Sucralose – Technological Justification

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Sucralose – Technological Justification

Introduction

Sucralose is a new high quality intense sweetener, which is suitable for use in a diverse range of food products from carbonated beverages to baked goods. Sucralose is made from sugar and is on average 600 times sweeter than sugar. It has taste characteristics which are very similar to sugar, and is also extremely stable. Sucralose maintains its sweetness even when exposed to high temperature food processing such as pasteurisation, sterilisation, UHT processing and baking. In addition, it remains stable in food products throughout extended periods of storage, even at low pH.
(see appendix 1)

Sensory Characteristics

Sweetness Intensity

Studies have shown that sucralose is a high quality sweetener with a sugar-like taste and a sweetening power approximately 600 times that of sugar. Like all other high intensity sweeteners, the relative sweetness intensity of sucralose compared to sugar varies as a function of concentration. The sweetness factor for sucralose in water has been shown experimentally to range from about 750 to 500 times sweeter than sugar (see appendix 2).

In common with all intense sweeteners, the potency of sucralose in foods and beverages varies depending on the concentration used and the other ingredients present. The higher the usage levels of sucralose, the lower the potency. Also ingredients such as fats, acids, etc, tend to reduce the potency of sweeteners including sucralose. Therefore it is not appropriate to use a sweetness factor of 600 for sucralose across all applications. For food products with a high sweetness intensity and/or a high fat content (for example), the potency of sucralose has been shown to be as low as 400 times sweeter than sugar (See appendix 3).

Table 6 in appendix 3, “Sucralose: It’s properties and Applications” shows the sweetness potency for sucralose in a range of food products, covering the main categories petitioned for in the proposed amendment to the Sweeteners Directive. The prototype sucralose levels were chosen so that the sweetness intensity matched that of a typical sugar sweetened product. The sweetness potency, for a particular product, was then determined by comparing the sucralose level with the sugar content of the standard product. The results show clearly that the sweetness potency of sucralose varies between different food product formulations.

In some cases, such as the cake and cookie, the potency calculated is really too high as the sugar in the standard product is providing a lot more than just sweetness. So in fact the sucralose is really only replacing a portion of the sugar and not the entire amount.

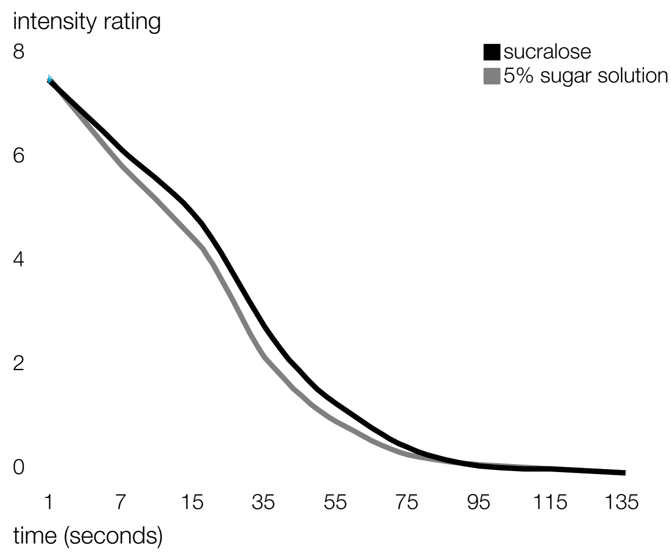
Summary Table 1: Sweetness Factors for Sucralose in Food Products

Cola	450
Jam	540
Strawberry Milk	680
Yoghurt	450
Canned Peaches	530
Beans in Tomato Sauce	680

Sweetness and Flavour Profile

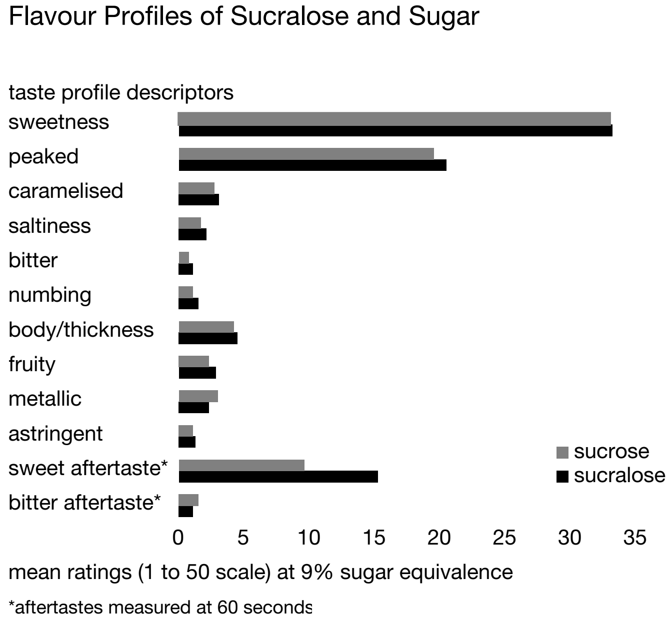
Time intensity measurements have demonstrated that the sweetness profile of sucralose is very similar to that of sugar (Figure 1). Sucralose displays a rapid onset of sweetness and a similar sweetness duration to sugar.

Figure 1:



In addition to sweetness, sweeteners possess a number of side tastes that give rise to an overall flavour. To compare the flavour profiles, equisweet solutions of sucralose and sugar, equivalent to 9% sugar and prepared in water of neutral pH, were evaluated by a 12 member taste panel. The key taste attributes were assigned a score rating by each individual member and then the scores were averaged. The results produced confirm that the flavour profiles of sucralose and sugar are very similar.

Figure 2:



Furthermore, sucralose has been shown to maintain its sweetness and flavour throughout storage, without the development of off-flavours.

Stability

One of the major technical advantages of sucralose is its stability to high temperature food processing and long term storage, even when used in low pH products.

Process Stability

The stability of sucralose during food manufacture has been confirmed by a series of processing trials, covering the main processes used in the food industry. Generally, the trials were conducted using industrial equipment and in all cases, analysis of the samples confirmed that no measurable loss of sucralose had occurred during processing (see appendix 4). The stability of sucralose was confirmed by analysis following pasteurisation, sterilisation, UHT and baking. All the results provided in the various reports indicate that sucralose is remarkably stable to all the different food processing conditions.

For example, the detailed programme of work undertaken to assess the stability of sucralose in baked products showed even using diverse baking conditions that no measurable loss of sucralose had occurred during the preparation of:

- Sponge cake cooked at 180°C for 25 minutes
- Cookies baked at 210°C for 8 minutes
- Crackers baked at 230° for 4 minutes

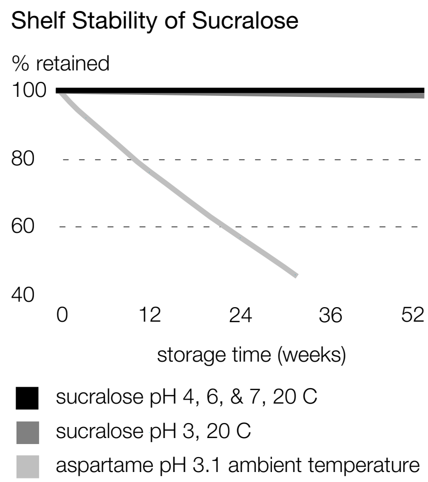
Shelf Life Stability

Shelf life studies have likewise demonstrated that sucralose sweetened products retain their sweetness throughout extended periods of storage. This uniform sweetness has also been shown to promote a more consistent overall flavour and can help reduce the incidences of off-flavours developing during the shelf life of the product (see appendix 5).

Sucralose is most stable in the pH range of 5-6, with the stability increasing as the pH increases from pH 1 to about pH 5.5. Thus, sucralose exhibits excellent shelf life stability in neutral pH products, as well as acidic products.

In summary, Figure 3 shows the degree to which sucralose hydrolysis occurs during storage at 20°C under different pH conditions and illustrates the stability of sucralose to acidic conditions.

Figure 3:



At pH 3, less than 0.5% sucralose is lost, while no significant change occurs at pH's 4, 6 and 7.

The results provided in Table 2 and appendix 6 demonstrate the stability of sucralose in a carbonated cola system over a 6 month period when stored at 20°C.

Table 2: Shelf Life Stability of Sucralose in Carbonated Cola

	Sucralose pH 3 Formulation	**Sucralose pH 2.7 Formulation**
Zero time	191 ppm (± 1.0%)	184 ppm (± 0.7%)
5 weeks	198 ppm (± 1.0%)	182 ppm (± 1.0%)
10 weeks	192 ppm (± 0.9%)	183 ppm (± 0.8%)
17 weeks	194 ppm (± 1.5%)	183 ppm (± 0.8%)
25 weeks	194 ppm (± 0.6%)	184 ppm (± 0.8%)

The stability of sucralose has also been shown to be unaffected by the presence of ethanol. Sucralose is suitable, therefore, for use in alcoholic beverages.

Interaction with Food Ingredients

In addition to determining the stability of sucralose in aqueous solution, studies were conducted to ascertain whether sucralose is likely to interact with other food ingredients (See appendix 7).

From a theoretical standpoint sucralose would be expected to be unreactive (apart from slow acid hydrolysis), and this is borne out in practice. A variety of food products have been stored for prolonged periods without loss of sweetness or the development of off-flavours. Furthermore, specific studies have confirmed that sucralose is unlikely to undergo interactions with any commonly used food ingredients.

Summary

Prototype product development has shown that sucralose provides the food industry with a number of benefits over the pre-existing high intensity sweeteners in the market place. Sucralose is unique in that it not only provides a remarkable sugar-like taste but that it is also extremely stable to the major food manufacturing conditions and over time. While the current sweeteners in the market place can either offer a good taste or stability, none can offer both of these characteristics together. The prototype product development within Tate & Lyle has also highlighted the fact that the sweetness intensity of sucralose differs not only between different products but also within products depending on the different flavouring systems and ingredients being used. Consequently, the sweetness intensity of sucralose has been seen to range between 750 and 400 times sweeter than sugar. As a result of these technical attributes (taste and stability) the food industry within the EU has developed a conditions of use table, requesting the levels of usage as laid down in the current proposed draft amendment to the sweeteners directive. In support of the benefits and functionality of sucralose in these food categories the food and beverage industry from around the world have already developed and marketed a number of new products (appendix 8).