



## The product-by-product sugar reduction challenge

Using sensory science to determine the optimal sugar  
substitute

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A Leatherhead Food  
Research white paper

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# The product-by-product sugar reduction challenge

While sugar substitutes, sweeteners and sweetness enhancers are widely available, the technical challenges of sugar reduction and replacement require product developers to find the substitute(s) which works for each individual product. In this white paper, Elena Petra discusses the vital role sensory research plays in finding that all important ingredient match with sugar.

In recent years, several studies have been published that associate sugar consumption with certain health risks. Some health professionals say sugar is directly linked to the obesity epidemic. They believe a hard-line approach is required, like the anti-smoking campaign of the 1970s. Consumer attitudes are also changing and the demand for products with low to no sugar is higher than ever before.

Sugar reduction can potentially play a role in the fight against obesity and in nudging consumers towards healthier choices. Industry stakeholders are generally working towards achieving the sugar reduction targets set out in guidelines from public health bodies. Brands failing to adapt to the new circumstances are likely to fall short on consumer acceptability.

## **Why is sugar reduction a sensory challenge?**

Replacing sugar is not as simple as food developers would like. It contributes to texture, viscosity and mouthfeel and has a non-lingering aftertaste. Sugar is such a longstanding ingredient that consumers directly associate 'sweetness' with characteristics that only sugar can impart to a

food. In other words, the learned experience, developed via increased and repeated exposure to sugar, makes the quest for its replacement even more difficult.

## **Each substitute ingredient poses unique sensory challenges**

Sensory research is of utmost importance in choosing the most suitable ingredient for sugar replacement. A vast number of potential sweeteners, sweetness enhancers and ingredient blends are available. Each has its own characteristics and impacts on the overall sensory experience.

Artificial sweeteners such as acesulfame-K or aspartame have been used for many years and new ones continue to emerge. In terms of the intrinsic sensory properties of artificial ingredients, most are known to bring out metallic or bitter notes and can hardly match the rich body, mouthfeel and viscosity that sugar imparts to a food matrix. Furthermore, common misconceptions around the impacts of artificial ingredients on health add to the selection challenge.

Natural sweeteners such as stevia are gaining ground, however they bring their own taste and textural challenges. Research has shown

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that inclusion of stevia can impart liquorice notes, lingering sweetness, and a different behaviour during consumption at certain concentrations.

### **Creating an ingredient shortlist with preliminary sensory evaluation**

In order to tackle the issue of ingredient availability and to narrow down the list of potential sugar substitutes, a number of preliminary sensory techniques can be used. These include discrimination tests, ranking between samples or rating between trial samples and a control. Deployed at an early stage in product development, it is a more efficient and cost-effective approach than producing and evaluating full trial formulations with each available ingredient.

### **Choosing the appropriate sensory method to evaluate the substitute ingredient**

Once a shortlist of substitutes has been identified, detailed evaluation of trial formulations is the next step. A wide range of sensory methods can be applied to investigate and understand the effects of a sugar substitution. However, the challenge is to choose the most appropriate method to address the impact of the respective ingredient. In a simple scenario, the shortlist will comprise known, previously used compounds so the sensory expert has a baseline understanding from which to experiment around samples. With novel ingredients, a more extensive approach and deeper consideration may be required.

### **Which descriptive sensory methods are most relevant?**

A trained panel can profile a control recipe (sugar) against several trial samples incorporating substitute ingredients at various concentrations. A sensory profile of each formulation is created, providing a detailed description of sensory attributes to ascertain differences between trial samples and the control recipe.

However, this traditional profiling method is not always appropriate when evaluating sweeteners. Alternative techniques might better capture the temporal effects, delayed turnout or intensity changes in flavour and aftertaste that several sugar substitutes are known to demonstrate. Methods to consider include Progressive Profiling with its focus on fewer sensory descriptors. Time Intensity tracks the most relevant sensory characteristics and monitors their intensities over consumption. Last but not least, Temporal Dominance of Sensations does not consider attribute intensities, but is there to identify and track the most striking attribute during the consumption experience.

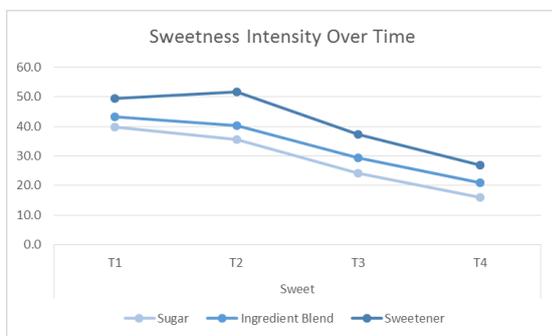
### **A case study in the sensory evaluation of sugar replacement**

Leatherhead Food Research conducted a sugar reduction project focussing on increasing sweetness perception for two different products. It involved the evaluation of formulations that used a particular sweetener and an ingredient blend.

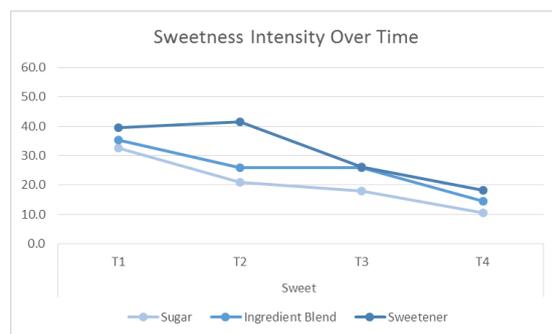
The Time Intensity method was used to capture changes in intensity for both products in all formulations as well as the control (sugar) over time of perception. Figures 1 and

2 illustrate the behaviour of sweetness for all formulations and the control of each product.

This study highlights the issues a product developer must consider when replacing sugar. The same substitute solution influences sweetness perception differently across the two different products. More specifically, at the third time point (T3) of evaluation in Product 1, panellists found the sweetener formulation to be more intense than the ingredient blend formulation. However, in Product 2 they were of almost equal intensity. This kind of



**Figure 1:** Sweetness intensity at 4 different time points (T1-T4) for sugar, ingredient blend and sweetener formulation for Product 1



**Figure 2:** Sweetness intensity at 4 different time points (T1-T4) for sugar, ingredient blend and sweetener formulation for Product 2

information is essential to the product developer in order to decide the most appropriate ingredient to use for substitution.

## Combining sensory science with microscopy in sugar replacement decisions

Microscopic analysis of samples reveals the nature of structural changes to the distribution and interaction of ingredients when sugar is replaced with a bulk sweetener. This can inform the development of a product blueprint that also maps features such as colour, taste and texture.

Overlaying sensory evaluation with microscopic evidence provides a deeper understanding of how sugar replacement impacts foods at a structural and textural level. This insight puts the manufacturer in a stronger position to reduce sugar or reformulate to create healthier products while retaining features that delight consumers. Find out more about Leatherhead's blueprinting technique in our white paper, [Building a product blueprint for successful innovation](#).

## How can consumer methods contribute?

A trained sensory panel has the advantage of providing objective measurements of the differences between product samples. However, it does not indicate consumer perception. Consumer data can be used to supplement the sensory information for each sample, enriching and enabling the product developer's decision-making process. Consumer methods such as Ideal Profile (which helps compare a sample against consumers' vision of the ideal one), Temporal Drivers of Liking in combination with Temporal Dominance of Sensations (which identifies drivers of liking with respect to attribute dominance over consumption time), Just About Right scales or Liking scores add value

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to the information obtained for each product or formulation variation. This empowers food developers and marketing teams to make a fully informed decision on the optimal ingredient(s) to incorporate into their product.

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## **How Leatherhead can help**

Leatherhead Food Research can aid food and beverage sugar reduction strategies with a full range of sensory discrimination and descriptive tests. Our trained sensory panel provides detailed product evaluation and an 11,000-strong consumer database supports the decision-making process, enabling us to target specific consumer groups or capture global consumer perception.

Close collaboration with the science and innovation team at Leatherhead provides an additional layer of scientific understanding via techniques such as microscopy.

## **About the author**

Elena is a Consumer and Sensory Scientist within the Consumer, Sensory and Market Insight department at Leatherhead. Her role involves client communication, project management, data analysis and reporting. After completing her BSc studies in Nutrition and Food Science in Greece, Elena obtained an MSc in Sensory Science from Wageningen University (Netherlands). Following her studies, she worked in PepsiCo's Sensory & Consumer Insights department (Hamburg R&D Centre) before joining Leatherhead Food Research.

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### About Leatherhead Food Research

Leatherhead Food Research provides expertise and support to the global food and drinks sector with practical solutions that cover all stages of a product's life cycle from consumer insight, ingredient innovation and sensory testing to food safety consultancy and global regulatory advice. Leatherhead operates a membership programme which represents a who's who of the global food and drinks industry. Supporting all members and clients, large or small, Leatherhead provides consultancy and advice, as well as training, market news, published reports and bespoke projects. Alongside member support and project work, our world-renowned experts deliver cutting-edge research in areas that drive long-term commercial benefit for the food and drinks industry. Leatherhead Food Research is a trading name of Leatherhead Research Ltd, a Science Group (AIM:SAG) company.

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