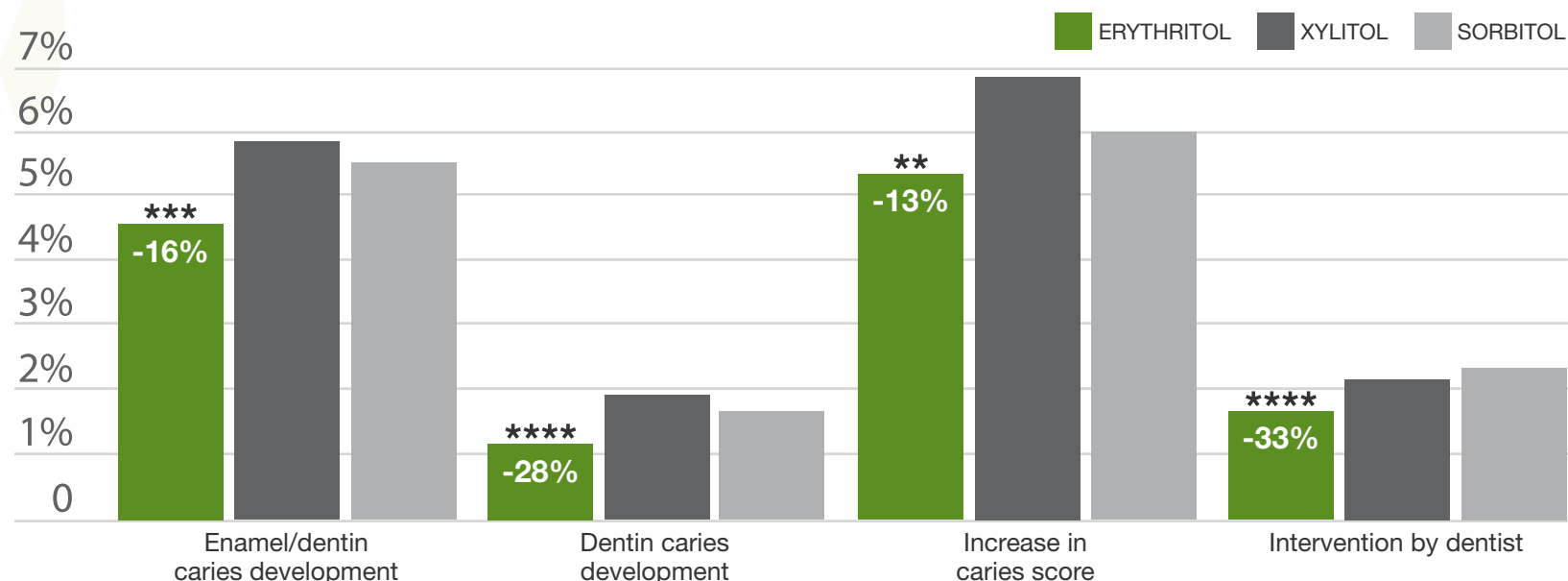
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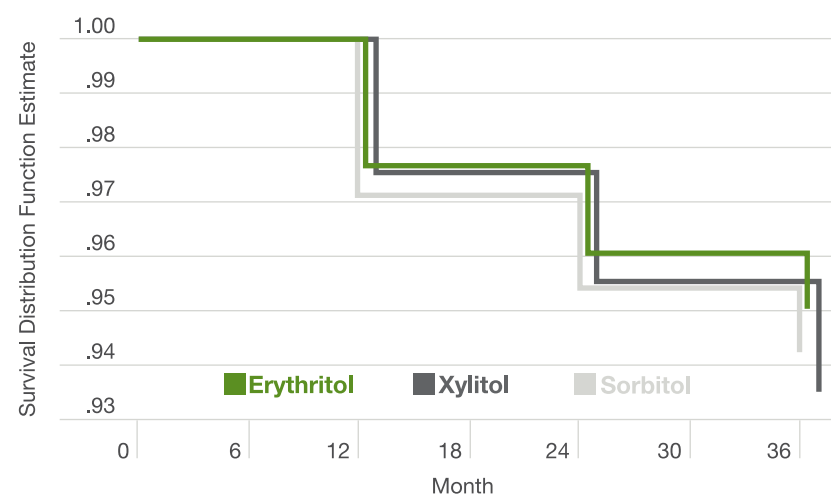
Dental Study Results

Dentin Caries Development:

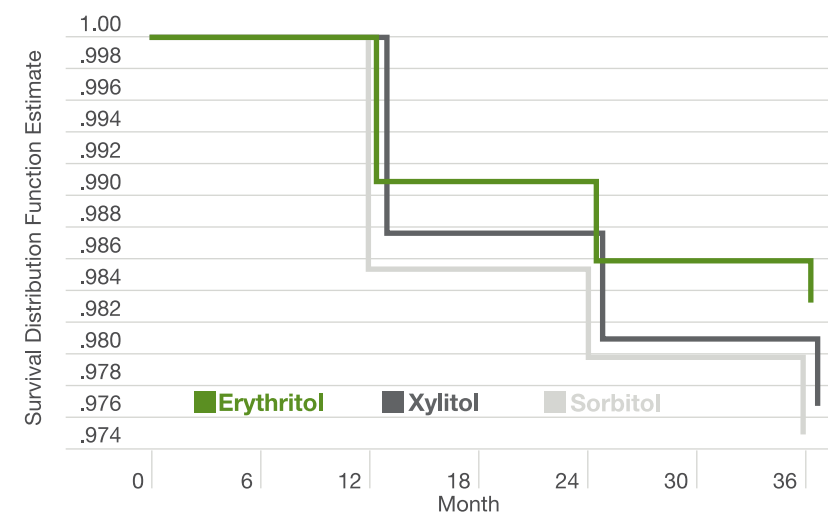
Number (%) of surfaces with caries development or restoration during entire study.



*p<0.05, **p<0.01, ***p<0.001, ****p<0.0001, all vs. sorbitol



Time to develop enamel/dentin carries
(carries score 0-3 to 4-6)



Time to dentist intervention
(restoration score 0 to 3-8)

[more results](#) ►



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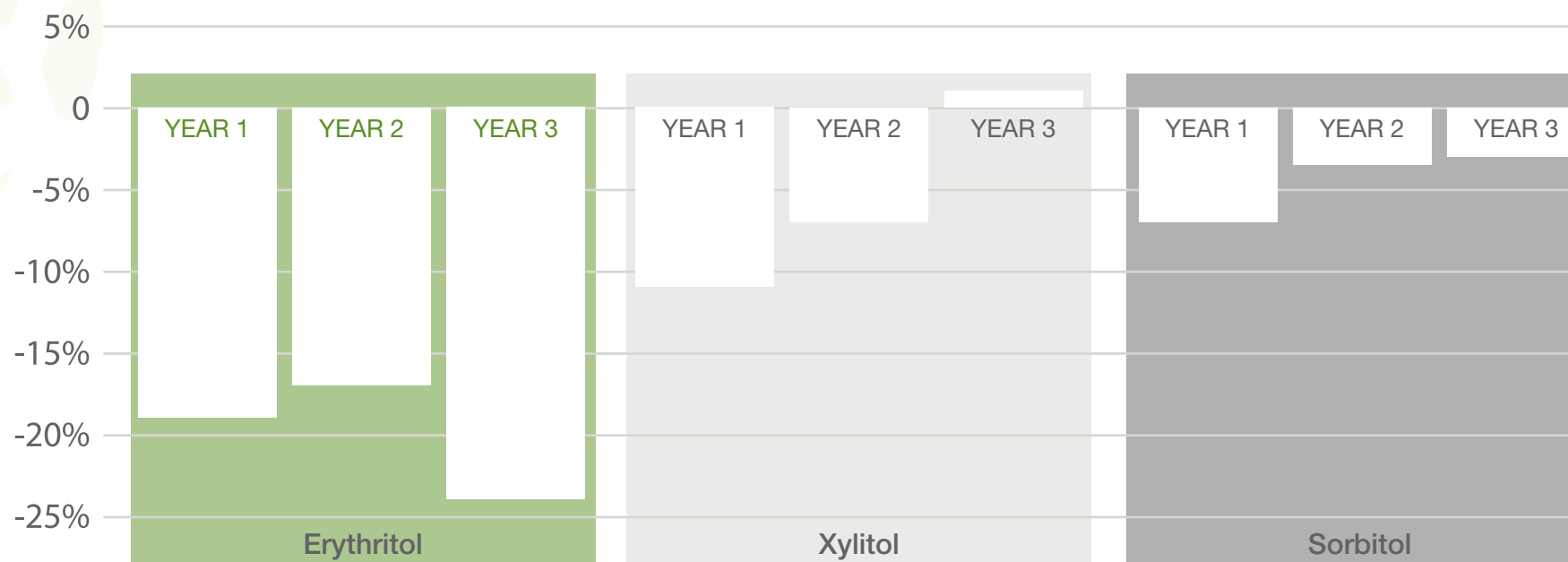
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Dental Study Results

Dental Plaque Weight

Change against baseline over 3 years



Oral Counts

Saliva *Streptococcus mutans* (SM) count and plaque SM counts in quadrants 1 and 2 were significantly lower in erythritol group than in the sorbitol (control) group.

	Erythritol				Xylitol				Sorbitol			
	2008 n=165	2009 n=141	2010 n=138	2011 n=128	2008 n=156	2009 n=145	2010 n=137	2011 n=131	2008 n=164	2009 n=149	2010 n=142	2011 n=130
Saliva SM*	1.76 (0.08)	1.56 (0.08)	1.58 (0.08)	1.21 (0.09)	1.85 (0.08)	1.61 (0.08)	1.68 (0.08)	1.47 (0.09)	1.74 (0.08)	1.44 (0.08)	1.62 (0.09)	1.65 (0.08)
Plaque SM1	1.55 (0.08)	1.34 (0.08)	1.38 (0.08)	1.11 (0.09)	1.68 (0.08)	1.41 (0.08)	1.41 (0.08)	1.24 (0.09)	1.48 (0.08)	1.44 (0.08)	1.35 (0.08)	1.45 (0.09)
Plaque SM2	1.52 (0.08)	1.41 (0.08)	1.29 (0.08)	1.10 (0.08)	1.77 (0.08)	1.50 (0.08)	1.45 (0.08)	1.37 (0.08)	1.60 (0.08)	1.45 (0.08)	1.44 (0.08)	1.40 (0.08)
Plaque SM3	1.66 (0.08)	1.57 (0.08)	1.43 (0.08)	1.23 (0.08)	1.80 (0.08)	1.48 (0.08)	1.47 (0.08)	1.41 (0.08)	1.67 (0.08)	1.54 (0.08)	1.42 (0.08)	1.33 (0.08)
Plaque SM4	1.69 (0.08)	1.36 (0.08)	1.49 (0.08)	1.13 (0.08)	1.78 (0.08)	1.34 (0.08)	1.39 (0.08)	1.23 (0.08)	1.60 (0.08)	1.36 (0.08)	1.48 (0.08)	1.31 (0.08)
	2008 n=161	2009 n=137	2010 n=137	2011 n=125	2008 n=149	2009 n=138	2010 n=129	2011 n=125	2008 n=161	2009 n=148	2010 n=141	2011 n=128
Saliva LB	4.36 (0.13)	3.94 (0.16)	3.37 (0.17)	3.46 (0.18)	4.36 (0.13)	4.28 (0.14)	3.82 (0.17)	3.93 (0.17)	4.47 (0.13)	4.11 (0.15)	3.81 (0.16)	3.52 (0.18)

Significant p-values: 2011 Saliva SM p=0.0019. Plaque SMI p=0.0256. Plaque SM2 p=0.0280

* "The Caries Preventative Effect of Erythritol, Xylitol and Sorbitol," conducted by Prof. Mare Saag, Prof. Eino Honkala, and Prof. Kauko Mäkinen, the Department of Stomatology, Faculty of Medicine, University of Tartu, Estonia. This study was funded by Cargill.



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Dental Professional Outreach



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Cargill supports customers with a comprehensive Dental Professional Outreach program. The program educates dental professionals on the dental benefits of Zeros[®] erythritol and points them to products that contain it so that they can recommend these products to their patients, resulting in a win-win for both Cargill and customers.

The program reaches dental professionals through public relations initiatives, professional conferences/exhibits, sponsorships, speaking engagements, webinars and direct marketing efforts. Zeros[®] erythritol customers can participate in Cargill's Dental Professional Outreach program to promote their products in many ways. For example, customers can display and sample products at professional conferences as well as tap into Cargill's proprietary opt-in dental professional database to directly reach the audience with product information.

There is tremendous power in having a dental professional recommend your products directly to consumers!



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Zerose® is a natural* zero calorie sweetener that provides unique functional and nutritional benefits across the food, beverage, pharmaceutical, dental and personal care industries.

To learn more about what Zerose® can do for you, contact your Cargill sales representative.



Find a Cargill sales
representative to
request your sample
of Zerose® ▶

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*FDA has not defined natural. Contact Cargill for source and processing information.

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