SCIENTIFIC BACKGROUND

# Toothfriendly gummy candies

## Formulating jellies without cariogenic or erosive potential

# Healthy teeth, healthy belly?

*Dr. Albert Bär explains which non-laxative Toothfriendly ingredients are particularly interesting for jelly manufacturers.*

The risk of gastro-intestinal discomfort – bloating or diarrea– has been the biggest bottle-neck hampering the development of sugar-free gummy candies. For products which are eaten in large amounts, and are mainly consumed by children, a good tolerance is essential. There are, however, a handful of non-laxative ingredients – sweeteners, soluble fibers and jelling agents – which facilitate the production of Toothfriendly gummy candies.

## Erythritol

Among the polyols, only erythritol comes with an execptionally good intestinal tolerance. First introduced in Japan, erythritol hit the US market in 1997 and achieved EU's approval in 2006, making it available for confectionery producers worldwide. Being a well tolerated bulk sweetener, erythritol is an interesting candidate for the formulation of sugar-free gummy bears as it provides practically zero calories.

So far we have seen plenty of erythritol-containing chewing gum launches but technically, it is possible to include erythritol also in candies. However, as erythritol has a low solubility and a tendency to crystallize, it is usually not the primary candidate for candies with a soft and translucent texture. It could work as part of the sweetening mix though.

## Isomaltulose

Another non-laxative bulk sweetener making waves is isomaltulose, a fully digestible toothfriendly carbohydrate often quoted as the "next generation sugar". Isomaltulose made its confectionery debut with Barry Callebaut's toothfriendly chocolate, a non-laxative cocoa innovation marketed especially for children.

While isomaltulose does not qualify for the "sugar-free" claim – as it is, chemically speaking, a sugar-products sweetened with isomaltulose can be labeled as "Toothfriendly", provided that no other cariogenic or erosive ingredients are added.

So far gummy bears with isomaltulose have been produced on small-scale only, but the results look promising. Since isomaltulose is derived from pure sugar beet it gives gummy bears a sugar-like taste being very similar to the one of traditional gummy bears. However, taste always goes hand in hand with flavour and therefore can be individually defined. Depending on the hydrocolloids used in individual recipes - be it gelatine or pectine - different results can be achieved.

What could be a potential challenge for isomaltulose-based gummy candies is the fact that under EU food regulations confectionery with added sugars (such as isomaltulose) may not contain sweeteners at the same time. This difficulty may be – at least partly - overcome by using intense sweeteners such as neohesperidine DC as a sweetness enhancer.

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## D-Psicose

In future, pure D-psicose (D-allulose) may attract particular interest by confectionery manufacturers because this novel sugar may be Toothfriendly but not laxative. It also appears to have a very low energy value. At the moment, however, its use is limited to certain countries (e.g. Japan, US).

## Intense sweeteners

All intense sweeteners that are authorized for use in food production are fit for formulating Toothfriendly gummy candies. Although not all of them have been tested specifically, it is clear that they will not have an impact on plaque pH at the required low levels of use.

## With caution: polyols

Most polyols are safe for teeth and suitable for the production of Toothfriendly confectionery. This being said, most polyols (with the notable exception of erythritol) are not fully absorbed in the gut and may cause abdominal discomfort in susceptible individuals if consumed in excessive amounts. As a result, foods that contain more than 10% added polyols must bear the statement “Excess consumption may produce laxative effects.”

Besides polyols, also pure resistant maltodextrin, polydextrose and gellan gum and certain other polymeric carbohydrates are not fermented by oral bacteria. These ingredients are, therefore, suitable as thickening and bulking ingredients for the formulation of toothfriendly confectionery.

However, it must be noted that certain complex carbohydrates may contain fermentable by-products and/or may be degraded to fermentable breakdown products during the food production process which makes them unsuitable for the production of dentally safe confectionery.

In other words, the fermentability of a food ingredient (sugar, oligosaccharide, polysaccharide, sugar alcohol) cannot be predicted with certainty from its chemical structure. Each of these carbohydrate categories contains products which may be fermentable and products which are not fermentable.

## Soluble fibers

Besides opting for non-laxative sweeteners, it is possible to improve the intestinal tolerance of Toothfriendly gummy candies by replacing some of the bulk sweeteners with soluble fibers. Fibers are tasteless and add little or no sweetness to the end product, meaning that the final sweetness may have to be adjusted with intense sweeteners.

*It is not possible to conclude that „sugar-free“ foods generally and by definition are Toothfriendly, as it is often believed erroneously.*

Nutriose FB is an example of a soluble fiber which exhibits an outstanding digestive tolerance, allowing incorporation at higher levels than certain other carbohydrates. It works well in soft gums, gelatin jellies, jelly babies or pectin jellies. If the goal is to create sugar-free gummy bears with higher digestive tolerance, Nutriose can be used to replace some of the bulk sweeteners.

Roquette, the manufacturer of Nutriose, has conducted long-term clinical studies demonstrating that the consumption of 45 grams of nutriose-enriched products evokes no gastrointestinal side effects, provided that no other laxative ingredients are included.


## Gelatine

Gelatine is a pure, natural collagen protein. In water, it swells rapidly and forms a clear, jelly-like mass when it cools down. Being neutral in taste and odour, gelatine has no negative impact on the sensory properties of the foods it is used in. Moreover, gelatine has no laxative or cariogenic potential – a vital advantage for confectionery manufacturers.

Since gelatine is a natural foodstuff, its use is neither limited nor restricted, and nor does it have an “E-number” – something that may be important for products destined for sale in European markets.

## With caution: food acids

Food acids, such as citric, tartaric and ascorbic acid are usually added to fruit- and berry- or cola-flavored candies.

Such food acids may have an adverse effect on dental health in different ways. Upon frequent and prolonged contact with the teeth, they may directly lead to erosion (demineralization) of the tooth surface (Lussi et al., 2004). Furthermore, food acids may acidify the dental plaque for an extended period of time depending upon the mode of consumption (for example: eating candies in small but frequent portions for a considerable lenght of time), thereby promoting not only demineralization of the tooth surface underneath the plaque but also the growth of acid-tolerant and thus particularly cariogenic plaque bacteria, such as Streptococcus mutans (Svanberg, 1980).

Candies which contain excessive amounts of food acids, may therefore, have a damaging effect on teeth and are not Toothfriendly, even if they do not contain any fermentable carbohydrates.

# Toothfriendly gummy candies

*The ‚Toothfriendly' standard - each product must be non-cariogenic and non-erosive under normal conditions of use - meets the toughest guidelines set by the dental profession.*

## Measuring the cariogenic potential of gummy candies

Toothfriendly candies should not contain unacceptable amounts of (a) carbohydrates that can be fermented by the dental plaque nor (b) food acids that directly attack the tooth surface.

The „Toothfriendly" properties of candies and other foodstuff can only be determined in-vivo because factors such as the dissolution time of a food (in the case of candies), contact time with the teeth (e.g., size of a candy) and neutralization of the acid(s) by saliva influence the magnitude of the erosive potential.

The method, which determines plaque-pH under the most realistic conditions, is the so-called plaque-pH telemetry. In this method, the pH is measured in human volunteers, i.e., *in-vivo*, with a so-called „indwelling" electrode, an electrode which is inserted in the artificial tooth of a partial prothesis. This electrode is facing an interproximal site (i.e., a predilection site of caries) and is covered by normal dental plaque that has accumulated on the electrode during a period of at least three but not more than seven days. With this method, the plaque-pH is measured on the tooth surface, i.e. under the dental plaque, or – in other words – at exactly the site where caries often occurs (Imfeld, 1983).

A candy, which during consumption and for 30 minutes after consumption does not depress the plaque-pH below 5.7, as measured by in-vivo plaque-pH telemetry, lacks a significant acidogenic potential and does, therefore, not expose the teeth to a significant risk of caries.

A candy, which during normal consumption does not expose teeth to an acid load of more than 40 µmol H+ x min, as measured in-vivo by means of a plaque-free indwelling electrode, does not bear a significant erosive potential.

The method and its application have been described in detail (Imfeld, 1983), but it has also been referred to in numerous scientific publications (e.g., Lingström et al., 1993). At present, plaque-pH telemetry is routinely applied at three university institutes (in Switzerland, Germany, China and soon in Thailand) for the determination of the cariogenic and erosive potential of foods.

## References


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*Figure 1. Volunteer is eating a sugar-free candy (circa 3-5 minutes). Before, during, and for 30 minutes after, the pH of the plaque is measured. As the product does not depress the plaque pH below the critical level of 5.7, it is considered non-cariogenic. After paraffin chewing a positive control with sucrose solution demonstrates that the plaque pH drops below 4.5 after sugar consumption.*