


Polyols, versatile ingredients for food (re-)formulation

New nutrition policies are developed all over the world with the aim to contribute to the prevention of overweight and obesity, and subsequently to the prevention of a number of associated non-communicable diseases. These policies often insist on the need for healthy formulated foods as part of a global approach.

Polyols are bulking ingredients with many technological properties similar to sugars, with varying degrees of sweetness (less or the same as sucrose). In addition they have proven benefits in terms of dental health, improved glycaemic control and calorie-reduction. These properties make them a unique asset in healthy food formulation.

Polyols are carbohydrates but they are not sugars

Some polyols are found naturally in various fruits and vegetables, for example sorbitol in plums, erythritol in grapes, or xylitol in mushrooms. **Starting materials for industrial processes are all from natural sources (corn, wheat, sugar beet, milk, etc.).**

Depending on the agricultural source, the carbohydrates contained are processed as such, or in the case of corn or wheat enzymatically hydrolysed, i.e. cut by selected enzymes in smaller units. The resulting mono-, di-, oligo- or polysaccharides are then treated with hydrogen and further purified before packaging. Polyols can also be obtained by fermentation process, as with erythritol. The defining characteristic is the occurrence of an alcohol group in place of the carbonyl group in the aldose and ketose moieties[1].

The distinction between sugars and polyols is important yet frequently overlooked[2].

The fact that polyols may be called “sugar alcohols” e.g. in certain non-EU jurisdictions contributes to the confusion. Polyols are neither sugars, nor alcohol!

The most widely used polyols are Sorbitol, Mannitol, Maltitol, Isomalt, Lactitol, Xylitol and Erythritol. Polyols have a history of safe use all over the world for more than 30 years.

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Polyols help to replace sugars thanks to their ability to fulfil many of the same technological functions

Because polyols are not sugars, the European legislation[3] recognises inter alia their interest to replace sugars for the production of energy-reduced food, non-cariogenic food or food with no added sugars. They are commonly used for **"bulk sweetening"** because, unlike high intensity sweeteners, they replace sucrose at a 1:1 ratio. Hence there is no need to compensate with other ingredients such as fats the "missing volume" that may result from sugar's removal from foods' recipe.

However sugars do not bring only sweetness but also various technological functionalities, which make them difficult to replace. For example sugars bring:

- bulking, especially in semi-solid foods such as in chocolate and hard candies
- humectancy in chewing gum and jellies,
- texture and mouthfeel (as in chewing gum and biscuits),
- preservation in jam and fruit preparations,
- freezing point depression in ice cream and frozen desserts.

Polyols have many of the properties of sugars, making them well suited not just to replace sweetness but to take over many of the functional properties provided by sugars.

High intensity sweeteners solely replace the sweet taste. All other afore-mentioned technological functions are provided by polyols, in addition to their moderated and adjustable sweet taste. Depending on their type and on the food matrix in which they are used , they act as bulking agents, emulsifiers, stabilisers, humectants, thickeners, texturisers, glazing agents, anti-caking agents and/or sweetener. These multi-functionalities make them very attractive for food formulation.

Polyols allow up to 40% calorie reduction compared to sugars-containing foods

The lower caloric value of polyols, when compared with sugars, is one distinct health advantage of using them in food. Polyols are assigned a caloric value lower than the caloric value assigned to available carbohydrates[4], e.g. in the European Union:

- 2,4 kcal/g for polyols other than erythritol (vs 4 kcal/g for carbohydrates)
- 0 kcal/g for erythritol.

Based on the latest estimates in European Union countries, overweight affects 30-70% and **obesity affects 10-30% of adults**.

Over **60% of children** who are overweight before puberty **will be overweight in early adulthood**.

Source: WHO Europe

The tables below illustrates with two examples of formulation how the replacement of sugars with polyols allow up to 40% calorie-reduction compared to the sugars-containing foodstuffs (reference for polyols energy value in the calculations: 2,4 kcal/g).

Jelly candies	Gelatine Type A 220 Blooms	Water	Citric acid (50% ds)	Flavour/ Colour	Sucrose	Glucose syrup	Polyols syrup
Standard formulation (%)	8	18	1.5	_	43.1	29.4	/
Formulation with polyols (%)	8	18	1.5	_	/	/	72.5
Energy (kcal)	32	_	_	_	290		174
Energy reduction on sweeteners (%)					-40%		
Energy reduction on total product (%)	-36%						

Hard-boiled candies	Flavour/ colour	Water	Sucrose	Glucose syrup	Polyols
Standard formulation (%)	1	3	48	48	_
Formulation with polyols (%)	1	3	_	_	96
Energy (kcal)	_	_	384		230.4
Energy reduction on total product (%)	-40%				

Worldwide, **60-90% of school children** and nearly 100% of adults have dental cavities.

Traditional curative dental care is a significant economic burden for many high-income countries, where **5-10% of public health expenditure relates to oral health**.

Source: WHO – Oral health fact sheet 318 – April 2012

Polyols help to improve dental health

Tooth decay is caused by micro-organisms that live in the mouth. These micro-organisms live on sugars that they ferment into acid waste products. It is these acids that cause tooth decay by dissolving the tooth enamel, a process called “demineralisation”.

Research has shown that polyols do not have the same effect on teeth as sugars because they are a poor source of energy for the micro-organisms that cause tooth decay. This means that, unlike sugars, polyols are not fermented into decay-causing acids. For this reason **they have been described as “tooth friendly” or non-cariogenic sweeteners.**

A minority of Europeans still have all their natural teeth: **41% state that they have all their natural teeth** while a third of them say that they still have 20 natural teeth or more.

Source: Special Eurobarometer 330 – Report Oral Health – Published February 2010

Based on an EFSA opinion[5], the following health claim is permitted in the European Union for foods in which sugars are replaced with polyols under determined conditions:

“Consumption of foods/drinks containing [polyol’s name] instead of sugar contributes to the maintenance of tooth mineralisation”[6]

Polyols help to improve glycaemic control

Normally, when a person's blood glucose level rises – after a meal for example – their body produces insulin. This insulin then helps to transport the glucose into the cells of the body where it can be converted into energy. However people with diabetes are either unable to produce enough insulin (known as type 1 diabetes) or their tissues have become resistant to insulin, making it harder for glucose to enter the body's cells for further metabolism (known as type 2 – or adult onset – diabetes, which is common in overweight people).

Polyols are a useful tool in enabling people to control their blood-glucose and insulin levels; research has shown that all polyols have lower glycaemic and insulinemic values than both glucose and sucrose. This means that they can be used to help people achieve lower blood glucose and insulin levels – important for everyone, but especially for those with diabetes or hyperinsulinism.

Based on an EFSA opinion[5], the following health claim is permitted in the European Union for foods in which sugars are replaced with polyols under determined conditions:

"Consumption of foods/drinks containing [polyol's name] instead of sugar induces a lower blood glucose rise after their consumption compared to sugar-containing foods drinks"[6].

About **60 million people in the European Region have diabetes**, and the prevalence is increasing in all age groups, already affecting 10-15% of the population in some Member States.

Source: WHO World Health Day 2016: diabetes

[1] Livesey G. Health potential of polyols as sugar replacers, with emphasis on low glycaemic properties.

[2] Definitions are laid down in Regulation (EU) 1169/2011:
- "Sugars" means all monosaccharides and disaccharides present in food, but excludes polyols.
- "Polyols" means alcohols containing more than two hydroxyl groups.

[3] Regulation (EC) 1333/2008.

[4] Regulation (EU) 1169/2011.

[5] EFSA opinion on the substantiation of health claims related to the sugar replacers xylitol, sorbitol, mannitol, maltitol, lactitol, isomalt, erythritol, D-tagatose, isomaltulose, sucralose and polydextrose and maintenance of tooth mineralisation by decreasing tooth demineralisation and reduction of postprandial glycaemic responses pursuant to Article 13(1) of Regulation (EC) 19624/2006. EFSA Journal 2011; 9 (4): 2076.

[6] Regulation (EU) 432/2012.

EPA is the European Association of Polyol Producers, which regroups the world leader producers of polyols. EPA aims to provide scientifically-based information about polyols to interested parties including consumers, health practitioners and regulatory bodies.

EPA's identification number in the EU Joint Transparency Register: 96540262048-16

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