



International  
Sweeteners  
Association



## Low calorie sweeteners: Insights into their use, benefits and role in a healthy diet

*Based on latest scientific evidence*

# Content

- 3 An introduction to low calorie sweeteners
- 4 The history of low calorie sweeteners
- 5 The science behind the benefits of low calorie sweeteners
- 11 Calorie-saving swaps as part of a healthy diet
- 12 Behind the headlines:  
The truth about low calorie sweeteners
- 14 Sugar reduction in foods and drinks through reformulation:  
The role of low calorie sweeteners
- 15 References

## What information can I find in this leaflet?

This leaflet has been developed by the International Sweeteners Association (ISA) and aims to provide you with factual, science-based information on low calorie sweeteners, their role and benefits. We hope that it will be a useful resource in which you will find answers to common myths or questions about low calorie sweeteners and insightful information on how they can be used as part of a healthy diet. It includes an overview of the scientific evidence behind the benefits that low calorie sweeteners can offer, as well as further information related to the history, safety assessment and approval of low calorie sweeteners by regulatory authorities in Europe.

### About ISA

The International Sweeteners Association (ISA) is a non-profit making organisation registered under Belgian law representing manufacturers and users of low calorie sweeteners. The ISA is recognised by the European Commission, national and international regulatory authorities, and the World Health Organization, and has Non-Government Observer status with the Codex Alimentarius Commission which establishes international food standards.



For more information, please visit the ISA website: [www.sweeteners.org](http://www.sweeteners.org)

Scan the QR code to download the ISA booklet 'Low calorie sweeteners: Role and benefits' for more detailed, science-based information on low calorie sweeteners' use, safety and benefits.



# An introduction to low calorie sweeteners



Low calorie sweeteners provide us with desirable sweet taste, yet with no, or virtually no, calories, when used to replace sugar in foods and drinks, or as table-top sweeteners. All low calorie sweeteners have a much higher sweetening power than sugar, meaning that they are hundreds of times sweeter than sugar by weight. Only tiny amounts are needed to produce the desired level of sweetness in foods and beverages. This is why they are also usually referred to as *intense sweeteners* or *high intensity sweeteners*.

Low calorie sweeteners have a long history of safe use. The discovery of the first sweetener, saccharin, dates back to over a century ago, in 1879. Since then, a number of low calorie sweeteners including acesulfame potassium, aspartame, cyclamate, saccharin, steviol glycosides (stevia) and sucralose has been developed. For a low calorie sweetener to be approved for use on the market, it must first undergo a thorough safety assessment by the competent food safety authority. In the EU

this is the job of the European Food Safety Authority (EFSA). All approved low calorie sweeteners can therefore be safely used in a variety of sweet-tasting foods and drinks.

Each low calorie sweetener has a unique profile, but they all share the important benefit of providing sweet taste with no/ virtually no calories. They are also non-cariogenic – which means they won't cause tooth decay – and they can be useful to people with diabetes since they do not affect blood glucose levels, unlike sugar. In light of the recent recommendations by health organisations worldwide to reduce the intake of sugar in our everyday diet, low calorie sweeteners actually offer a simple way to do this. They can help us reduce our intake of calories from sugar and still allow for great-tasting sweet products.

## At a glance:

### Low calorie sweeteners...



...provide sweet taste with no/ very few calories



...are used in foods, beverages and table-top sweeteners in very small amounts given their sweetness potency



Their safety has been thoroughly tested and confirmed by regulatory authorities around the world



## Use of low calorie sweeteners in Europe

In the European Union (EU), the European Food Safety Authority (EFSA) is responsible for providing independent scientific advice to the decision makers who regulate food safety in Europe. In the approval process for low calorie sweeteners, EFSA must review the scientific safety data for each low calorie sweetener and ensure that the sweetener is safe before it can be approved for use in foods and beverages. Analysing the safety studies is a thorough process and its completion may take up to several years. Following the publication of a scientific opinion by EFSA, the European Commission and Member States experts are responsible for the authorisation of use of low calorie sweeteners in foods and drinks on the EU market. There are currently 11 low calorie sweeteners approved for use in Europe.

# The history of low calorie sweeteners

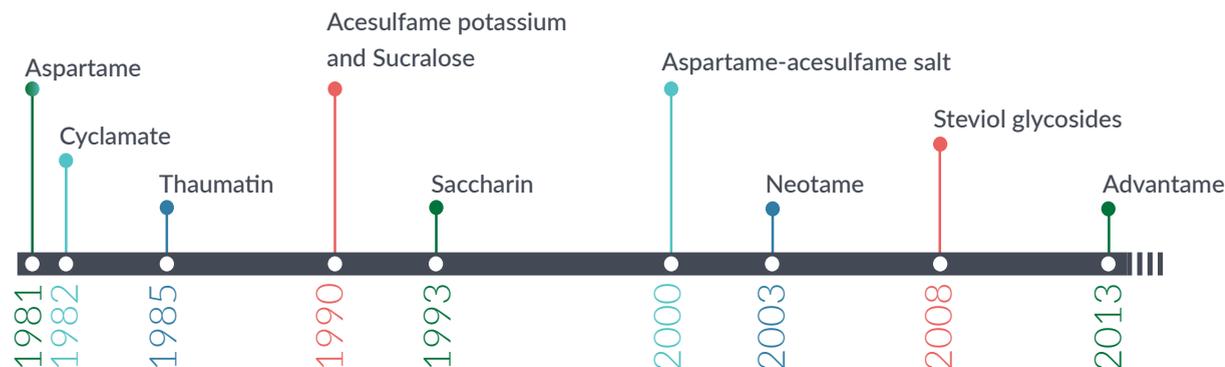
Low calorie sweeteners have a long history of safe use, which dates back to the discovery of the first sweetener, saccharin, almost 140 years ago. Over the last century, many low calorie sweeteners have been developed for use in a variety of foods and beverages worldwide.

Low calorie sweeteners are among the most thoroughly tested food ingredients in the world, with a strong body of scientific evidence and extensive research supporting their safe use in foods, beverages and table-top sweeteners.

At an international level, the responsibility of

evaluating the safety of all additives including low calorie sweeteners rests with the Joint Expert Scientific Committee on Food Additives (JECFA) of the United Nations Food & Agriculture Organization (FAO) and the World Health Organization (WHO). JECFA serves as an independent scientific committee which performs safety assessments and provides advice to FAO, WHO and the member countries of both organisations.

### Joint FAO/WHO Expert Committee on Food Additives (JECFA) evaluation of low calorie sweeteners



# The science behind the benefits of low calorie sweeteners

## How low calorie sweeteners can help in calorie and sugar reduction

Low calorie sweeteners provide no/ very few calories. Therefore, when they are used instead of sugar, which add 4 kcal/g in our foods and drinks, low calorie sweeteners can help reduce the overall calorie content of a food or beverage. For example, if we replace 1 teaspoon of sugar in our tea or coffee with a table-top sweetener, we can save 16-20 kcal, which corresponds to 4-5 grams of sugar.

## Evidence from human studies supports low calorie sweeteners' role in weight loss

The question of whether low calorie sweeteners are helpful to people wishing to manage caloric intake and body weight has been the subject of a large number of high-quality human clinical trials in recent years. The totality of published research in this area has been analysed in a 2016 systematic review and meta-analysis (Rogers *et al.*, 2016). The authors conclude in their publication: "*we found a **considerable weight of evidence in favour of consumption of low calorie sweeteners in place of sugar as helpful in reducing relative energy intake and body weight, with no evidence from the many acute and sustained intervention studies in humans that low calorie sweeteners increase energy intake.***"



## Low calorie sweeteners' effect on energy intake and body weight

*A review of epidemiological and clinical human studies (Rogers et al., 2016)*

### Observational (prospective cohort) studies:

10 articles reporting 12 studies

**Conclusions:** The results from prospective studies on low calorie sweeteners, body weight and obesity are inconsistent. Observational studies are difficult to interpret as associations may be due to confounding factors or reverse causality.



### Short-term intervention studies:

56 articles reporting 218 comparisons

**Conclusions:** The results of short-term studies comprise a large body of evidence showing that consumption of low calorie sweeteners in place of sugar reduces overall energy intake acutely, with no indication that low calorie sweeteners increase appetite.

energy intake



### Sustained intervention studies:

13 articles reporting 15 comparisons

**Conclusions:** The results of these clinical trials collectively support that the consumption of low calorie sweeteners led to a relative reduction in energy intake, and greater loss (or reduced gain) of body weight. Notably, there was no example of a sustained exposure intervention trial where low calorie sweeteners' use led to a relative increase in mean energy intake or body weight.





## What the experts say

In a consensus paper published in *Nutrition Bulletin*, a panel of six renowned experts summarised the scientific evidence on the benefits of low calorie sweeteners, as reviewed at the International Sweeteners Association Conference in Brussels, in April 2014 (Gibson *et al.*, 2014). Based on the available evidence, the experts concluded:

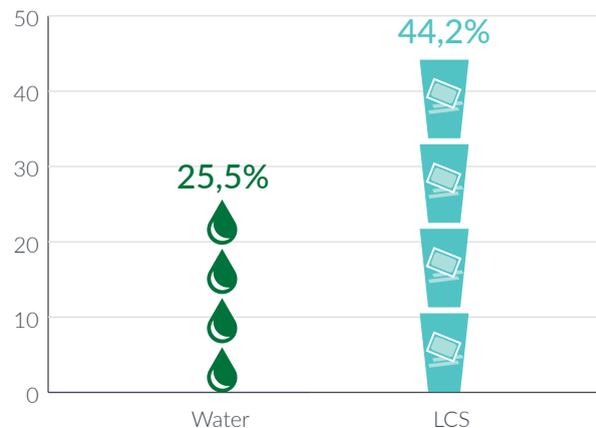
“Low calorie sweeteners help to reduce energy when used in place of higher energy ingredients [such as sugar].”

## Low calorie sweeteners are a helpful tool in weight maintenance

The use of low calorie sweeteners seems also to be a strategy for a successful and long-lasting weight loss. Keeping a healthy and stable body weight is known to be beneficial for our overall health and well-being. Losing weight is hard, and keeping the lost weight off is the biggest challenge.

A clinical study published in 2016 in the peer-reviewed journal *Obesity* confirmed previous findings that low calorie sweetened drinks can indeed help in long-term weight loss maintenance (Peters *et al.*, 2016). In fact, this study found that people who consumed low calorie sweetened drinks as part of their diet had better outcomes compared to those who drank water only, and specifically had significantly greater maintenance of weight loss, higher reduction in waist circumference, and felt less hungry.

Participants (%)



44,2%

of participants who consumed low calorie sweeteners (LCS) achieved at least 5% weight loss compared to only 25,5% of those who had only water (not allowed to drink diet drinks). N= 154 for LCS group, N= 149 for water group, P<0.001

(Peters *et al.*, 2016)



In a systematic review and meta-analysis published in 2014, the authors concluded that “data from RCTs [randomized controlled trials], which provide the highest quality of evidence for examining the potentially causal effects of LCS [low calorie sweeteners] intake, indicate that substituting LCS options for their regular-calorie versions results in a modest weight loss and may be a useful dietary tool to improve compliance with weight loss or weight maintenance plans.” (Miller and Perez, 2014)

Another two-year clinical study found that using foods and drinks with low calorie sweeteners during a weight loss programme helped people with obesity lose more weight and maintain it more effectively for a 2-year period compared to non-users. (Blackburn et al., 1997)

Similarly, another human study with 318 participants showed that obese people using low calorie sweeteners in their efforts to lose weight achieved greater results over a 6-month period. (Catenacci et al., 2014)



78%

of participants who consumed low calorie sweetened drinks felt that they helped them control or reduce their total food or calorie intake, suggesting that these beverages could play a role in a weight control programme.



“ Low calorie sweeteners can enhance weight loss under real-life conditions when used as part of a behavioural weight loss programme. ”

(Gibson et al., 2014)



## Five reasons why low calorie sweeteners can be a helpful tool in diabetes

Low calorie sweeteners...



...can help you reduce your sugar intake



...do not affect blood glucose levels



...provide low or no calories and can help in calorie reduction



...can be an ally in weight management, when used in place of sugar and as part of a weight loss/ maintenance programme



...provide more sweet-tasting options with fewer carbohydrates and calories

Of course, when it comes to the overall effect of the diet on glucose control, it is important that people with diabetes check the food labels to review the full ingredient list.

## Low calorie sweeteners provide greater choice for people with diabetes

Replacing sugar with low calorie sweeteners can be beneficial in nutritional strategies for blood glucose management in people with diabetes. They can be used in place of sugar to lower the total carbohydrate intake in a meal, which can be useful to people with diabetes in their efforts to meet post-prandial (post-meal) blood glucose level goals. With the advances in the development of low calorie sweetener options, there is also now a wide range of great-tasting lower-sugar products, which can make diabetes meal-planning easier.

### What the science shows about low calorie sweeteners' effect on blood glucose

Human studies show that low calorie sweeteners do not affect blood glucose levels in both healthy individuals and people with diabetes. In a systematic review by Romo-Romo et al. (2016) summarising the available randomised clinical trials (RCTs) in the scientific literature, the vast majority of clinical studies confirmed that the different low calorie sweeteners do not affect glycaemic indexes such as blood glucose, insulin secretion or glycosylated hemoglobin (Hb1Ac). This same conclusion was also reached in an earlier systematic review evaluating the impact of diet composition on blood glucose regulation. (Russel et al., 2013)

In its medical nutrition therapy recommendations published in 2017, the American Diabetes Association concludes: *"The use of non-nutritive sweeteners has the potential to reduce overall calorie and carbohydrate intake if substituted for caloric sweeteners and without compensation by intake of additional calories from other food sources. Non-nutritive sweeteners are generally safe to use within the defined acceptable daily intake levels."*

The European Food Safety Authority (EFSA) has concluded: **"Consumption of foods containing low calorie sweeteners instead of sugar induces a lower blood glucose rise after their consumption compared to sugar-containing foods"** (EFSA, 2011).

This is an authorised health claim in the EU Register of nutrition and health claims (Commission Regulation (EU) No 432/2012).



## Low calorie sweeteners contribute to oral health

Tooth decay is the most prevalent condition among common diseases, affecting almost half of the world population (44%) in 2010 (FDI World Dental Federation, 2015). Contrary to sugar, approved low calorie sweeteners are not cariogenic and do not cause tooth decay as they are not fermentable by the bacteria present in the oral cavity.

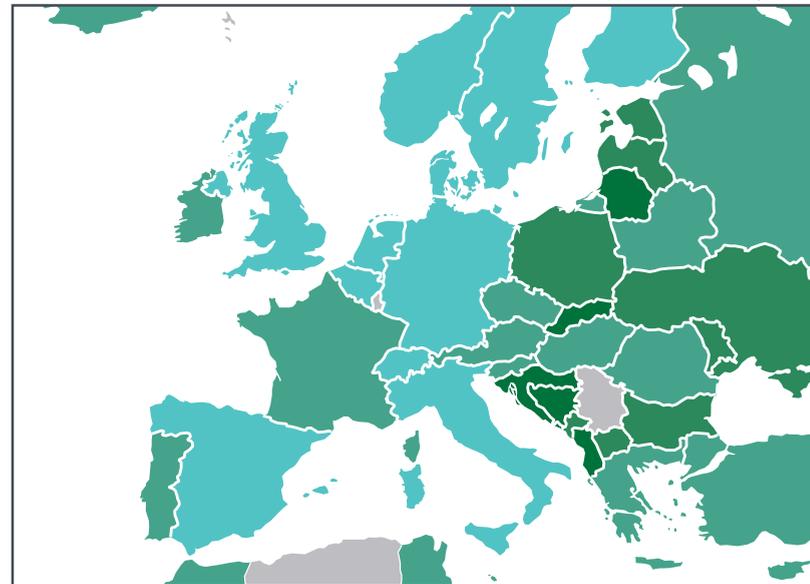
Dental caries (or common tooth decay) is the outcome of the demineralisation of tooth enamel by acid in the mouth. Acid is produced by oral bacteria that metabolises, or ferments, carbohydrates (sugars and starches) that we ingest. Ordinarily, we minimise our risks of common tooth decay by having a good oral hygiene and eating a healthy diet. But these practices may not always entirely remove risk, and frequent consumption of foods and/or beverages high in sugar, particularly without good dental hygiene, may present an increased risk for tooth decay (Peres *et al.*, 2016). Unlike sugar, approved low calorie sweeteners are not fermentable by oral bacteria, so they cannot contribute to, or promote, dental decay.



Low calorie sweeteners do not contribute to tooth decay

### Tooth decay in Europe

Average number of decayed (D), missing (M), and filled (F) teeth (T) in 12-year-olds latest available data 1994-2014



■ high > 3.5 ■ moderate 2.6 - 3.5 ■ low 1.2 - 2.5 ■ very low 0.0 - 1.1 ■ no data

(From: *The Challenge of Oral Disease – A call for global action* by FDI World Dental Federation. Maps and graphics © Myriad Editions 2015)

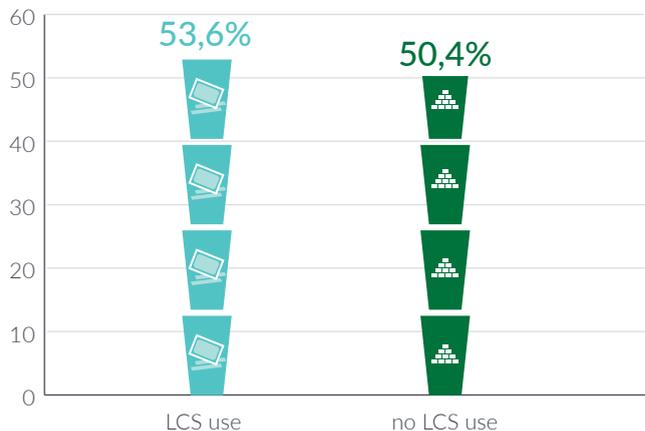
The European Food Safety Authority (EFSA) has concluded: **“intense sweeteners maintain tooth mineralisation by decreasing tooth demineralisation if consumed instead of sugars”** (EFSA, 2011). This is an authorised health claim in the EU Register of nutrition and health claims (Commission Regulation (EU) No 432/2012).

## Using low calorie sweeteners may help reinforce choosing a healthier diet and lifestyle

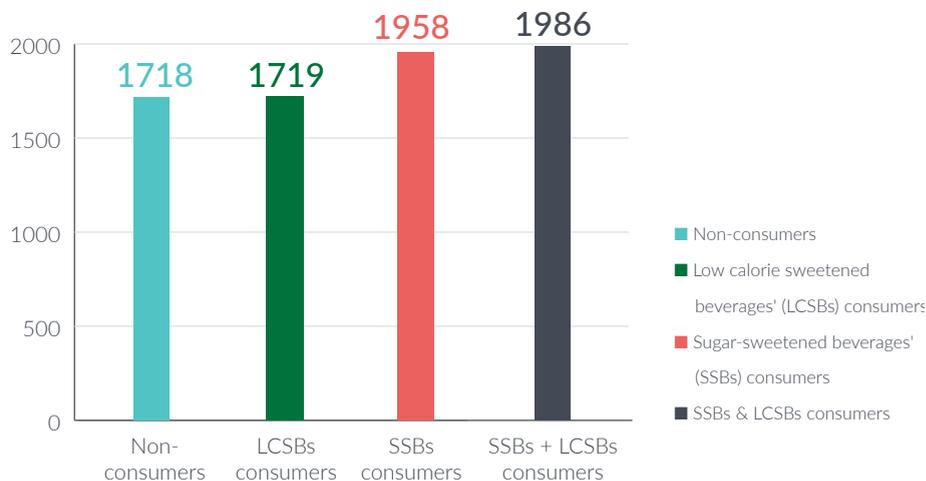
Taking small steps towards a healthier diet and lifestyle is critical to health and well-being. Consuming low calorie sweetened foods and drinks in place of sugar-sweetened products can be part of a healthy eating pattern, and has been linked to a better diet quality and a healthier lifestyle in recent studies.

In the UK National Diet and Nutrition Survey (2008–2011; n = 1590), diet drinks' consumers had a better diet quality compared to consumers of sugary drinks, characterised by lower fat and sugar intake, as well as significantly lower calorie intake (1719 kcal/day for low calorie sweetened beverage users vs 1958 kcal/day for sugar-sweetened beverage users). (Gibson, 2016)

### Healthy Eating Index



### Energy intake (kcal/day)



Consumers of low calorie sweetened beverages in the US tend to have higher quality diets which include more fruit and vegetables, wholegrain, low fat dairy, and less fat- and sugar-containing foods, based on an analysis of 22,000 people participating in the National Health and Nutrition Examination Survey (NHANES) between 1999 and 2008 (Drewnowski and Rehm, 2014).

LCS = Low calorie sweeteners  
SSB = Sugar-sweetened beverage

# Calorie-saving swaps as part of a healthy diet

Calorie-saving swaps can help people take smart steps towards a healthier diet by replacing a sugar-sweetened food or drink with its lower calorie equivalent. Using low calorie sweeteners (LCS) in place of sugar can help reduce calories in a variety of foods and drinks while maintaining desired sweet taste in the diet.

For example, by adding table-top sweeteners instead of sugar in your coffee or tea, you can 'save' approximately 20 kcal for each teaspoon of added sugar. Similarly, by swapping for a diet or light soft drink, you can reduce your calorie intake by around 140 kcal (typical caloric content of a regular 330 ml soft drink can).

Calorie-saving swaps: replacing sugary foods and drinks with low calorie sweetened options...\*

## Smart, calorie-saving swaps

						
 <b>sugary foods</b>	1 teaspoon of white/ brown sugar = <b>16-20 kcal</b>	1 can (330 ml) of regular soft drink = <b>140 kcal</b>	1 tablespoon of ketchup with sugar = <b>16 kcal</b>	1 low fat fruit yogurt with sugar = <b>180 kcal</b>	1 scoop of vanilla ice cream with sugar = <b>170 kcal</b>	A serving of raspberry jelly with sugar = <b>80 kcal</b>
 <b>low calorie sweetened foods</b>	Table-top sweeteners in coffee/ tea = <b>~0 kcal</b>	1 can (330 ml) of diet/ light or zero soft drink = <b>&lt;1 kcal</b>	1 tablespoon of ketchup with LCS = <b>8 kcal</b>	1 low fat fruit yogurt with LCS = <b>100 kcal</b>	1 scoop of vanilla ice cream with LCS = <b>90 kcal</b>	A serving of raspberry jelly with LCS = <b>&lt;10 kcal</b>

\*Average estimate

# Behind the headlines: The truth about low calorie sweeteners



**Low calorie sweeteners  
are safe.**

Low calorie sweeteners are among the most thoroughly tested food additives in use today. Before a sweetener is approved for use in foods and beverages on the market it must undergo a thorough safety evaluation by independent scientific advisory bodies such as the European Food Safety Authority (EFSA) in Europe (previously the European Commission's Scientific Committee for Food (SCF)), and the Joint FAO/WHO Expert Committee on Food Additives (JECFA) at international level. Food safety regulators establish levels of Acceptable Daily Intake (ADI). The ADI is the amount of a food additive, expressed on a body weight basis, which can be safely consumed on a daily basis over a person's lifetime without any health effects.

**Low calorie sweeteners can be safely consumed  
by children...**

Food safety authorities around the world confirm that low calorie sweeteners can be safely used by children. They can help decrease the calorie intake from sugar, which may be a healthy step in the diet for some children. Low calorie sweeteners, like any food additive, are not generally approved for use in foods intended for infants and young children under the age of three. Sufficient calorie intake is critical for the developing child, so choosing a wide variety of nutritious foods in the right amounts will allow a child to grow into a healthy weight.

**Low calorie sweeteners  
do not make you fat.**



**...And by pregnant or lactating women.**

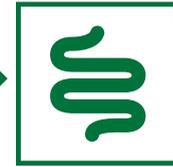
Women do not need to avoid or be concerned about consuming foods or drinks with low calorie sweeteners whilst pregnant. The consumption of approved low calorie sweeteners within the ADI is safe during pregnancy and there is no scientific evidence to indicate that there is any risk for either the mother or the baby. The variety of foods and drinks sweetened with low calorie sweeteners can help satisfy a pregnant woman's desire for sweetness while adding fewer or no calories to her diet. It is important to remember, though, that both pregnant and breastfeeding women need to consume adequate calories to nourish their developing baby or child, and so should consult with their doctor or dietitian about their nutritional needs. Importantly, foods and drinks with low calorie sweeteners can be a helpful tool for women with gestational diabetes in their efforts to manage their blood glucose levels through optimum food choices.

The myth that they would make us fat has its roots in observational studies suggesting that people who are overweight or obese more often tend to consume low calorie sweetened foods and drinks. This might well be the case, however, what these studies fail to take into consideration is the high possibility that this is actually happening because people who want to manage their weight consume more low calorie sweeteners in their efforts to control their weight. **This is known as reverse causation, which such studies cannot rule out. Thus, this is a fundamental limitation for interpreting this type of epidemiological studies. More importantly, another fundamental limitation is the inability of such studies to prove any cause and effect relationship.** Observational studies, by their nature, only show associations, and associations can be affected by many things.

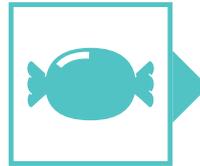
Indeed, a 2016 study found that the intent to lose or maintain body weight was one likely predictor of current low calorie sweeteners' use (*Drewnowski and Rehm, 2016*). Similar results were obtained for people who were 'trying to not gain weight'.

In contrast to observational studies, abundant research shows that low calorie sweeteners do not, and cannot, cause weight gain. This includes results from numerous randomised clinical trials (*Rogers et al., 2016; Peters et al., 2014, 2016; Miller and Perez, 2014*), that are actually designed to test cause and effect relationship.

Contrary to a few studies that touted possible effects of low calorie sweeteners on either body weight or blood glucose control, by affecting the normal physiology or function of the gut, there are numerous and very solid research studies that refute these assertions. A comprehensive review conducted in 2016 concludes that low calorie sweetener activation of the human gut sweet taste receptors does not cause changes in gut motility, gut hormones or appetitive responses that could cause weight gain (*Bryant and McLaughlin, 2016*). A 2016 review of low calorie sweetener metabolism also shows how no adverse effect on the gut microbiota could either be anticipated or expected with human consumption of low calorie sweeteners. (*Magnuson et al., 2016*)



**Low calorie sweeteners do not affect the role of the gut in health.**



**Low calorie sweeteners do not make you hungry nor crave for sweet foods.**

The theory that low calorie sweeteners might enhance appetite and intake, which was formulated in the 1980's, has not been confirmed in later studies. In fact, human studies suggest that low calorie sweeteners neither promote nor suppress appetite. A recent review examined the effects of low calorie sweeteners on appetite for sweet taste and their relation to weight management, and concluded that the use of low calorie sweeteners showed no consistent association with a heightened appetite for sugar or sweet products (*Bellisle, 2015*). On the contrary, in many instances, the use of low calorie sweeteners was associated with a lower intake of sweet-tasting substances. This suggests that low calorie sweeteners may help satisfy a desire for sweetness and do not encourage a "sweet tooth".

An early hypothesis, based on a study in rats (*Swithers and Davidson, 2008*), that low calorie sweeteners would accelerate body weight gain by disrupting sweetness-energy associations has also not been confirmed. More recent studies show that low calorie sweeteners neither promote weight gain nor increase fat pad mass in animals (*Park et al., 2017; Boakes et al., 2016; Tordoff et al., 2016*).



# Sugar reduction in foods and drinks through reformulation: The role of low calorie sweeteners

There is a number of approved, safe and great-tasting low calorie sweeteners with unique taste profiles and characteristics, that can be used to replace sugar in foods and beverages to provide a wider choice of sweet-tasting products with less sugar and fewer calories. The increased range of low calorie sweeteners available, and the fact that these can be either used alone or in blends, make them useful tools in food reformulation efforts.

While sugar reduction is sometimes more complicated than 'just taking the sugar out', since sugar has other functional properties like providing bulk or textural qualities, innovation and advances in recipe development have enabled food manufacturers to provide a wide variety of great-tasting foods and beverages sweetened with low calorie sweeteners. An increasing number of products is available worldwide as a helpful choice for people of all ages who want to enjoy a sweet-tasting product with fewer calories than the sugar-sweetened variety.

Generally in Europe in order for a manufacturer to use a low calorie sweetener in a given product, the food or beverage must have an energy reduction of 30% or must contain no added sugars (Annex II, Regulation 1333/2008 on food additives). For consumers, this can mean significant calorie saving from sugar, especially in light of recent recommendations to reduce the intake of sugars in our diet to less than 10% of our daily energy intake (WHO, 2015).

In March 2017, Public Health England (PHE) published a technical report entitled '**Sugar Reduction: Achieving the 20%**', which highlights that replacing foods and drinks sweetened with sugar with those containing no or low calorie sweeteners can be **useful in helping people to manage their weight as they reduce the calorie content of foods and drinks while maintaining a sweet taste.**

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April 2017

