

Soluble Corn Fibre*: Health Benefits and Product Applications



Innovating to Meet Nutrition,
Health and Wellness Needs Every Day

***PROMITOR® Soluble Corn Fibre**
PROMITOR® Soluble Gluco Fibre in Europe



Scan for more
information.

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

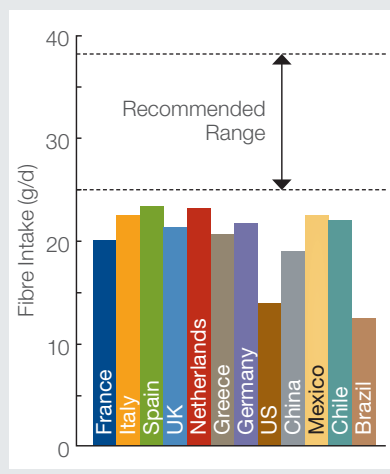


- **Despite the fact that many consumers say that they are making efforts to consume diets high in dietary fibre current fibre intakes remain low.**
- **Research indicates that diets higher in fibre are associated with improved health and reduced risk of certain diseases.**
- **Added and functional fibres can help bridge the gap between actual intake and global dietary recommendations.**
- **Tate & Lyle's PROMITOR® Soluble Corn Fibre* is a good example of an ingredient that manufacturers can use in the development of new and innovative products to meet the population's fibre needs and that provide health benefits including supporting gastrointestinal health, maintenance of healthy blood glucose, and potentially supporting bone health.**

Decades of research indicate that diets higher in fibre are associated with reduced risk for heart disease and diabetes^{1,2} as well as improved gut health and digestion² while average intakes are well below the recommended amount^{1,3}. With low fibre intakes among global populations, there is potential for long-term public health implications^{1,3}.

Data indicate that consumers believe fibre is important to health and that they recognize the lack of fibre in their diets⁴. Yet, closing the fibre intake gap historically has not been easy, as many diets continue to lack adequate servings of fruits, vegetables, whole grains, and fibre-fortified foods. Recent innovations are making it easier for food manufacturers to fortify their products with fibre to help boost fibre content and close this intake gap. An abundance of research continues to demonstrate that fibres added to foods provide similar benefits as "intact" fibres inherent to whole foods.

Figure 1
Adult Fibre Intakes by Country⁵⁻⁸



Tate & Lyle's Soluble Corn Fibre (PROMITOR®) is commonly added to foods to boost fibre content without sacrificing taste, texture or enjoyment. Studies have also demonstrated health benefits of soluble corn fibre, an added or functional fibre.

Fibre Intakes and Recommendations

Dietary Fibre Gap: Intakes vs. Recommendations

Most fibre recommendations for adults call for intakes ranging from 25-38 g/day depending on country specific guidelines^{2,5}. The World Health Organization suggests worldwide recommendations of 25 g per day⁵. Figure 1 notes a wide range of fibre intakes across various countries against the recommended range for consumption⁵⁻⁸. In the United States (U.S.), for most age and gender groups, less than 5% meet the dietary recommendations for fibre⁹ despite consistent messaging to the public to increase dietary fibre intake.

Fibre Sources

Dietary fibres are nondigestible carbohydrates in the diet that when consumed pass through the small intestine into the large intestine, where they may be partially or completely fermented by colonic microflora². While traditional sources of fibre like whole grains, fruits, and vegetables should be encouraged, fibres added to foods are also important contributors to dietary fibre intakes. Fibres that are isolated or synthesized nondigestible carbohydrates which have beneficial physiologic effects in humans are now available on the market and sometimes referred to as functional fibres². These fibres can be extracted from the original food source that they are being added back to (e.g., bran added to grain-based foods); or be manufactured from grains like corn or wheat (e.g., soluble corn fibre); or be modified forms of traditional fibres; or come from fruit, vegetables, legumes, nuts, and seeds². Fibres such as these provide unique functional properties in a variety of food applications and are useful in developing products that have exceptional taste and appeal to the consumer. Adding these types of fibres to commonly consumed foods or to new foods is one

* PROMITOR® Soluble Corn Fibre, PROMITOR® Soluble Gluco Fibre in Europe

Fibre Innovation for Health

strategy in increasing the dietary fibre intake of target populations in order to bridge the gap between usual intakes and recommendations. PROMITOR® Soluble Corn Fibre* is a source of dietary fibre that can be added to a variety of foods.

Physiological Functions and Benefits of Fibre

The physical and chemical structure and fermentation capacity of a dietary fibre are partially responsible for the many physiological benefits associated with dietary fibre consumption. Dietary fibre intake has been inversely associated in epidemiological studies with the risk of coronary heart disease, stroke, hypertension, obesity, prediabetes, type 2 diabetes, certain gastrointestinal disorders, and various cancers¹. Evidence indicates that consumption patterns high in certain fibres are associated with lower total and LDL cholesterol, blood pressure, and blood glucose in healthy individuals and those with prediabetes and type 2 diabetes; can help with both weight loss and maintenance; and can improve bowel regularity, laxation, and gastrointestinal health^{1,5,10-15}. While the breadth of scientific evidence supports these effects, science continues to build on other additional health benefits of fibre consumption such as fermentation by colonic microflora and immunomodulation¹⁵.

PROMITOR® Soluble Corn Fibre* is a fibre ingredient developed by Tate & Lyle and used in foods and beverages across the Americas, Europe and Asia Pacific as a potential solution to increase fibre intake.

Benefits

PROMITOR® Soluble Corn Fibre* has been tested by a number of independent researchers to validate its effectiveness and demonstrate physiological health benefits. The following are some highlights of the research on the health benefits of PROMITOR® Soluble Corn Fibre*:

- **Is well-tolerated¹⁶⁻²⁰, even at high intake levels (40 g/day bolus and 65 g/day multiple doses), and has been found to be better tolerated than inulin¹⁸.**
- **Promotes healthy laxation^{19,20} and produces fewer negative faecal metabolites²⁰.**
- **Has prebiotic properties^{20-22,24,30} which may support a healthy gut by producing short-chain fatty acids that feed the beneficial bacteria in the intestines.**
- **May assist with weight control by providing minimal calories (1.2-2 kcal/g)^{25,26}.**
- **Supports healthy blood glucose control by eliciting a lower glycaemic response²⁷⁻²⁹.**
- **May support bone health by increasing calcium absorption^{23,24,30}.**

Characterization of PROMITOR®

PROMITOR® Soluble Corn Fibre* 70 provides a minimum of 70% dietary fibre and contains less than 20% sugar with a caloric content of 2 kcal/g**. PROMITOR® Soluble Corn Fibre* 85 provides a minimum of 85% dietary fibre and contains less than 2% sugar with a caloric content of 1.2 kcal/g**. The latter is produced by the removal of low molecular weight sugars from PROMITOR® Soluble Corn Fibre* 70 yielding a product with a higher fibre content and reduced sugar content for the formulation of “no sugar added” foods and beverages. Both products are produced through the enzymatic hydrolysis of corn starch. They are both low in viscosity, water soluble and are very stable to heat, pH, and processing stresses.

Resists Digestion and is Fermented in the Gut

PROMITOR® Soluble Corn Fibre* contains a mixture of α 1-6, α 1-4, α 1-2 glucosidic linkages that contribute to the low digestibility of the ingredient. A study in pigs observed that at least 70% of PROMITOR® Soluble Corn Fibre* resists digestion in the small intestine and passes into the large intestine for fermentation²⁵. Changes in faecal short chain fatty acids (SCFA), pH, and breath hydrogen are indicators that gut fermentation is taking place. However, in humans, it is difficult to directly measure the extent to which a dietary fibre resists digestion and is fermented by colonic microbiota, because the SCFA are readily absorbed; animal and *in vitro* models are better utilized for this purpose. In a randomized, controlled, single-blind, crossover study, 24-hour breath hydrogen was found to

* PROMITOR® Soluble Corn Fibre, PROMITOR® Soluble Gluco Fibre in Europe
**These values reflect US ingredient only.
Calories vary based on global regulations.

Fibre Innovation for Health

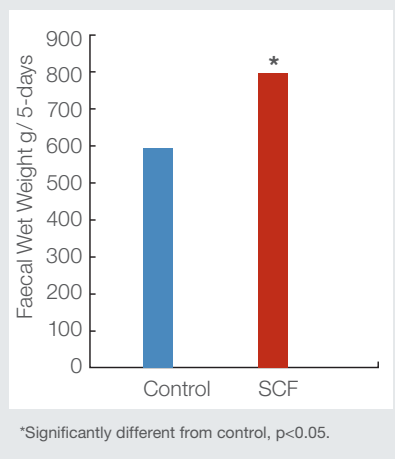
be significantly increased after 18 overweight adults consumed breakfast and lunch foods in which 30% of the available carbohydrate was replaced with 55 g of PROMITOR® Soluble Corn Fibre*²⁸. Faecal pH was significantly lowered in a randomized controlled, double-blind, crossover trial that investigated the effects of 21 g/day of PROMITOR® Soluble Corn Fibre* in 21 overweight, healthy adult men²⁰. In rats fed PROMITOR® Soluble Corn Fibre*, reduced pH levels were observed in the cecum and colon³⁰ and increased concentrations of SCFAs acetate and propionate were detected in the cecum^{29,30}. Similarly, two *in vitro* evaluations that utilized human faecal inoculum from healthy adults found acetate, propionate, and butyrate levels were elevated with the addition of PROMITOR® Soluble Corn Fibre*^{21,22}. In another *in vitro* simulation of gastric digestion and large bowel fermentation using animal faecal material, PROMITOR® Soluble Corn Fibre* was the most fermented ingredient, followed by pullulan, polydextrose, soluble fibre dextrin, and resistant starch³¹.

Good Digestive Tolerance

It is well known that a sudden increase in dietary fibre may cause mild gastrointestinal disturbances, but these are generally transient and improve with adaptation to the dietary fibre source. PROMITOR® Soluble Corn Fibre* is well tolerated at various doses¹⁶⁻²⁰. Clinical trials assessing the gastrointestinal tolerance of PROMITOR® Soluble Corn Fibre* at doses of 12-27 g/day found it to be well tolerated over a period of 10 days to 3 weeks^{16,17,19,20}. In a trial of 20 healthy volunteers

Figure 2

Five Day Faecal Wet Weight (g) of Control vs. Soluble Corn Fibre¹⁹



PROMITOR® Soluble Corn Fibre* in both a single dose at 40 g and in multiple doses reaching 65 g over the day were well-tolerated¹⁸.

Improves Laxation

PROMITOR® Soluble Corn Fibre* improves digestive health through its effect on laxation. Thirty-six healthy adults who consumed 20 g/day of PROMITOR® Soluble Corn Fibre* in breakfast cereal and muffins for 10 days in a randomized placebo-controlled, double-blind crossover study experienced an increase in faecal weight (Figure 2)¹⁹. Increased faecal weight was also observed in another randomized, placebo-controlled, double-blind crossover study of 21 healthy overweight men who ingested 21 g/day of PROMITOR® Soluble Corn Fibre* for 21 days²⁰.

Prebiotic Benefits

PROMITOR® Soluble Corn Fibre* may induce a prebiotic effect by promoting the growth of beneficial bacteria while limiting the growth of less desirable bacteria. After the consumption of 21 g/day of PROMITOR® Soluble Corn Fibre* for 21 days, there was a 1 log increase in *Bifidobacterium* spp. in 21 healthy men compared to a no fibre control²⁰. Another study in 24 adolescents noted an increase in beneficial bacteria – *Bacteroides*, *Butyrivibrio*, *Oscillibacter* and *Dialister* – which was correlated with an increase in calcium absorption when 12 g/day of PROMITOR® Soluble Corn Fibre* was consumed for three weeks^{23,24}. The significant increase in beneficial bacteria observed in human studies has been supported by *in vitro* studies that have used human faecal inoculum under conditions that simulate the human gastrointestinal tract^{21,22}.

Favorable Blood Glucose and Insulin Response

PROMITOR® Soluble Corn Fibre* elicits a low glycaemic response and is valuable for use in products for diabetes control and in products intended to reduce glycaemic load. Two clinical studies^{27,28} and one animal study²⁹ have evaluated the glycaemic effects of PROMITOR® Soluble Corn Fibre*. The postprandial glycaemic response to PROMITOR® Soluble Corn Fibre* was compared to the glycaemic response to glucose in 12 healthy adults in a randomized controlled crossover study (Figure 3)²⁷. PROMITOR® Soluble Corn Fibre* had a significantly lower incremental glucose and insulin response than the glucose control. Another acute study²⁸ observed a significant lowering effect on postprandial blood glucose

* PROMITOR® Soluble Corn Fibre, PROMITOR® Soluble Gluco Fibre in Europe



and insulin at a dose of 55 g of PROMITOR® Soluble Corn Fibre* in randomized, single-blind, crossover study in 18 overweight Dutch adults compared to a full calorie control. Finally, a series of soluble corn fibre formulations investigated in an animal study were found to yield significantly lower postprandial blood glucose and insulin responses than a maltodextrin control²⁹.

To date, the data on PROMITOR® Soluble Corn Fibre* supports a blood glucose and insulin lowering effect. Thus, this product can not only serve as a good source of fibre, but may also

lower blood glucose response, a desirable feature for those with diabetes and healthy individuals.

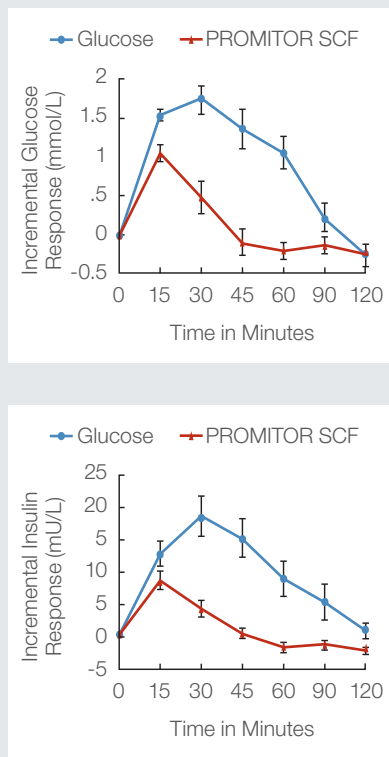
Potential Bone Health Benefits

Adequate calcium consumption is important throughout the lifespan, particularly for building strong bone, optimizing bone mass and reducing the risk of osteoporosis³². Calcium is a shortfall nutrient, hence any attempts to increase calcium absorption and retention is of critical significance³². In a three week, randomized, double-blind, placebo-controlled crossover study of 24 adolescents, calcium absorption was increased by 12% when 12 g/day of PROMITOR® Soluble Corn Fibre* was consumed, compared to a control, in conjunction with a background diet that contained 600 mg/d of calcium²³. In addition, researchers found that the change in calcium absorption was positively correlated with significant increases in gut bacteria, *Bacteroides*, *Butyricoccus*, *Oscillibacter* and *Dialister*, which may explain the mechanism that enables greater calcium absorption²⁴. While the results of this human study only assessed calcium metabolism, a 12 week study conducted in rats investigated the impact of PROMITOR® Soluble Corn Fibre* on bone indices as well as calcium metabolism³⁰. Compared to a cellulose control, soluble corn fibre improved total bone mineral content (BMC), total bone mineral density (BMD), trabecular BMC and BMD, cortical BMC, and cortical area and thickness in the distal femur (Figure 4)³⁰. Bone strength of the distal femur was also significantly improved by the ingestion of PROMITOR® Soluble Corn Fibre*³⁰.

While additional long term studies in humans are needed to assess potential impact on bone indices, these data suggest that PROMITOR® Soluble Corn Fibre* may help support bone health by increasing calcium absorption while providing a source of fibre. Both of these are critical nutrition issues for various segments of the population, especially adolescents and women.

Figure 3

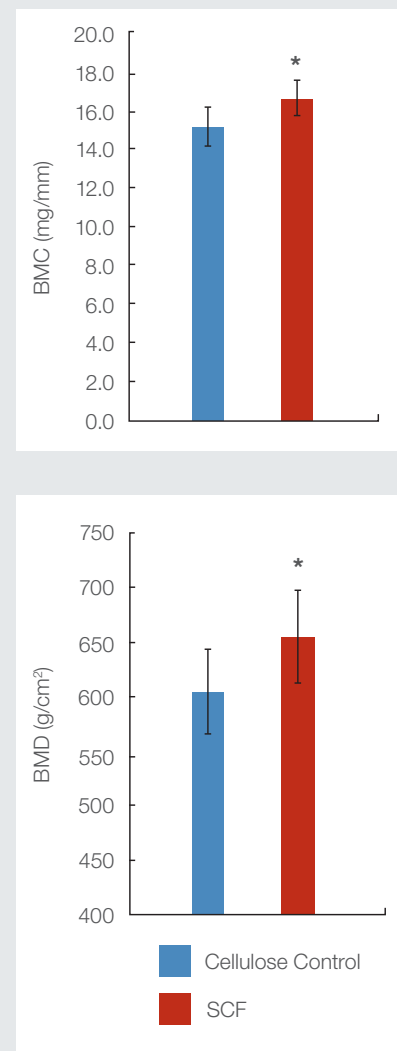
Effect of PROMITOR® Soluble Corn Fibre on Glucose and Insulin Response²⁷



Significant difference between treatments at each time point at p<0.05.

Figure 4

Effects of Soluble Corn Fibre on BMD and BMC in Sprague-Dawley Rats³⁰



*Significantly different from control, p<0.05.

* PROMITOR® Soluble Corn Fibre, PROMITOR® Soluble Gluco Fibre in Europe

Nutritional Impact of the Use of PROMITOR® Soluble Corn Fibre*



Soluble corn fibre can be used in a wide variety of prepared foods, beverages, and condiments including, cereals, baked goods, candy, dairy products, frozen foods, soups, salad dressings, fruit drinks, carbonated beverages, meal replacement drinks, and flavored water.

On a product's ingredient listing, in the case of PROMITOR® Soluble Corn Fibre* 70, it can normally be listed as *soluble corn fibre, corn syrup or corn syrup solids* and in the case of PROMITOR® Soluble Corn Fibre* 85, it can normally be listed as *soluble corn fibre or maltodextrin*. Its contribution to the product's overall fibre would be included in the fibre listing on the Nutrition Facts Panel.

To learn more about PROMITOR® Soluble Corn Fibre*, please visit www.promitorfibre.com.

Current fibre intakes are very low among U.S. adults, at about one-half of the US daily fibre recommendation of 25-38 grams per day for women and men^{2,33}. In other nations⁵, average fibre intakes also fall well below recommended intakes. Diets high in fibre have been associated with lower risk of heart disease and improved blood glucose control while also supporting digestive health and laxation and aiding in weight management^{34,35}.

Simple substitutions of similar foods made with PROMITOR® Soluble Corn Fibre* can help to close the fibre intake gap. In this menu example, fibre increases by 20 grams. PROMITOR® Soluble Corn Fibre* is well tolerated and research to date suggests that it supports digestive health and laxation, may help elicit a lower glycemic response, has prebiotic benefits, and may support bone health through its ability to help increase calcium absorption.

Nutrition Facts		Fibre Increase	% Fibre Increase
Baseline Menu:	Menu with PROMITOR® Soluble Corn Fibre*:		
Calories 1,980	Calories 1,970		
Total Fat 66 g Saturated Fat 22 g	Total Fat 64 g Saturated Fat 22 g		
Cholesterol 225 mg	Cholesterol 215 mg		
Sodium 2,950 mg	Sodium 2,750 mg		
Total Carbohydrate 266 g Dietary Fibre 15 g Sugars 119 g	Total Carbohydrate 278 g Dietary Fibre 35 g Sugars 128 g	20 g	133%
Protein 82 g	Protein 84 g		



2,000 Calorie Menu, Baseline**	With PROMITOR® Soluble Corn Fibre* Substitutions
Breakfast: 1 cup cinnamon toast crunch cereal ¾ cup low-fat milk 1 cup grapefruit sections 1 slice toast w/ 1 tbsp apricot jam 1 cup latte w/ ¼ cup low-fat milk	Breakfast: 1 cup cinnamon oat crunch cereal, made with PROMITOR® Soluble Corn Fibre* ¾ cup low-fat milk 1 cup grapefruit sections 1 slice toast w/1 tbsp apricot spread, made with PROMITOR® Soluble Corn Fibre* 1 cup latte w/ ¼ cup low-fat milk
Lunch: 1 cup tomato soup Antipasto salad: 2 cup romaine lettuce, 1 oz salami, 1 ½ oz provolone cheese, 2 tbsp chopped hard-cooked egg, 1 tbsp olives, 2 tbsp oil & vinegar dressing 1 slice Italian bread 1 cup unsweetened iced tea	Lunch: 1 cup creamy tomato basil soup, made with PROMITOR® Soluble Corn Fibre* Antipasto salad: 2 cup romaine lettuce, 1 oz salami, 1 ½ oz provolone cheese, 2 tbsp chopped hard-cooked egg, 1 tbsp olives, 2 tbsp oil & vinegar dressing 1 slice Italian bread 1 cup unsweetened iced tea
Dinner: Chicken fajitas: 2-6 inch flour tortillas, 1 cup sautéed red & green bell peppers, ½ cup onion, 1 tbsp sour cream ½ cup Spanish rice 1 cup low-fat milk	Dinner: Chicken fajitas: 2-6 inch flour tortillas, 1 cup sautéed red & green bell peppers, ½ cup onion, 1 tbsp sour cream ½ cup Spanish rice 1 cup low-fat milk
Snack: 1 cup apple juice 2 oatmeal-raisin cookies	Snack: 1 cup apple juice 1 fruit-filled cereal bar, made with PROMITOR® Soluble Corn Fibre*

**Menu based on USDA Food Pattern, Dietary Guidelines for Americans, 2010

* PROMITOR® Soluble Corn Fibre, PROMITOR® Soluble Gluco Fibre in Europe

Innovating to Meet Nutrition, Health & Wellness Needs Every Day

Nutrition Professionals Opportunity to Educate Consumers

Despite the fact that many consumers say that they are making efforts to consume diets high in dietary fibre and that they review labels for dietary fibre content when purchasing products, current fibre intakes remain low^{4,5}. This has long-term implications for public health related to risk of coronary heart disease, stroke, hypertension, certain gastrointestinal disorders, obesity, and the continuum of metabolic dysfunctions including prediabetes and type 2 diabetes^{1,15}. According to a 2010 food and health survey by the International Food Information Council, 72% of individuals stated that they are trying to consume more dietary fibre⁴. Nutrition professionals can help to move consumers toward the goal of increasing fibre intake with education on benefits and sources of dietary fibre as consumers desire to make dietary changes.

Conclusions

While individuals should increase their consumption of dietary fibre from sources such as beans and peas, other vegetables, fruits, and whole grains¹, the incorporation of added fibre like PROMITOR® Soluble Corn Fibre* into foods as part of a well-balanced diet can help close the intake gap between recommended and actual intakes. Tate & Lyle's PROMITOR® Soluble Corn Fibre* is a good example of an ingredient that manufacturers can use in the development of new and innovative products to meet the population's fibre needs and that provide health benefits including supporting gastrointestinal health, maintenance of healthy blood glucose, and potentially supporting bone health.

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



Tate & Lyle's global Commercial and Food Innovation Center, Hoffman Estates, Illinois, USA

Better-for-You Ingredients for Health & 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.

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

* PROMITOR® Soluble Corn Fibre, PROMITOR® Soluble Gluco Fibre in Europe

References:

- 1 U.S. Department of Agriculture and U.S. Department of Health and Human Services. Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 2010. <http://www.cnpp.usda.gov/dgas2010-dgareport.htm>
- 2 Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes: Energy, Carbohydrates, Fiber, Fat, Fatty Acids, Cholesterol, Protein and Amino Acids. Washington, DC: National Academies Press; 2002/2005.
- 3 Spiller GA (ed.) CRC Handbook of Dietary Fiber in Human Nutrition, 3rd Edition. CRC Press LLC, Boca Raton, Fla. 2001.
- 4 International Food Information Council Foundation. 2010 Food & Health Survey: Consumer Attitudes Toward Food Safety, Nutrition & Health. July 23, 2010. <http://www.foodinsight.org/Content/3651/2010FinalFullReport.pdf>
- 5 Gray J. Dietary Fibre. Definition, Analysis, Physiology and Health. ILSI Europe Dietary Fibre Concise Monograph Series. 2006. http://www.ilsa.org.ar/biblioteca/ILSI_Europa_Monografias/DietaryFibre%5B1%5D.pdf
- 6 Murphy N, Norat T, Ferrari P, et al. Dietary fibre intake and risks of cancers of the colon and rectum in the European prospective investigation into cancer and nutrition (EPIC). *PLoS One*. 2012;7:e39361.
- 7 Clemens R, Kranz S, Mobley AR, et al. Filling America's Fiber Intake Gap: Summary of a Roundtable to Probe Realistic Solutions with a Focus on Grain-Based Foods. *J Nutr*. 2012;142: 1390S-1401S.
- 8 Cho SS and Dreher M (eds.) Handbook of Dietary Fiber. Marcel Dekker Inc., NY. 2001.
- 9 Marriott BP, Olsho L, Hadden L, et al. Intake of added sugars and selected nutrients in the United States, National Health and Nutrition Examination Survey (NHANES) 2003-2006. *Crit Rev Food Sci Nutr*. 2010;50:228-258.
- 10 Howlett JF, Betteridge VA, Champ M, et al. The definition of dietary fiber – discussions at the ninth Vahouny fiber symposium: building scientific agreement. *Food Nutr Res*. 2010;54:1-5.
- 11 Codex Alimentarius Commission. Guidelines on Nutrition Labeling: CAC/GL 2-1985.: Joint FAO/WHO Food Standards Programme, Secretariat of the CODEX Alimentarius Commission; Rome, Italy 2010.
- 12 American Association of Cereal Chemists. Definition of dietary fiber: report of the Dietary Fiber Definition Committee to the Board of Directors of the American Association of Cereal Chemists. *Cereal Foods World*. 2001;46:112-126.
- 13 Health Canada. Proposed Policy: Definition and Energy for Dietary Fibre. December 2010. <http://www.hc-sc.gc.ca/fr-an/consult/fibre-fibres/index-eng.php>.
- 14 European Food Safety Authority. Statement of the scientific panel on dietetic products, nutrition and allergies on a request from the commission related to dietary fibre (request No.EFSA-Q-2007-121). 17th plenary meeting corresponding to item 10.1; 6 July 2007. *EFSA J*. 2007. <http://www.efsa.europa.eu/en/efsajournal/pub/1060.htm>.
- 15 Kaczmarczyk MM, Miller MJ, Freund GG. The health benefits of dietary fiber: Beyond the usual suspects of type 2 diabetes mellitus, cardiovascular disease and colon cancer. *Metabolism*. 2012;61:1058-66.
- 16 Sanders L, Kendall C, Maki K, et al. A novel maize-based dietary fiber is well tolerated in humans. *FASEB J*. 2008; 22:lb761.
- 17 Stewart ML, Nikhanj SD, Timm DA, et al. Evaluation of the effects of four fibers on laxation, gastrointestinal tolerance and serum markers in health humans. *Ann Nutr Metabol*. 2010; 56:91-98.
- 18 Housez B, Cazaubiel M, Vergara C, et al. Evaluation of digestive tolerance of a soluble corn fibre. *J Hum Nutr Diet*. 2012. doi: 10.1111/j.1365-277X.2012.01252.x; published online.
- 19 Timm DA, Thomas W, Boileau TW, et al. Polydextrose and soluble corn fiber increase five-day fecal wet weight in healthy men and women. *J Nutr*. 2013;143:473-478
- 20 Vester Boler BM, Serao MC, Bauer LL, et al. Digestive physiological outcomes related to polydextrose and soluble maize fibre consumption by healthy adult men. *Br J Nutr*. 2011;106:1864-71.
- 21 Maathuis A, Hoffman A, Evans A, et al. The effect of undigested fraction of maize products on the activity and composition of the microbiota determined in a dynamic *in vitro* model of the human proximal large intestine. *J Am Coll Nutr*. 2009; 28:657-66.
- 22 Titoria P, Gibson P, Komitopoulou E, et al. Understanding Prebiotics. Confidential Collaborative Project In House Final Report No. 120368. Leatherhead Food International. March 2007.
- 23 Whisner CM, Martin BR, McCabe GP, et al. Soluble Corn Fiber Effects on Calcium Absorption and Retention in Adolescent Girls and Boys. *FASEB J*. 2012; 26:373.4.
- 24 Whisner CM, Nakatsu CH, Martin BR, et al. Soluble corn fiber modulates calcium absorption by altering colonic microbiota. *FASEB J* 2013. 27:1056.1.
- 25 Cervantes-Pahm SK, Kim BG, Stein HH. Digestible energy in resistant starch and dietary fiber sources fed to pigs. *J. Anim. Sci.* 2009; 87, E-Suppl. 2.
- 26 Fastinger N, Knapp B, Guevara M, et al. Glycemic response and metabolizable energy content of novel maize-based soluble fibers F4-809, F4-810 and F4-810LS using canine and avian models. *FASEB J*. 2007; 21:A744.
- 27 Kendall C, Esfahani A, Hoffman A, et al. Effect of novel maize-based dietary fibers on postprandial glycemia and insulinemia. *J Am Coll Nutr*. 2008; 27:711-8.
- 28 Konings E, Schoffelen PF, Stegen J, et al. Effect of polydextrose and soluble maize fibre on energy metabolism, metabolic profile and appetite control in overweight men and women. *Br J Nutr*. 2013. Jul 23:1-11. [Epub ahead of print].
- 29 Knapp B. Select Novel Carbohydrates Affect Glycemic and Insulinemic Response, Energy Value, and Indices of Gut Health as Measured Using Canine, Avian, Rodent, and *in vitro* Model Systems. Dissertation. Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Animal Sciences. University of Illinois, Urbana-Champaign, 2010.
- 30 Weaver CM, Martin BR, Story JA, et al. Novel fibers increase bone calcium content and strength beyond efficiency of large intestine fermentation. *J Agri Food Chem*. 2010; 58:8952-8957.
- 31 Hoffman AJ. *in vitro* Testing of Functional Dietary Fiber Ingredients at the University of Illinois. In House Report Jan 31, 2006.
- 32 Heaney RP, Abrams S, Dawson-Hughes B, et al. Peak Bone Mass. *Osteoporosis Intl*. 2000; 11: 985-1009.
- 33 U.S. Department of Agriculture; Agricultural Research Service. What We Eat in America: Nutrient Intakes from Food by Gender and Age. National Health and Nutrition Examination Survey (NHANES) 2007-2008. Available from: http://www.ars.usda.gov/SP2User-Files/Place/12355000/pdf/0708/Table_1_NIN_GEN_07.pdf.
- 34 Anderson JW, Baird P, Baird P, et al. Health benefits of dietary fiber. *Nutr Rev*. 2009;67:188-205.
- 35 Slavin JL. Position of the American Dietetic Association: health implications of dietary fiber. *J Am Diet Assoc*. 2008;108:1716-31

This leaflet is provided for general circulation to the nutrition science and health professional community and professional participants in the food industry, including prospective customers for Tate & Lyle Food ingredients. It is not designed for consumer use. Tate & Lyle accepts no legal liability for the accuracy or completeness of its contents and customers should not rely on the contents. Customers should note that, while this leaflet contains our good-faith assessment of the matters discussed, based on information available as at the publication date, legal, regulatory and labeling policies and requirements are subject to change and jurisdictional variation. Customers should take their own advice with regard to the legal and regulatory aspects of our food ingredients and their application to determine suitability for their particular purposes, product claims, labeling strategies or specifications.