The science of low calorie sweeteners
– separating fact from fiction

10 Key Facts

1. Obesity remains a major public health problem in the UK - currently 60% of adults and a third of 2-15 year-olds are overweight or obese. Sweetness is a strong stimulant of food/drink intake. Sugar provides sweetness and also contributes towards energy intake. The development of products containing low calorie sweeteners could therefore allow consumers to enjoy sweet foods and drinks with fewer calories. Including some of these foods in the diet in place of sugar-containing alternatives, alongside a range of other small dietary and lifestyle changes, might help to promote weight loss and weight maintenance.

2. Low calorie sweeteners are a class of food additives that provide a sweet taste with the benefit of few calories. They can broadly be divided into two categories – *bulk sweeteners* and *intense sweeteners*. Sugar has a number of physical properties that contribute to the structural and sensory characteristics of food (as well as providing sweetness) and bulk sweeteners are used when these functional characteristics are required. The main class of compounds used as *bulk sweeteners* are sugar alcohols (*e.g.* sorbitol, mannitol, xylitol) and these provide 2.4kcal/g (compared with 4 kcal/g for sucrose). Bulk sweeteners can be used to replace sugar in foods, especially in confectionery and chewing gum. Their use at more than 10g/100g requires a warning statement as larger amounts can lead to gastrointestinal side effects in sensitive individuals..

3. *Intense sweeteners*, as their name implies, are many times sweeter than sugar. Examples include saccharin, aspartame and acesulfame K (ace K) which are up to 200 times sweeter than sucrose. Sucralose and neotame have been more recently approved and are about 600 and 7000 times sweeter than sugar respectively. Intense sweeteners are commonly used to provide sweetness in a wide range of food products including beverages, dairy products, desserts and confectionery. Blends of sweeteners (*e.g.* ace-K/aspartame) can also be used particularly in soft drinks to achieve particular taste profiles. Their use can result in a different 'mouth feel' to sugar. Some intense sweeteners are broken down on digestion (*e.g.* aspartame) while others are not metabolised and are excreted intact (e.g. sucralose)

4. Humans have an innate disposition for sweet tasting foods and drinks. Young infants who are exposed to taste stimuli accept sweet and reject bitter tastes. From an evolutionary perspective, sweetness is associated with calories from sugar and nutritive value, whereas bitterness is associated with dietary toxins (and possible harm). Preferences for sweetness appear to be strongly influenced by age – preferences for intensely sweet taste are higher in infancy and childhood and decline as people get older.

5. All low calorie sweeteners undergo a comprehensive and thorough safety evaluation by regulatory authorities before being approved. As part of this assessment, an *acceptable daily intake* (ADI) level is determined, which is a safe level of human intake over a lifetime. The levels permitted in foods are established so that even high intakes of sweeteners from all sources would not exceed the ADI. Consumption surveys confirm that intakes of low calorie sweeteners are well below the respective ADI values in all population groups.

6. Low calorie sweeteners are used in a range of different food and drink products, particularly in the production of low calorie versions of foods and drinks. However, achieving a good tasting product that remains consistent throughout its shelf life is not always straightforward. Replacing sugar with low calorie sweeteners in foods presents some technical challenges, as sugar has a number of functional characteristics in addition to providing sweet taste. Often, combinations of bulk and intense sweeteners are required to match the taste and texture of sugar-sweetened products. With an understanding of the technical characteristics of different sweeteners, it is possible to produce lower calorie products that still taste good and provide more consumer choice.

7. Initial concerns that intense sweeteners might stimulate rather than decrease energy (calorie) consumption have not been substantiated by more recent studies which suggest a modest decrease in total energy intake in subjects consuming foods containing intense sweeteners, compared to regular products. While some 'compensation' for the missing calories in foods/drinks containing sweeteners is observed, the full energy deficit is not completely offset. Intense sweeteners do not appear to induce the same pancreatic and brain responses as sugars and studies in humans do not support the theory that intense sweeteners disrupt appetite and satiety mechanisms, and therefore the ability to adjust energy intake to needs.

8. Observational studies investigating the role of low calorie sweeteners in weight control have produced some contradictory findings. There are particular difficulties in interpreting these types of studies because, for example, people who are overweight are more likely to consume foods/drinks containing low calorie sweeteners (a case of reverse causality). So far, there have been few intervention studies and these have also produced contradictory results. There is, therefore, a need for more good quality randomised controlled trials (RCTs). However, overall the evidence suggests that (despite partial caloric compensation), beverages sweetened with intense sweeteners can contribute to weight control.

9. Low calorie sweeteners do not influence insulin or blood glucose levels and so have been suggested to be useful for people with diabetes. However, at present, healthy eating guidelines for people with diabetes neither discourage sugar nor encourage sweetener consumption (*e.g.* Diabetes UK). The role of sweeteners in diabetes prevention, management and metabolic health is still unclear, and confounded by the complex physiology of taste and macronutrient and energy balance.

10. With regard to dental health, when sugar-sweetened foods and drinks are consumed frequently, bacteria on the tooth surface convert the fermentable carbohydrates into acid and cause the local pH to fall. Over time, especially if regular brushing with fluoride toothpaste is not carried out, this can eventually wear away the surface of the tooth and cause dental cavities. Low calorie sweeteners are non-fermentable and therefore do not contribute to tooth decay. There is also convincing evidence that chewing sugar-free gum reduces the risk of dental caries.

This is a summary from the British Nutrition Foundation conference 'The science of low calorie sweeteners – separating fact from fiction' held in London on 15th April 2010. Speakers were Prof Judy Buttriss (British Nutrition Foundation), Prof Adam Drewnowski (University of Washington Centre for Obesity Research), Prof Tom Sanders (King's College London), Prof Andrew Renwick (School of Medicine, University of Southampton), Mary Quinlan (Tate & Lyle), Dr France Bellisle (Université Laval, Quebec), Prof Nick Finer (Dept of Medicine, University College London), Dr Colette Shortt (McNeil Nutritionals Ltd) and Ailbhe Fallon (Fallon Currie Consulting, London). Catherine Collins (St George's Hospital NHS Trust) and Brigid McKevith (Cereal Partners UK) also joined the panel discussion. The conference was chaired by Prof John Blundell (Institute of Psychological Sciences, University of Leeds) and Prof Judy Buttriss (British Nutrition Foundation).

For more information about the conference and the British Nutrition Foundation, please see our website: http://www.nutrition.org.uk