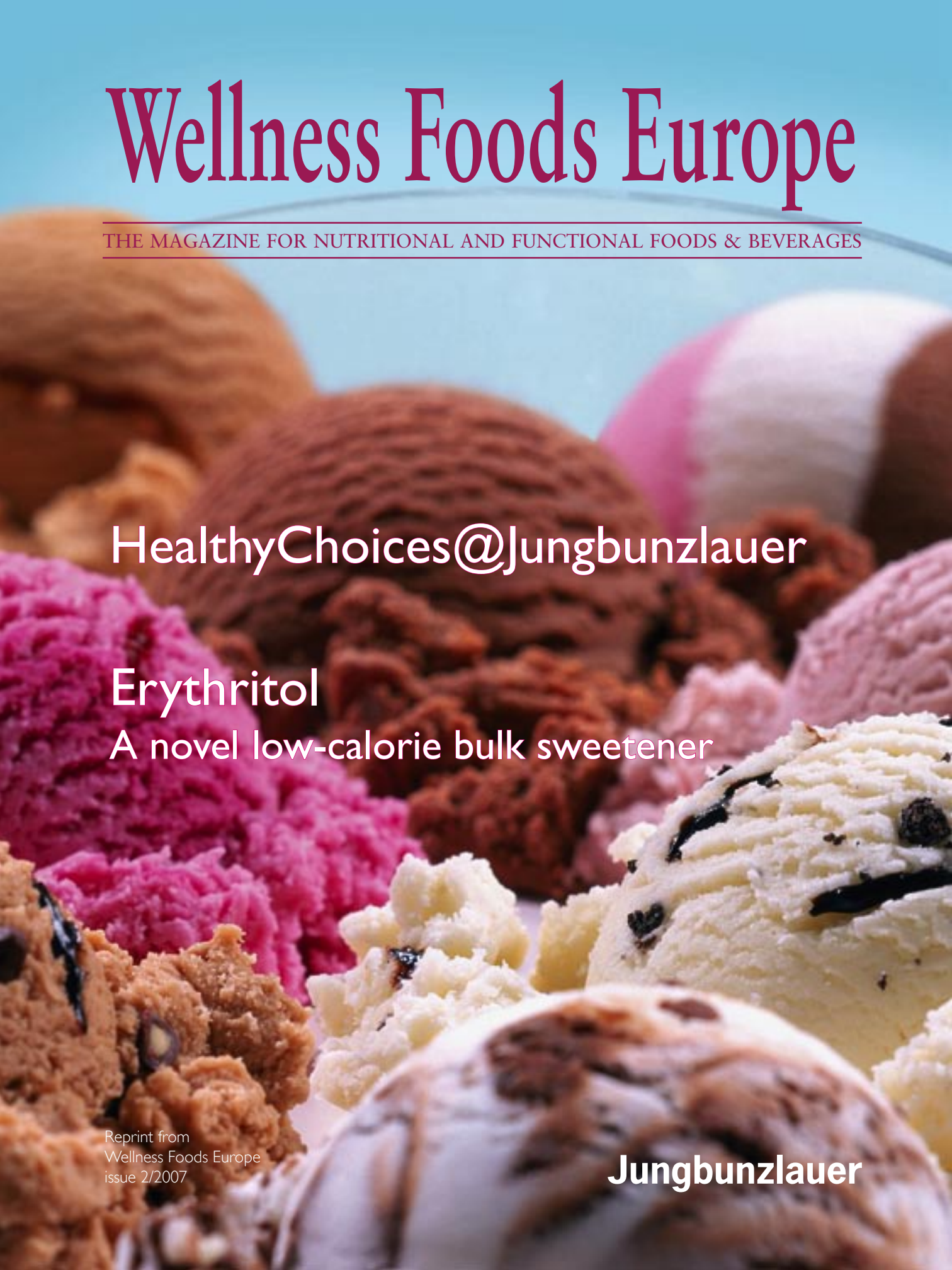
Wellness Foods Europe

THE MAGAZINE FOR NUTRITIONAL AND FUNCTIONAL FOODS & BEVERAGES



HealthyChoices@Jungbunzlauer

Erythritol

A novel low-calorie bulk sweetener

Reprint from
Wellness Foods Europe
issue 2/2007

Jungbunzlauer

Sweetener blends with erythritol – reducing sugar is adding value

by Ferid Haji, Product Manager Erythritol
Jungbunzlauer International AG, Basel, Switzerland

Reducing sugar in the human diet is one of the most prominent topics in the food industry worldwide. It is the one important idea immediately apparent while reviewing the effect of modern nutrition on civilisation: In the beginning of the 21st century the number of overweight, obese and malnutritioned people is rising steadily. In the meantime the overweight and obese individuals outnumber the starving by far. Even in areas of the world where very traditional diets and eating habits are followed (e.g. Asia), the rate of overweight people has reached new dimensions.

Sugar, as one of the three major food constituents has always been a major part of human nutrition. The term sugar usually refers to sucrose, the typical table top sweetener. It is produced mainly out of sugar cane or sugar beet and is available today in a number of varieties to fit to the requirements of the food industry.

Another ingredient commonly referred to as sugar is sweet corn syrup. The variety used most often is high fructose corn syrup (HFCS). This type of starch derivative is sweeter than sucrose, so less HFCS is needed to achieve the same sweetness. The reason for this is that fructose, which has a sweeter taste, makes up a larger portion of the HFCS than glucose and other constituents: The fructose share can be up to 90 %. There is no difference in the caloric content of sugar and HFCS, which both supply 4 kcal/g. For sweetening purposes sugar and sweet corn syrups are today's standard and benchmark in terms of taste, availability, pricing and technical properties.

The main goal of sugar replacement or reduction in food and beverages is the reduction of calories provided by simple carbohydrates (mono- and disaccharides). There are many different options to reduce calories that are readily available in the food and bever-

age industry. One group of products which fit perfectly into reduced or sugar free applications, due to their tremendous versatility is sugar alcohols.

Sugar alcohols (also called polyols) are alternatives that can replace the function and flavour of well established sugars in foods. They have been used in the food industry for a very long time and they serve as effective sugar replacers in a wide range of applications. They are grouped together based solely on their similar chemical structure but they have very different properties. They share a common feature: At a lower caloric content compared to sugar they present an attractive sweetness close to the sugar level. With this valuable property they will play an extraordinary role in the nutrition of the 21st century.

The group of polyols containing sorbitol, maltitol, isomalt, xylitol, mannitol and lactitol has recently been extended with erythritol. Due to its clean sweet taste which is very close to the sugar taste and its low calorie content of 2.4 kcal/g erythritol is an excellent choice for sugar replacement. Comparison of the sweetness reveals that erythritol is 30 % less sweet than sugar (measured in an aqueous solution in the same concentration). For an application the real sweetness provided by erythritol varies between 60–80 %.

Erythritol's high laxation threshold, Glycemic Index of nearly zero and clean taste profile set it apart from other polyols. The main reason for these unique properties is the low weight of the erythritol molecule. It is the only polyol with 4 carbon molecules whereas other polyols range from 5–12 carbon molecules. The differences in molecular weight and sizes are distinct: 122 g/mol for erythritol compared to 184 g/mol for a 5 carbon bodied xylitol and 344 g/mol for 12 carbon bodied maltitol. The molecular size is one of the decisive factors determining the fate of the polyol in the human digestive tract. For erythritol, the small molecular size leads to a quick absorption in the upper digestive tract. Thus, very little erythritol reaches the lower digestive tract. The lower digestive tract, however, is where degradation of polyols and osmotic effects lead to the effects of gastric distress. While this feature in fact is linked to polyols in general, it is with a very little effect for erythritol only[1].

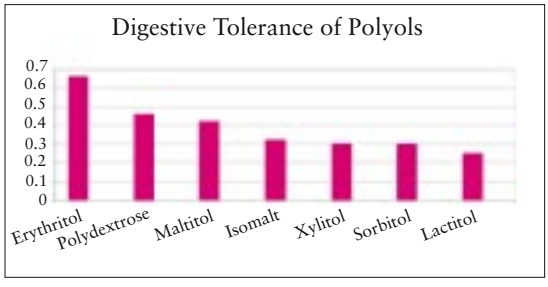


Fig 1. Digestive tolerance of erythritol

The smaller erythritol molecule explains also why the effective calorie content is only 0.2 kcal/g compared to the 2.4 kcal/g assigned by the European Legislation. Exploitation of the almost zero calorie feature unfortunately is reserved for other parts of the world.

One other very important point of differentiation: Erythritol is a natural substance. Like sugar it occurs naturally. It is typically found in food products like grapes, soy sauce, wine and even in honey or cheese[2]. Erythritol is produced by a natural microbial fermentation process, in fact, it is the only sugar alternative today produced by such a natural process. With this impressive set of features erythritol has made its way into the low sugar products outside Europe and is about to enter the European market as well. In Japan and the USA the product is approved and available for more than a decade. In July 2006 erythritol has been approved by the European Commission as multipurpose food additive (2006/52/EC). So far, France and the Netherlands are the only member states that have officially adopted the European Directive. The other countries have to follow by February 2008.

While the advantages that erythritol can offer to energy reduced or sugar reduced products are convincing, the sweetness performance may need adjustment. Studies have proven that consumers rarely will sacrifice taste in order to receive a healthy benefit. For consumers the sweetness is essential to the taste, and as a consequence work must be explored to profit from the positive effects of erythritol plus having additional sweetness in the finished product.

The options available for adding sweetness to products where the erythritol sweetness shall be strengthened are numerous. In fact, a developer has many options to chose from based on the taste of the product, labelling considerations, energy content or additional health benefits.

Though fructose in form of the HFCS is sought to be reduced it still has an interesting metabolic behaviour that make it fit well into a natural sweetener together with erythritol. Fructose is metabolised independently from Insulin and has a much slower impact on the blood sugar level. This makes it a suitable sweetener for diabetics, just like erythritol. Since fructose has a sweetness of about 120 % compared to regular sugar it can increase sweetness in low amounts already.

Inulin and fructooligosaccharides are valuable products to create blends with erythritol. The sweetness of inulin is not the decisive criterion since it is less than 30 % sugar equivalent. But inulin offers another benefit: It has a positive heat of solution. Inulin shows a warming effect upon dissolution. This is the opposite of the cooling effect shown by erythritol and other polyols upon dissolution. For a number of foods the cooling effect is not suitable. Using chocolate as an example: A milk chocolate with erythritol reducing the sugar content offers a distinct cooling effect. The use of inulin and erythritol together can reduce or even eliminate the cooling effect and raise the taste quality of the chocolate significantly. As an additional highlight it should be mentioned that inulin is also a non digestible fibre and prebiotic. It promotes the growth of the probiotic flora which leads to an overall improvement in di-

Table: Groups of sweeteners available for blends with erythritol (sweetness vs. sugar)*

Natural sweeteners	High intensity sweeteners	Polyols	Plant extracts
Sugar	Aspartame (180x)	Xylitol (1.0x)	Stevia rebaudiana (250–300x)
Inulin (0.1x)	Acesulfame K (180–200x)	Maltitol (0.9x)	Luo Han Guo (300x)
Fructooligo saccharides (0.3x)	Sucralose (320–1000x)	Sorbitol (0.6x)	
Fructose (1.2x)	Neotame (8000–130000x)	Mannitol (0.5x)	

*Table does not claim completeness

"Natural" preferred? > With regard to the current trend to All Natural and Organic products erythritol is a great ingredient because it fits perfectly into the trend of using ingredients originating in nature and using natural processes to make them available in the quantity needed. In contrast to "Organic" there is no valid legal definition for the term "Natural". However, guidelines exist that help to identify what can be considered "Natural", e.g. from the UK Food Standard Agency[3]. Under such guideline other sweeteners that could claim to be natural products are inulin, fructose and of course, regular sugar.

gestion. Thus, using inulin is a healthy value added.

Blends of erythritol and sugar lead to products with a very high potential in taste but they find a major handicap in the European Sweeteners Directive: To make an "energy reduced" claim a minimum of 30% calorie reduction needs to be realized[4]. A pure table top sweetener blend of erythritol and sugar is possible up to a ratio of 80 %: 20 % based on the European energy conversion factors but as a sweetening system in food where the calorie contribution depends on some more ingredients the reduction is hardly achievable. As a matter of fact the calorie savings of erythritol/sugar blends can hardly be exploited labelling-wise.

High Intense Sweeteners > The high intense sweeteners are the other major group of successful sugar replacers beside the polyols. Their advantages are easily recognisable: no calories (non nutritive) and an extraordinary sweetening power. In today's sugar free products they are ubiquitous and still new application areas are being discovered. The enormous sweetening capacity is an ideal tool to increase the sweetness of erythritol products. Only smallest amounts of aspartame, acesulfame potassium or sucralose are needed to close the sweetness gap. In such blends a great synergy can be observed, since erythritol and aspartame/acesulfame potassium reinforce each others sweetness. The sum of sweetness is higher than the individual sweetness of each part. This of course leads to an interesting savings potential in absolute amounts needed for a certain sweetness effects. Furthermore, erythritol is able to reduce or eliminate the aftertaste of the high intense sweetener and it adds mouthfeel as a bulk ingredient.

Erythritol blends with other polyols > Sorbitol and maltitol are the most important sugar alcohols for food products today. They have revolutionised the sugar free products. Their uniqueness is based on the reduced calorie load and their sweetness ranging from 50–100 % compared to sugar. As these polyols have different properties, blends are much more common than single polyols because the blends allow fine tuning of different product parameters. All polyols cause gastric distress upon overconsumption. Therefore, they are banned in beverages in Europe and the obligatory laxation warning needs to be labelled on any product containing polyols. Though scientific evidence shows that erythritol is much less laxative than all other polyols, the laxation warning is mandatory for it as well. But still its advantages weigh heavy and blending it with the other polyols leads to significant improvements in:

- Overall taste impression
- Fermentation origin –> "Natural"
- Laxative effect
- Glycemic Index –> suitability for type II diabetics[5]
- Hygroscopicity

Erythritol is also a valid alternative to xylitol which still suffers from recent weak availabil-

ity and price increases. Xylitol is a very prominent polyol for chewing gums and candies for the reason that its benefit for the teeth goes beyond the normal tooth friendliness of polyols: It reduces the plaque and the bacteria count in plaque. Erythritol, has a similar effect as proven in scientific studies[6]. In addition to the same cooling effect which fits well to chewing gums and candies it offers a much higher laxation threshold and lower hygroscopicity compared to xylitol. The latter influences the shelf life stability and preserves the finished products value just longer.

Plant extracts > The use of plant extracts is currently not a topic in Europe since the two types which are having an economic importance are not yet approved: Stevia rebaudiana and luo han guo. Stevia, however, is currently running through the European Novel Food approval process. Both plant extracts and derivatives thereof are in use in other areas of the world already.

The two plant extracts act as high intensity sweeteners the difference being that stevia can expect a non nutritive status whereas luo han guo provides approx. 2.3 kcal/g.

Once an approval is achieved they may attract some interest especially due to their Natural character. The acceptance by the consumer will mainly be determined by the taste profile which goes into the direction of licorice for Stevia and which offers a caramel note for luo han guo. The qualitative synergies with erythritol will be interesting to explore.

This article describes the most important sweetening tools available. Using erythritol, in combination with other sweeteners, opens a wide range of blends with particular advantages and features: Natural sweetening, taste improved artificial sweetening, low glycemic indexed sweetness, etc. Though it is true that only sugar tastes like sugar, the approach of finding the original taste without sugar addition is supported by using erythritol. Judgement on the quality and performance of a sweetener blend may depend on other factors like technical properties or product strategy, but one thing is certain: Taste and sweetness will make the difference.

Erythritol is part of HealthyChoices@Jungbunzlauer which stands for Jungbunzlauer's new portfolio of ingredients addressing the top health trends: mineral fortification, sugar replacement and salt substitution.

---

[1]Tolerance of low-digestible carbohydrates: a general view, Geoffrey Livesay, British Journal of Nutrition (2001), 85, Suppl. 1, S7–S16

[2]Erythritol: A review of biological and toxicological Studies, W.O. Bernt, J.F. Borzelleca, G. Flamm, I.C. Munro, Regulatory Toxicology and Pharmacology 24 (1996), S191–S197.

[3]Criteria for the use of the terms Fresh, Pure, Natural etc in food labellings, Food Advisory Committee of the UK Food Standard Agency (FSA)

[4]European parliament and council directive 94/35/EC of 30 June 1994 on sweeteners for use in foodstuffs

[5]Effects of oral administration of erythritol on patients with diabetes. Ishikawa M, Miyashita M, Kawashima Y, Nakamura T, Saitou N, Modderman J. Regul Toxicol Pharmacol. 1996 Oct; 24(2 Pt 2): S303-8.

[6]Similarity of the Effects of Erythritol and Xylitol on Some Risk Factors of Dental Caries. Mäkinen KK, Saag M, Isotupa KP, Olak J, Nõmmela R, Söderling E, Mäkinen P-L: Caries Res 2005; 39:207-215

The author: Ferid Haji, Product Manager Erythritol,
Jungbunzlauer International AG
St. Alban-Vorstadt 90, 4002 Basel, Switzerland
Phone: +41 61 2955279
Fax: +41 61 2955255
E-Mail: ferid.haji@jungbunzlauer.com
www.jungbunzlauer.com