



THE ROLE OF LOW- AND NO-CALORIE SWEETENING INGREDIENTS IN PROMOTING HEALTH

Innovating to Meet Nutrition, Health, and Wellness Needs Every Day



To learn more about Tate & Lyle ingredients and innovations, please visit www.foodnutritionknowledge.info and www.tateandlyle.com.

MAKING FOOD EXTRAORDINARY

TATE & LYLE

Innovative sweetening ingredients can help reduce calorie content in foods, while meeting consumer taste expectations.



LOW- AND NO-CALORIE SWEETENING INGREDIENTS: ROLE IN CALORIE REDUCTION AND HEALTH PROMOTION

Obesity: A global health concern

Obesity, diabetes, and metabolic syndrome have become major public health problems as diseases that are associated with an imbalance between calorie intake and expenditure. According to the World Health Organization, worldwide obesity has more than doubled since 1980.¹ To curb the obesity epidemic, balancing calories consumed and calories expended is key.² Authoritative bodies recommend reducing consumption of excess calories to prevent weight gain and are calling on the food industry to reduce calorie content and portion sizes.^{1, 3, 4} Innovative sweetening ingredients can help reduce calorie content in foods, while meeting consumer taste expectations.

Evidence supports use of low- and no-calorie sweeteners

Leading health organisations acknowledge the value of sweeteners to reduce calories as part of an overall healthy diet and physical activity regimen. A scientific statement from the American Heart Association (AHA) and American Diabetes Association (ADA) concluded non-nutritive sweeteners (NNS), when used carefully, may aid in reducing total energy intake and assist with weight loss/control, while providing beneficial effects on related metabolic parameters.⁵ Further,

the AHA has suggested that the food industry needs more innovative low- and no-calorie sweeteners, bulking ingredients, and sweetness enhancers to use in food and beverage products.⁵ An Academy of Nutrition and Dietetics position paper states that “consumers can safely enjoy a range of nutritive and NNS when consumed within an eating plan that is guided by current nutrition recommendations as well as individual health goals and personal preferences.”⁶

Several research studies have linked intake of NNS to weight management, improved blood glucose control, and better overall health.

- A meta-analysis of 15 randomized clinical trials and 9 prospective cohort studies evaluated research that examined the relationship between NNS and body weight and composition. Findings from the prospective cohort studies showed no association between NNS intake and body weight or fat mass and a small positive association with BMI; however, data from randomized clinical trials, which provide the highest quality of evidence for examining the potentially causal effects of NNS intake, indicate that substituting NNS for regular-calorie options results in a modest weight loss, and that NNS may be a useful dietary tool to improve compliance with weight loss or weight maintenance plans.⁷
- Choosing NNS can also be helpful in moderating carbohydrate intake, which is important for blood glucose management. Four randomized trials, varying from 1 to 16 weeks in duration,

found no deleterious impact on measures of glycemic response when NNS were consumed compared to various nutritive sources (e.g., sucrose, starch) or placebos (e.g., cellulose).⁸⁻¹¹ Further, a 2010 review paper concluded that consumption of NNS does not affect glycemic response in people with diabetes mellitus.¹²

- In terms of overall health, a study of more than 9,000 adults found that people using NNS tended to consume more vitamins and minerals and eat fewer calories overall.¹³

INNOVATIVE CALORIE AND SUGAR REDUCTION SOLUTIONS

Taste is a main driver when choosing foods and beverages.¹⁴ Research indicates that consumers show a strong interest in reducing sugar and calories in their diets, but ultimately taste drives purchase decisions.¹⁴ A variety of low- and no-calorie sweetening ingredients can help reduce the amount of calories in food products to varying degrees without sacrificing taste. These sweeteners can be utilized in higher energy foods and beverages to reduce calories and potentially overall energy intake. Tate & Lyle develops ingredients that provide nutrition, health, and wellness solutions including a strong portfolio of low- and no-calorie sweetening ingredients that the food industry can utilize to reduce calories in foods and beverages, which can provide more options for consumers in their efforts to make wise choices on daily energy intake.

DOLCIA PRIMA® Allulose

Allulose* is a low-calorie sweetening ingredient that exists in nature and offers the taste and texture of sugar without all the calories. Allulose can be found in certain fruits and foods including figs, raisins, molasses, and maple syrup and it can be made from several sources of carbohydrates. Allulose is 70 percent as sweet as sugar and can replace sucrose (table sugar) or high-fructose corn syrup (HFCS) to reduce calories. Because allulose is less sweet than sucrose and cannot be used as a 1:1 replacement, it will likely be used in combination with other sweetening ingredients, such as low-calorie sweeteners or caloric bulk sweeteners. Allulose offers unique benefits for calorie reduction:

- Very low in calories because it is not metabolized^{15, 16}
- Does not raise blood glucose or insulin levels in healthy individuals or when consumed by people with type-2 diabetes¹⁷⁻¹⁹
- Modestly reduces postprandial glycemic response in people with type 2 diabetes when consumed in combination with glucose²⁰
- Has the functionality of sugar, including caramelization and browning; adding bulk and texture to products; and depressing freezing point in frozen products
- Ideal for use in a variety of foods and beverages, including yogurt, ice cream, and baked products*
- Blends well with other sweeteners for calorie reduction

Allulose is generally recognized as safe (GRN 400 and 498) by the United States Food and Drug Administration (FDA) for use in foods and beverages, which means it is safe for people of all ages to consume.²¹

Stevia Sweeteners

Sweet Green Fields and Tate & Lyle offer a complete range of innovative stevia sweeteners* produced from stevia leaf extracts. Stevia sweeteners are high-potency, zero-calorie sweeteners of natural origin made from the stevia plant that allow for calorie reduction without sacrificing taste.

Sensory data shows that approximately 80% of the population is sensitive to bitter off-notes associated with some natural, stevia-based sweeteners on the market. However, the stevia offerings from Sweet Green Fields and Tate & Lyle have a substantially cleaner aftertaste than other stevia-derived sweeteners, allowing higher sugar replacement levels without sacrificing taste.

The sweetness potency of the stevia sweeteners ranges from about 200–300 times sweeter than sugar, depending on the level of sweetness being replaced. Stevia sweeteners contribute zero calories and can be used to enable calorie and sugar reduction in foods and beverages. Stevia sweeteners exhibit good stability and are suitable for use in low-pH products such as beverages and they have demonstrated stability to high temperature processes such as pasteurisation.

The Sweet Green Fields and Tate & Lyle stevia sweetener options are appropriate for a wide-range of applications, including:*

- Baked goods
- Beverages
- Cereals
- Dairy
- Dressings, sauces
- Frozen foods
- Processed fruits and vegetables
- Snacks



PUREFRUIT™ Monk Fruit Extract

Monk fruit grows on lush vines in small farms in the sub-tropical climate of Asian hillsides, where temperate conditions and elevation are ideal. PUREFRUIT™ Monk Fruit Extract is a sweetener that provides natural, great-tasting, zero-calorie sweetness and is extracted from the monk fruit.

At around 100-200 times the sweetness of sugar, this ingredient allows for sugar reduction up to 100% in certain foods and beverages.

PUREFRUIT™ Monk Fruit Extract is appropriate for a wide-range of applications, including:*

- Baked goods
- Beverages
- Cereals
- Confections
- Dairy
- Desserts, ice cream
- Dressings, sauces
- Nutritional supplements
- Processed fruits

*Subject to local regulations and market availability.

SPLENDA® Sucralose

In 1976, sucralose was discovered as the result of a joint sweetener research project conducted by Tate & Lyle and Queen Elizabeth College in London, UK. SPLENDA® Sucralose is made from sugar and is a leading zero-calorie sweetener that has a sugar-like taste profile. It has about 600 times the sweetness of sugar and, depending upon the application, can be used to replace nutritive sweeteners such as sugar or glucose syrup. SPLENDA® Sucralose is heat stable in cooking and baking and works well in a broad range of food and beverage systems including low-pH environments and in the presence of live cultures.*

Food and beverages formulated with sucralose elicit a lower blood glucose response than similar products with sugar.²²

Unlike sucrose and glucose, sucralose has the added benefit of maintaining tooth mineralization and is non-cariogenic.^{22, 23}

SPLENDA® Sucralose is appropriate for a wide range of applications, including:*

- Breakfast cereals
- Canned fruit, jams, jellies, pie fillings
- Chilled and frozen desserts
- Condiments, relishes, dressings
- Gelatin desserts, puddings
- Gum, breath mints, candies, cough drops
- Ready-to-eat/frozen baked goods
- Sauces, toppings
- Soft drinks, flavoured milk, nutritional beverages
- Yogurt, ice cream

*Subject to local regulations and market availability.

NUTRITIONAL IMPACT OF THE USE OF STEVIA SWEETENERS, PUREFRUIT™ MONK FRUIT EXTRACT, AND SPLENDA® SUCRALOSE

In this menu example, simple substitutions with products containing these non-nutritive sweeteners could result in a reduction of 235 calories per day.**

2,000-CALORIE MENU, BASELINE***	WITH STEVIA SWEETENER, PUREFRUIT™ MONK FRUIT EXTRACT, AND SPLENDA® SUCRALOSE SUBSTITUTIONS
Breakfast: 1 English muffin w/2 tbsp apricot spread 1 lg hard-boiled egg 1 med banana 1 cup orange juice	Breakfast: 1 English muffin w/2 tbsp apricot spread 1 lg hard-boiled egg 1 med banana 1 cup Tropical Tangerine Juice, made with PUREFRUIT™ Monk Fruit Extract
Lunch: Tuna salad sandwich: 2 oz water-packed tuna, 1 tbsp mayonnaise, 2 slices rye bread, 1 lettuce leaf ½ cup baby carrots 1 cup low-fat milk 6 oz low-fat strawberry yogurt	Lunch: Tuna salad sandwich: 2 oz water-packed tuna, 1 tbsp mayonnaise, 2 slices rye bread, 1 lettuce leaf ½ cup baby carrots 1 cup low-fat milk 8 oz blueberry drinkable yogurt, made with Stevia Sweetener, PROMITOR® Soluble Fibre, and Krystar® Crystalline Fructose
Dinner: Spaghetti with meatballs: 1 cup spaghetti, ½ cup marinara sauce, 2 ½ oz meatballs 1 tbsp shredded parmesan 2 cups mixed green salad w/ tomatoes 1 tbsp vinegar and oil dressing 1 cup low-fat milk	Dinner: Spaghetti with meatballs: 1 cup spaghetti, ½ cup marinara sauce, 2 ½ oz meatballs 1 tbsp shredded parmesan 2 cups mixed green salad w/tomatoes 1 tbsp vinegar and oil dressing 1 cup low-fat milk
Snacks: ½ cup grapes 1 oz raisin-nut granola bar 12 fl oz soft drink	Snacks: ½ cup grapes ¾ oz coconut and apple bar, made with SPLENDA® Sucralose, PROMITOR® Soluble Corn Fibre, and Krystar® Crystalline Fructose 12 fl oz blackberry peach flavoured sparkling juice beverage, made with Stevia Sweetener and PromOat® Beta Glucan

NUTRITION FACTS

		Change	% Change
Baseline menu	Menu with PUREFRUIT™ Monk Fruit Extract and SPLENDA® Sucralose		
Calories	2,115	Calories	1,880
		-235 c	-11 %
Total Fat	53 g	Total Fat	51 g
Saturated Fat	17 g	Saturated Fat	15 g
Cholesterol	305 mg	Cholesterol	305 mg
Sodium	2,390 mg	Sodium	2,380 mg
Total Carbohydrate	326 g	Total Carbohydrate	277 g
Dietary Fibre	20 g	Dietary Fibre	30 g
Sugars	173 g	Sugars	129 g
		-44 g	-25 %
Protein	87 g	Protein	88 g

** These values reflect US ingredient only. Calories vary based on global regulations.

*** Menu based on Healthy US Style Eating Pattern, Dietary Guidelines for Americans, 2015-2020.



To learn more about Tate & Lyle ingredients and innovations as well as health benefits and relevant research, please visit www.foodnutritionknowledge.info and www.tateandlyle.com.

INNOVATING TO MEET NUTRITION, HEALTH, AND WELLNESS NEEDS EVERY DAY

A commitment to innovation

Tate & Lyle, a global leader in wellness innovation, is committed to delivering innovative ingredients that can be incorporated into great-tasting foods to help consumers meet their nutrition, health, and wellness needs every day. That is

because Tate & Lyle invests heavily in innovation and research and in developing ingredients that can be incorporated into a wide-variety of food and beverage solutions. Teams of food and nutrition scientists are continuously innovating, researching, and testing ingredients that will meet current and future health and nutrition needs.

At the same time, Tate & Lyle has a robust market research program designed to provide the necessary insights on consumer preferences

around the world. The research program allows Tate & Lyle to customize its offerings and provide tailor-made solutions in local and regional markets.

Better-for-you ingredients for health and wellness

In response to global public health efforts calling for people to reduce calories and sodium and increase fibre intakes, Tate & Lyle offers a number of innovative ingredient solutions that meet these needs.



For more information on DOLCIA PRIMA® Allulose, visit www.dolciaprima.com.



For more information on Stevia Sweeteners, visit www.tateandlyle.com/ingredient/stevia-solutions.



For more information on PUREFRUIT™ Monk Fruit Extract, visit www.purefruit.com



For more information about SPLENDA® Sucralose, visit www.splendasucralose.com.

REFERENCES

1. World Health Organization. Obesity and Overweight Fact Sheet. June 2016.
2. Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes: Energy, Carbohydrates, Fibre, Fat, Fatty Acids, Cholesterol, Protein and Amino Acids. Washington, DC: National Academies Press; 2002/2005.
3. Dietary Guidelines Advisory Committee. Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 2015.
4. Public Health England. Health Matters: obesity and the food environment. March 2017.
5. Gardner C, Wylie-Rosett J, Gidding SS, Steffen LM, Johnson RK, Reader D, Lichtenstein AH. Non-nutritive sweeteners: Current use and health perspectives. *Circulation*. 2012;126:509-519.
6. Position of the Academy of Nutrition and Dietetics: Use of Nutritive and Nonnutritive Sweeteners. 2012;112:739-758.
7. Miller P and Perez V. Low-calorie sweeteners and body weight and composition: a meta-analysis of randomized controlled trials and prospective cohort studies. *Am J Clin Nutr* 2014;100:765-77.
8. Barriocanal LA, et al. Apparent lack of pharmacological effect of steviol glycosides used as sweeteners in humans. A pilot study of repeated exposures in some normotensive and hypotensive individuals and in Type 1 and Type 2 diabetics. *Regul Toxicol Pharmacol*. 2008;62:37-41.
9. Grotz VL, et al. Lack of effect of sucralose on glucose homeostasis in subjects with type 2 diabetes. *J Am Diet Assoc*. 2003;103:1607-1612.
10. Cooper PL, et al. Sucrose versus saccharin as an added sweetener in non-insulin-dependent diabetes: Short- and medium-term metabolic effects. *Diabet Med*. 1988;5:676-680.
11. Maki KC, et al. Chronic consumption of rebaudioside A, a steviol glycoside, in men and women with type 2 diabetes mellitus. *Food Chem Toxicol*. 2008;46(suppl 7):S47-S53.
12. Franz MJ, et al. The evidence for medical nutrition therapy for type 1 and type 2 diabetes in adults. *J Am Diet Assoc*. 2010;110:1852-1889.
13. Sigman-Grant MJ, Hsieh G. Reported use of reduced-sugar foods and beverages reflect high quality diets. *J Food Sci*. 2005;7:S42-46.
14. International Food and Information Council Foundation. 2016 Food & Health Survey. 2016.
15. Williamson P, Schunk T, Woodyer R, et al. A single-dose, microtracer study to determine the mass balance of orally administered, C-labeled sweetener in healthy adult men. *FASEB*. 2014.
16. Iida T, Hayashi N, Yamada T, et al. Failure of D-psicose absorbed in the small intestine to metabolize into energy and its low large intestinal fermentability in humans. *Metabolism: Clinical and Experimental*. 2010;59:206-214.
17. Kendall C, Wolever T, Vuksan V, et al. Comparison of glycemic responses elicited by 25g glucose, 25g allulose. 2014. Glycemia Consulting Inc. Toronto, ON, Canada.
18. Wolever T, Jenkins AJ. A Randomized, Controlled, Crossover Study to Assess the Effects of a Sweetener on Postprandial Glucose and Insulin Excursions in Healthy Subjects. 2015. Glycemic Index Labs. Toronto, ON, Canada.
19. Wolever T, Jenkins AJ. A Randomized, Controlled, Crossover Study to Assess the Effects of a Sweetener on a Postprandial Glucose and Insulin Excursions in Subjects with Type 2 Diabetes. 2015. Glycemic Index Labs. Toronto, ON, Canada.
20. Noronha JC, Braunstein C, Glenn A et al. Effect of Small Doses of Fructose and Allulose on Postprandial Carbohydrate Metabolism in Type 2 Diabetes: An Acute Randomized Double-blind Crossover Trial. 35th International Symposium on Diabetes and Nutrition. Diabetes and Nutrition Study Group (DNSG) of the European Association for the study of Diabetes (EASD). Denmark. June 2017.
21. FDA: U.S. Food and Drug Administration GRAS Notices. GRN No. 400 (2012) <http://www.accessdata.fda.gov/scripts/fdcc/index.cfm?set=GRASNotices&id=400> and GRN No. 498 (2014) <http://www.accessdata.fda.gov/scripts/fdcc/index.cfm?set=GRASNotices&id=498>.
22. EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA); Scientific Opinion on the substantiation of health claims related to the sugar replacers xylitol, sorbitol, mannitol, maltitol, lactitol, isomalt, erythritol, D-tagatose, isomaltulose, sucralose and polydextrose and maintenance of tooth mineralisation by decreasing tooth demineralisation (ID 463, 464, 563, 618, 647, 1182, 1591, 2907, 2921, 4300), and reduction of post-prandial glycaemic responses (ID 617, 619, 669, 1590, 1762, 2903, 2908, 2920) pursuant to Article 13(1) of Regulation (EC) No 1924/2006. *EFSA Journal*. 2011;9:2076. <http://www.efsa.europa.eu/efsajournal>.
23. Federal Drug Administration Food Labeling: Health Claims; Dietary Noncariogenic Carbohydrate Sweeteners and Dental Caries. Federal Register Online 2006;71:60:15559-15564. <http://www.fda.gov/ohrms/dockets/98fr/06-3007.htm>.

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