

facts



Erythritol makes a difference –
tasty and creamy ice cream
without added sugar

Jungbunzlauer

*From nature
to ingredients®*

Introduction



A thorough analysis of today's ice cream market has revealed that sugar reduction in the industry is still in its infancy. While sugar reduction could be used as a tool to provide a healthy value added to ice cream, the reason for the finding is quite simple: ice cream is not a food product we consume for its nutritional value. Ice cream is eaten for fun and for pleasure – it is no more than an indulgence. In this respect, it is similar to chocolate and certain types of candies which have the lowest number of sugar reduction or calorie saving claims in the whole food range.

An indulging treat should, however, not automatically mean that we have to accept the high levels of sugars and calories that ice cream has traditionally been associated with. Indeed, there is a segment of consumers who are looking for an alternative to sugar and calorie laden ice creams and it is up to the industry to deliver such a product to the stores. The minimum requirement for an ice cream maker when marketing such types of ice cream is that the finished product exhibits nutrition or health benefits which the consumer can clearly see as approved claims. If this is not achieved, the consumer will not notice the special character of the product and ignore the innovations. However, once the attention of the consumers has been drawn to this novelty, they will want to be satisfied by a taste that is in no way less convincing than the regular product.

The purpose of this paper will therefore be to highlight how to use the fermentation-based bulk sweetener erythritol in order to formulate a no sugar added dairy-based ice cream that maintains the original sugar-based taste and indulgence value.

Erythritol makes a difference

Erythritol is the first natural polyol, manufactured by a fermentation-based process. Aside from its natural status, its main benefit is a caloric value of zero (in Europe and Japan, 0.2 kcal/g in the USA) which makes it an excellent bulk sweetener to formulate mid, low, and zero calorie foods and beverages (1). It is quickly absorbed and excreted un-metabolised by the human body. This physiological characteristic makes it the best tolerated polyol – not only for diabetics but for anyone looking for health-conscious nutrition. Erythritol delivers a clean sweet taste with a 60–70% sweetness level of sugar.

With regards to ice cream, erythritol has three important advantages when compared to classical polyols. Firstly, erythritol is a zero calorie sweetener whereas other polyols add 2.4 kcal/100g (1). Secondly, no-added-sugar ice creams based on sorbitol and/or maltitol often impart an artificial taste impression. Using erythritol, however, creates a taste and sweetness impression very close to a sugar-based recipe. Lastly, the human gut tolerates erythritol much better than classical polyols and that leads to significantly less digestive stress. Overall erythritol is ideal for the formulation of ice cream with reduced sugar and calorie content as it reduces calories while still providing texture and a pleasant sugar-like taste.

In Table 1, a typical ice cream composition is displayed. Both the mono- and disaccharide content as well as the cream can vary widely. In contrast, the dry matter is in a rather narrow range as its variation can easily make the texture hard/crumbly or too cold.

Table 1: A typical ice cream composition

Ingredient	%
Semi-skimmed milk	46.59
Cream	31.00
Sucrose	13.00
Skimmed milk powder	4.60
Dry glucose syrup	4.00
Emulsifier	0.40
Flavour	0.25
Stabiliser	0.16
Dry matter content	38.70

Nutrition claims

In contrast to other global markets, the European Union only allows the use of sugar alcohol bulk sweeteners if their use (alone or in combination with other polyols) leads to a qualified claim on “With no added sugars” or a reduction of calories. According to EC Regulation 1924/2006, a “With no added sugars” claim is qualified when the product does not contain any added mono- or disaccharides or any other food used for its sweetening properties (2). This definition allows the use of polyols if their purpose of use is bulking.

Dealing with polyols brings along a second labelling consideration in Europe. Once the sum of all polyols in the finished product exceeds 10%, the well-known laxation warning needs to be visible on the product label. In this development exercise, the target was the avoidance of the laxative warning (1).

Working on sugar reduction

The above example of a typical ice cream contains two types of sugar. Sucrose is used as a sweetener and bulking agent, while glucose syrup’s main task is controlling the crystallisation of sucrose. In a first step the target was to replace the sucrose, followed by finding a suitable option to replace the glucose syrup. The following characteristics had to be maintained:

- Dry matter content
- Texture and creaminess
- Taste
- Freezing properties

Special attention needs to be paid to the freezing properties. The carbohydrates present in the formulation strongly influence the freezing point through their inherent freezing point depression factor (fpdf). A change in the fpdf alters the temperature at which the liquid ice cream mix freezes over and becomes solid ice cream. If the freezing point is depressed too much, then the ice cream will be too soft. If the freezing point is too high, the ice cream will be too hard, which is adverse to pleasant consumption. It is imperative that the sugar replacement achieves a similar freezing point depression factor.

In order to get a basic understanding of how erythritol influences the ice cream texture and its sensory profile, the above mentioned full sugar recipe was adapted towards a “With no added sugars” claim.

In the initial trials, increasing levels of erythritol were used to replace sugar. The trend observed was that increasing quantities of erythritol led to a harder ice cream and an increasing cold feeling upon sensory testing. This is the consequence of two properties of erythritol.

- 1) Its small molecular size (1/3 of sucrose) gives it a threefold of freezing point depression factor. The ice cream consequently needs to be chilled to lower temperatures in order to achieve the desired texture.
- 2) Erythritol has a much stronger tendency to crystallise after freezing which hardens the texture strongly during initial storage.

The hardening observed has a negative impact on the softness and taste impression of the ice cream and needs to be limited. Besides sensory testing, texture analysis was consequently an integral part of the product analysis in the frame of these trials. As a result of the pre-trials, it was determined that the ideal usage level of erythritol should be in the range of 6.5–8.0% based on the total recipe. A minimum of 6.5% should be used to fully exploit erythritol's positive influence on the taste performance. An erythritol level beyond 8.0%, however, will create an overall hardening of the texture which cannot be reversed through the addition of other ingredients.



The complete sugar reduction is achieved by taking out the crystallisation inhibiting glucose syrup. However, due to erythritol's strong crystallisation behaviour, a crystallisation inhibitor is indispensable. Several options from the polyol range were tested in the frame of the project. It was found that sorbitol, maltitol, xylitol and their mixtures, all perform quite well alongside erythritol. It was also discovered that all three indeed soften the ice cream structure. This creates a great toolbox where the polyol pair can be varied to modify product hardness and creaminess. The actual second polyol can be chosen according to individual preference as they all will harmonise with erythritol. Texture as well as sensory analysis revealed that the preferred polyol ratio should be in a range of three parts erythritol to two parts of the second polyol.

“With no added sugars” claim, but no EU polyol warning

In order to achieve the “With no added sugars” claim and, at the same time avoid the mandatory EU laxative warning, an additional bulking agent is needed in the formulation.

Table 2: Dry matter difference between the full sugar and the polyol based sweetening system

Sweetening system	Reference %	No added sugar %
Sucrose	13.00	–
Dry glucose syrup	4.00	–
Erythritol	–	6.50
Sorbitol	–	3.40
Dry matter	17.00	9.90
Difference		7.10

Inulin, fructooligosaccharides (FOS), mixtures of both and polydextrose were reviewed in order to find the best addition to the formulation. All the products have interesting effects on the ice cream by adding bulk and by adding similar creamy sensory attributes. Fibres of course also have a positive effect on the digestive system. When the remaining dry matter gap after elimination of the sugar and glucose syrup and after addition of 9.9% of polyols is filled with either fibre, the end product will become eligible to the EU “high in fibre” claim, as it exceeds the minimum amount of 6g fibre/100g (2). All mentioned fibres modify the taste and sensory properties in a similar way. However, the first choice was polydextrose as it softens the ice cream texture slightly more effectively than inulin or FOS.

Managing sweetness

Since polyols (with the exception of xylitol and maltitol) and also the discussed fibres all offer a sweetness level which is significantly below sugar equivalence, the final formulation needed to be enriched with high intensity sweeteners. Sucralose was therefore used in this case. It is the most commonly used high intensity sweetener in frozen desserts and harmonised well with the overall flavour profile.

Summary

This paper highlights a development process for an ice cream that is eligible to a “With no added sugars” claim. Erythritol, a natural zero calorie sweetener with a sugar-like taste is used to replace sucrose from a traditional sugar based recipe. Sorbitol is used as an additional polyol in the formulation to level out the freezing point depression factor of the sweetening system and to create the freezing properties of the original formulation. Polydextrose is used to give more bulk to the recipe as the polyol usage was limited to below 10% in order to avoid a laxative warning. Sucralose is used to bring overall sweetness and flavour to equilibrium.

The “With no added sugars” recipe, frozen with a similar level of overrun of about 80%, offers a creaminess and scoopability similar to the sugar original. It exhibits a pleasant melting behaviour and imparts a well-rounded taste impression. The formulation can also easily be adapted to bear an “Energy-reduced” claim. The present calorie count is 26% less than the full sugar version. Stepwise replacement of fat through fibres can lead to a 30% calorie cut, which is the minimum reduction for an “Energy-reduced” claim.

Table 3: Recipes for full sugar and “With no added sugars” ice cream

Ingredients	Standard (full sugar) %	“With no added sugars” %
Cream	31.00	31.00
Semi-skimmed milk (1,5%)	46.59	46.59
Skimmed milk powder	4.60	4.60
Emulsifier	0.40	0.40
Stabiliser	0.16	0.16
Flavour	0.25	0.25
Sugar	13.00	–
Glucose syrup (dry)	4.00	–
ERYLITE® Erythritol	–	6.50
Sorbitol	–	3.40
Sucralose	–	0.01
Polydextrose	–	7.10
Dry matter	38.30	37.60
Calories (kcal/100g)	201.62	149.19
Calorie reduction		26.00



Directions

1. Weigh dry ingredients together. Mix well.
2. Add dry mix to milk and cream and mix thoroughly until smooth.
3. Heat mix to 55°C, hold for 20 minutes.
4. Pasteurize (85°C/30 sec) and homogenize (150/30 bar) mix. Cool down to 5°C.
5. Age mix at 4-5°C for 12 hours.
6. Add flavour and mix again before freezing.
7. Freeze mix at -7°C to attain an overrun of 100%.
8. Shock freeze (-40°C) ice cream immediately.
9. Store in shock freezer for at least 48 hours, then store at -20°C.

About Jungbunzlauer

Jungbunzlauer is one of the world's leading producers of biodegradable ingredients of natural origin. We enable our customers to manufacture healthier, safer, tastier and more sustainable products. Due to continuous investments, state-of-the-art manufacturing processes and comprehensive quality management, we are able to assure outstanding product quality. Our mission "From nature to ingredients®" commits us to the protection of people and their environment.

Jungbunzlauer offers ERYLITE® Erythritol as pure bulk sweetener as well as ERYLITE® Stevia, blends of ERYLITE® with steviol glycosides at different sweetness levels.

References

- (1) REGULATION (EU) No 1169/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 October 2011 on the provision of food information to consumers
- (2) REGULATION (EC) No 1924/2006 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 20 December 2006 on nutrition and health claims made on foods

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