



INNOVATIVE INGREDIENTS TO HELP ADDRESS THE DIABETES EPIDEMIC



TATE & LYLE

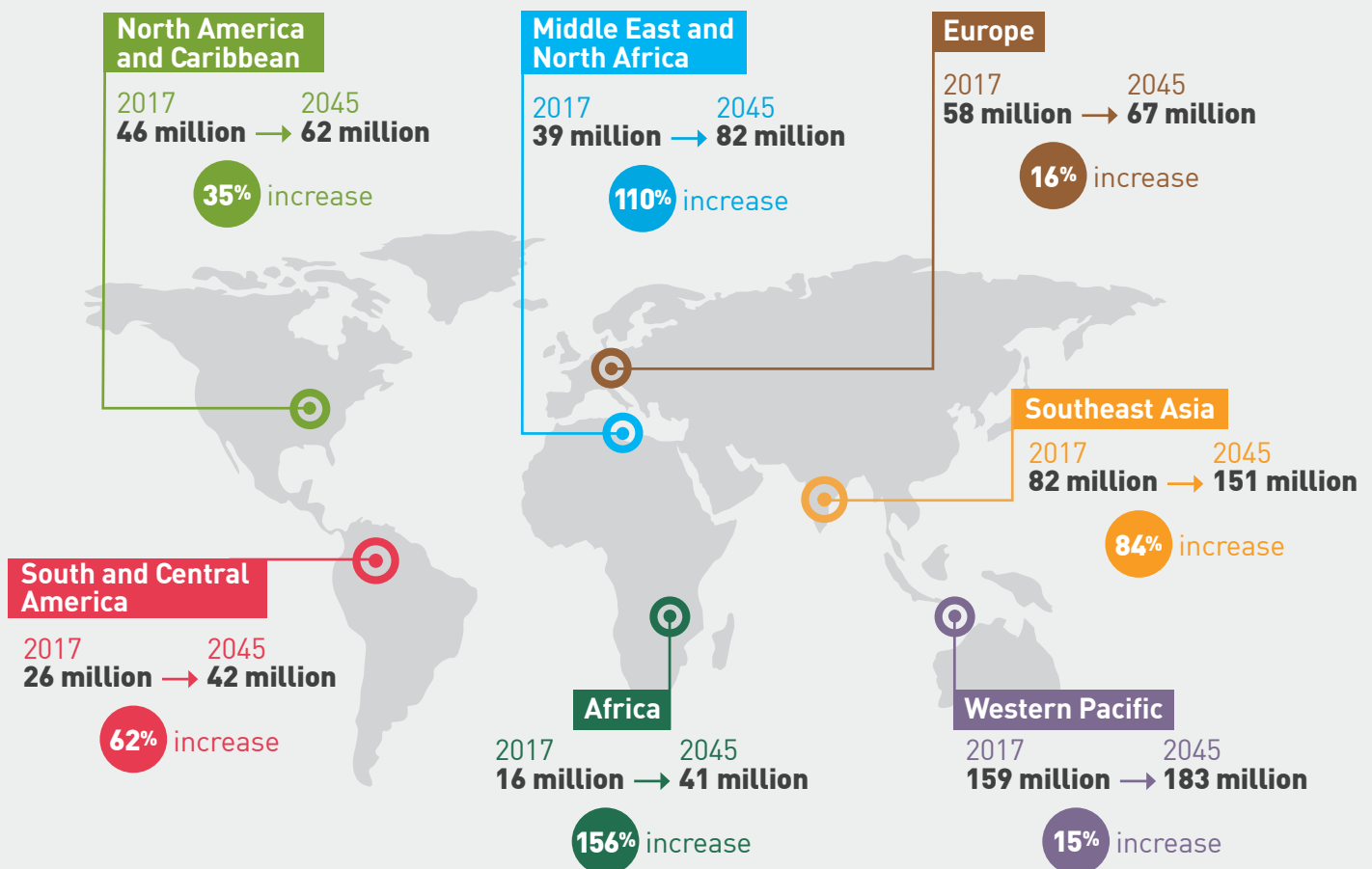
GLOBAL BURDEN OF DIABETES

Type 2 diabetes has become a growing global epidemic. Once an affliction of predominantly rich nations, type 2 diabetes has now spread to every region of the world.¹ Diabetes affected 425 million people worldwide, or 8.8 percent of adults, in 2017 and is expected to rise to 629 million by 2045.² A significant challenge is the estimate that indicates approximately 212 million people, or 50 percent of all adults with diabetes, are undiagnosed.² In addition to real human costs, diabetes is associated with an enormous economic burden.¹ Global estimates for healthcare expenditures for adults with diabetes were close to USD \$727 billion in 2017.^{1,2}

Type 2 diabetes is a chronic disease that occurs when blood glucose (sugar) levels are raised because the body cannot effectively use the insulin the pancreas secretes.² Insulin is a hormone necessary to transport glucose from the bloodstream into muscle and other tissues, where it is converted to energy and used for cellular functions. Insulin resistance occurs when the cells in the body do not respond to insulin, and the pancreas makes more insulin to overcome the cells' weak response.³

Number of people with diabetes worldwide²

Per region, 2017 and estimated by 2045 (aged 20 to 79 years)





People with “prediabetes” have higher-than-normal blood glucose levels, but not levels that are high enough to be diagnosed as diabetes. Most individuals with prediabetes don’t even know they have the condition. Hence, there is an urgent global need to screen, diagnose, educate and care for people with prediabetes and diabetes, as early diagnosis reduces the risk of costly complications later. Observational studies have also demonstrated an association of prediabetes with early kidney disease, nerve damage, vision problems and vascular disease.⁴

Risk Factors and Prevention

Individuals with prediabetes are at high risk of developing insulin resistance and eventually type 2 diabetes.³ One of the strongest links to these conditions is being overweight or obese.¹ Estimates for 2016 indicated 1.9 billion adults were overweight; of these, 650 million were obese, and more than 340 million children and adolescents aged 5 to 19 years were overweight or obese.⁵ Other risk factors for type 2 diabetes include physical inactivity, being 45 years of age or older, ethnicity (African American, Alaska Native, American Indian, Asian American, Hispanic/Latino, Native Hawaiian or Pacific Islander American) and having a family history of diabetes, heart disease or stroke.³

Different types of diabetes²

Disease State and Definition	Prevalence	Risk Factors	Prevention	Treatment
Type 1 Diabetes A chronic illness where raised levels of blood glucose (sugar) occur because the body cannot produce any or sufficient amounts of the hormone insulin.	Low; in adults, 5% of all diabetes cases	Family history, genetics and infection	Nothing	Prescribed insulin
Type 2 Diabetes A chronic illness where raised levels of blood glucose (sugar) occur because the body does not respond to insulin.	High	Obesity; overweight, poor diet, physical inactivity, increased age, and a family history of diabetes, heart disease or stroke	Weight loss, diet high in fiber, increased physical activity	Weight loss, increased physical activity, manage blood glucose response
Prediabetes Prediabetes is when blood glucose is higher than normal, but not elevated enough to be diagnosed as diabetes as a result of impaired glucose tolerance (IGT) or impaired fasting glucose (IFG).	Very high; most not diagnosed	Obesity; overweight, poor diet, physical inactivity, increased age, and a family history of diabetes, heart disease or stroke	Weight loss, diet high in fiber, increased physical activity	Weight loss, increased physical activity, manage blood glucose response

DIETARY MANAGEMENT IN DIABETES

There is strong evidence from randomized, controlled trials around the world that simple lifestyle measures such as weight reduction, a healthy diet and regular physical activity can prevent or delay the onset of type 2 diabetes.⁶

The World Health Organization suggests for the prevention of type 2 diabetes, a diet that limits saturated fats to less than 10 percent of total energy intake, adequate intake of dietary fiber (minimum 20 grams a day), and less than 10 percent of total energy intake from free (added) sugars.⁷ While a diet high in calories from any source contributes to weight gain, sugar and sugar-sweetened beverage consumption has been of concern due to its high intake in many parts of the world and its association with weight gain.⁸ In light of this, the World Health Organization recommends that adults and children reduce their consumption of sugar to less than 10 percent of total energy intake, and suggests a further reduction to below 5 percent for additional health benefits.⁹

In addition to weight loss, all guidelines recommend a healthy diet, with some providing specific guidance toward selecting high-fiber and low-glycemic foods, vegetables, fruits, fish, whole grains and monounsaturated fats while avoiding sugar, sweets and sweetened beverages.¹⁰



Prevention of Type 2 Diabetes⁷



Saturated fats
less than
10%
total energy intake



Fiber
minimum
20 grams
per day



Free (added) sugars
less than
10%
total energy intake

Factors That Affect the Blood Glucose Response

Another way to help address diabetes, including prediabetes, is to eat the right foods to control glycemic response. A systematic review conducted by the International Life Sciences Institute (ILSI) Europe reported that dietary components can modulate blood glucose levels.¹¹ One of the strongest influences on post-meal blood glucose is the amount and type of carbohydrates in the diet.¹² Dietary factors that delay the process of digestion and/or absorption of carbohydrates are important in reducing the glycemic response.¹²

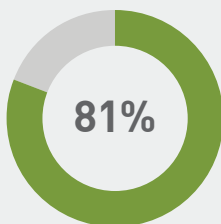
Soluble viscous fibers have a great impact on the postprandial glucose and insulin response after a meal. Foods high in soluble fiber, such as oats, fruits and legumes, and specific dietary fibers, such as beta glucan, pectin, psyllium, polydextrose and soluble corn fiber, have been shown to lower the rise in blood glucose levels after a meal both in healthy individuals and those with diabetes.¹³ In contrast, easily digestible and/or refined carbohydrates, such as white bread, short-grain white rice and cooked potatoes, produce a rise in blood glucose.¹⁴

Choosing non-nutritive sweeteners can also be helpful in moderating carbohydrate intake, which is important for blood glucose management.¹⁵

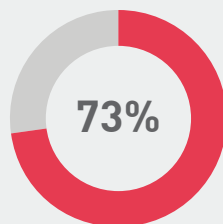


Consumer Approach to Disease Prevention or Management

Most consumers understand the important role that diet and exercise play in diabetes prevention. In fact, 81 percent strongly agree or agree that it is important to eat healthfully to prevent diabetes, and 73 percent strongly agree or agree that regular exercise is important.¹⁶ This finding is likely leading to an avoidance of sugars and carbohydrates, since they are the two calorie sources consumers blame the most for weight gain.¹⁷ When managing diabetes with diet, 64 percent of consumers take the step of limiting their sugar intake and 40 percent choose foods rich in fiber.¹⁸



Healthy Eating



Regular Exercise

81 percent strongly agree or agree that it is important to eat healthfully to prevent diabetes, and 73 percent strongly agree or agree that regular exercise is important.¹⁶

Working to help address this epidemic

Tate & Lyle is committed to partnering with food and beverage manufacturers to create delicious, “better for you” products, thereby helping consumers improve their diets throughout their life span. In fact, Tate & Lyle’s purpose is “Improving Lives for Generations.”

Maintaining a healthy weight and moderating carbohydrate intake are key elements of a healthful diet for people with diabetes and may lessen the likelihood of developing diabetes. Reducing excess calories is instrumental in meeting those objectives.

Tate & Lyle is proud to report that over the past four years alone, our portfolio of sweeteners and fibers have enabled our customers to remove over 20 trillion calories globally from people’s diets. Calories have been removed from a wide range of categories including beverages, bakery and even confectionery and ice cream.

Our Purpose Improving Lives for Generations

Through our purpose, we believe we can successfully grow our business and have a positive impact on society. It inspires us and informs what we do.

Working in partnership with our customers, we use our ingredients, expertise and people to bring our purpose to life every day. We do this by helping people make healthier and tastier choices when they eat and drink, and lead a more balanced lifestyle.

For over 150 years, we have been working to improve people’s lives. Our purpose is our passion. It’s in our DNA.



TATE & LYLE FIBERS AND NON-NUTRITIVE SWEETENERS AS PART OF THE SOLUTION

Tate & Lyle has a portfolio of ingredients that food and beverage manufacturers can use to help limit sugars, add fiber and promote a healthy blood glucose response.

Fibers

STA-LITE® Polydextrose

In 2011, based on available data, the European Food Safety Authority (EFSA) concluded that a cause-and-effect relationship was established between the consumption of foods/drinks containing polydextrose instead of sugar and a reduction in postprandial blood glucose responses (without disproportionately increasing postprandial insulinemic responses) as compared to sugar-containing foods/drinks.¹⁹

The consumption of polydextrose incorporated into foods or beverages has demonstrated a lowering of the glycemic response. In fact, studies have shown that polydextrose lowers glycemic response. For example, Jie et al. reported the ingestion of 12 g of polydextrose with 50g of glucose significantly lowered the glycemic response, compared to a glucose control in healthy adults.²⁰



*Caloric values reflect US labeling only. Caloric labeling varies based on local and country regulations.

**The applicability of label claims, health claims and the regulatory and intellectual property status of our ingredients varies by jurisdiction. You should obtain your own advice regarding all legal and regulatory aspects of our ingredients and their usage in your own products to determine suitability for their particular purposes, claims, freedom to operate, labeling or specific applications in any particular jurisdiction. This product information is published for your consideration and independent verification. Tate & Lyle accepts no liability for its accuracy or completeness.

STA-LITE® Polydextrose is a soluble fiber from Tate & Lyle that is ideal for sugar replacement and calorie reduction. STA-LITE® replaces bulk and mouthfeel, and depending on country regulations, has only 1 kcal/g.* It is extremely stable in heat and in acidic environments, has low viscosity and is easy to incorporate into a wide range of foods and beverages.**





PROMITOR® Soluble Fiber

Human clinical studies have evaluated the glycemic effects of soluble corn fiber. Kendall et al. showed that in healthy subjects the postprandial blood glucose and insulin response to PROMITOR® Soluble Fiber (soluble corn fiber) in a lemonade was significantly lower than a lemonade control containing glucose.²¹ Konings et al. also observed a significant lowering of postprandial blood glucose and insulin levels when 30 percent of available carbohydrates were replaced with PROMITOR® in foods and a beverage, compared to similar full-calorie meals in samples of overweight men and women.²²



PROMITOR® Soluble Fiber from Tate & Lyle is extremely soluble, low in color and has little to no taste. PROMITOR® has exceptional digestive tolerance, allowing food and beverage manufacturers to provide fiber enrichment and/or sugar reduction without concern about consumer acceptance. It is stable to heat, pH and processing stresses.*



Non-Nutritive or High-Potency Sweeteners

Allulose

Allulose is naturally found in low concentrations in certain fruits and foods, including figs, raisins, molasses and maple syrup. Allulose is absorbed but not metabolized, thus it has negligible calories.²³ Allulose consumed alone does not raise blood glucose or insulin levels in healthy individuals with normal glycemic levels, or in individuals with type 2 diabetes (unpublished internal reports). Allulose, when consumed with glycemic carbohydrates, modestly reduces postprandial glycemic response in individuals with type 2 diabetes, with prediabetes and with normal glycemia.^{24, 25, 26} While these results are interesting, further research is needed to determine if there are long-term benefits of allulose in the diet.

DOLCIA PRIMA® Allulose from Tate & Lyle is 70 percent as sweet as sugar and can replace sucrose or high-fructose corn syrup. It has 0.2 kcal/g and blends well with other sweeteners to reduce calories while providing a great sweet taste.*

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Monk fruit

Monk fruit extract (also called *luo han guo*) is a natural, zero-calorie sweetener obtained from monk fruit grown in the subtropical climate of Asia. In a study comparing the effects of consuming monk fruit in a beverage, it was found that the beverage with monk fruit did not raise daily energy intake, blood glucose nor insulin.²⁷

PUREFRUIT™ Monk Fruit Extract from Tate & Lyle has 100 to 200 times the sweetness of sugar, allowing for sugar reduction up to 100 percent in certain foods and beverages. This ingredient is appropriate for a wide range of applications in foods and beverages.*



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Stevia

Stevia sweeteners are extracted from the stevia plant, have zero calories and are considered to have 200 to 300 times the sweetness of sucrose. A few clinical studies have evaluated the postprandial glycemic effect of stevia products in healthy individuals and people with type 2 diabetes, with some indicating no significant change^{27,28,29,30} and others indicating a significant reduction,^{31,32} compared to a control (placebo, sucrose, water, mixed meal). Most studies have not observed a significant effect on fasting blood glucose levels, but a meta-analysis of available studies reported a very small, clinically insignificant, reduction in fasting blood glucose when stevia is consumed.³³



Sweet Green Fields and Tate & Lyle offer a complete range of innovative stevia sweeteners produced from stevia leaf extracts. Sweetness of stevia sweeteners ranges from about 200 to 300 times that of sugar.

Sensory data show that about 80 percent of the population is sensitive to bitter off-notes associated with some stevia-based sweeteners. The stevia offerings from Sweet Green Fields and Tate & Lyle can address a range of sugar-replacement levels while delivering clean, sweet taste with minimal to no bitterness vs. some stevia sweeteners. Stevia sweeteners are suitable for use for a wide range of applications in foods and beverages.



SOLUTIONS FOR BEVERAGE FORMULATION CHALLENGES

Formulating and marketing beverages with low-, reduced- or no-sugar claims can help consumers make healthy choices. However, formulators are often challenged to maintain great taste and texture while reducing sugars and carbohydrates. With a complete range of sweeteners and fibers, Tate & Lyle can help to provide solutions with great taste and balanced body and mouthfeel.



For example, use DOLCIA PRIMA® Allulose and PUREFRUIT™ Monk Fruit Extract to create a great-tasting raspberry sports drink with low glycemic response and reduced-calorie and lower-sugar content. Both ingredients help to provide a low glycemic response while cutting calories.

For a great-tasting tamarind juice drink, blend stevia, allulose, fructose and PROMITOR® Soluble Fiber to balance body and mouthfeel while reducing sugar and calories.

Tate & Lyle has technical application specialists to help beverage and food formulators find great-tasting, sugar-reduced and fiber-enriched solutions their consumers are sure to love, to help address the growing diabetes epidemic.

To learn more about formulating beverages consumers will love,
contact Tate & Lyle at [tateandlyle.com](https://www.tateandlyle.com)

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DISCLAIMER

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