

# Managing Diabetes with Functional Foods

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## Background

Diabetes mellitus (DM) is a complex group of metabolic disorders that leads to elevated blood glucose levels, a condition known as hyperglycemia. According to the American Diabetes Association, the estimated cost of diagnosed diabetes totaled \$245 billion in 2012, including \$176 billion in direct medical costs and \$69 billion in reduced productivity while at work. Of that \$245 billion, hospital inpatient care cost approximately \$105 billion (43%) and prescription medications to treat diabetic complications cost \$44 billion (18%).<sup>1</sup> In 2012, over 29 million Americans, or 9% of the population, suffered from some form of DM, and an additional 86 million Americans, or 27% of the population, were diagnosed with prediabetes, the precursor of type 2 diabetes.<sup>2</sup>

The abnormalities that typically characterize the pathogenesis of DM include peripheral insulin resistance and progressive failure, or complete loss of pancreatic  $\beta$ -cell function. When left uncontrolled, these complications can lead to chronic hyperglycemia and long-term complications like heart disease, stroke, blindness, gum disease, kidney disease, and amputations. Current treatments for diabetes fall short because they do not adequately address key issues in patient's lives: Maintaining proper gut health, and the changing of a patient's dieting habits.

## Types of Diabetes

There are several different types of diabetes, but the two main types include type 1 and type 2 DM. Type 1 diabetes (T1DM), formerly known as juvenile diabetes, is an autoimmune condition characterized by the destruction of pancreatic  $\beta$ -cells. As a result, people with T1DM can no longer produce insulin on their own and must rely on exogenous insulin to properly metabolize glucose.

Type 2 diabetes (T2DM), also known as adult-onset diabetes, is the most common form of diabetes, accounting for roughly 90-95% of all cases of diabetes.<sup>3</sup> T2DM usually begins with insulin resistance and eventually leads to progressive failure of  $\beta$ -cell function. Causes of T2DM include excess weight, physical inactivity, family history of diabetes, history of gestational diabetes, older age, and certain ethnicities.

Current treatment options for T2DM involve diet management, exercise, and oral anti-hyperglycemic medications. These treatments are typically major adjustments for patients, who are told to change their life-long eating and exercise habits. As  $\beta$ -cell function continues to decline, most T2DM patients eventually require insulin. At this time, there are no therapies available that slow or stop the loss of  $\beta$ -cell function once it begins. As a result, there is a crucial need to provide T2DM patients with long-term treatment before they reach this breaking point.

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Prediabetes is the precursor stage to T2DM and often referred to as the “grey area”. People with prediabetes may not meet all of the diagnostic criteria for T2DM, but they are often in the middle of the spectrum. Without intervention, prediabetes is likely to become T2DM in 10 years or less. For this reason, long-term treatment is especially important for anyone diagnosed with prediabetes.

*Blood Test Levels for Diagnosis of Diabetes and Prediabetes*

	A1C (percent)	Fasting Plasma Glucose (mg/dL)	Oral Glucose Tolerance Test (mg/dL)
Diabetes	6.5 or above	126 or above	200 or above
Prediabetes	5.7 to 6.4	100 to 125	140 to 199
Normal	About 5	99 or below	139 or below

*Definitions: mg = milligram, dL = deciliter*

*For all three tests, within the prediabetes range, the higher the test result, the greater the risk of diabetes*

*Source: Adapted from American Diabetes Association. Standards of medical care in diabetes—2012. Diabetes Care. 2012;35(Supp 1):S12, table 2.*

## Complications of Diabetes

Long-term complications of diabetes can develop gradually. The longer a patient has diabetes – and the less controlled their glucose levels are – the higher the risk of complications. Eventually, diabetes complications may be disabling or even life-threatening. Possible complications include:

- Coronary artery disease
- Heart attack
- Stroke
- Atherosclerosis
- Neuropathy
- Kidney damage
- Renal failure
- Retinopathy
- Cataracts

- Glaucoma
- Weakened immunity
- Poor wound healing
- Frequent skin infections

## Current Therapies

Despite the recent introduction of new diabetes medications, many patients continue to struggle with glycemic control. Metformin remains the primary oral medication of choice for patients with T2DM, but only because it has the highest benefit-to-risk ratio for intermediate outcomes, like moderate HbA1c reduction, less weight gain, and reduced risk of hypoglycemia. Many of the other medications lead to more weight gain, hypoglycemia, and edema, making metformin the least harmful, but not the most effective diabetic drug.

Even with aggressive intervention, one cross-sectional survey from 2004 found that roughly 63% of diabetics could not keep their HbA1c level below 7% with their current treatment regimen, suggesting that current therapies may not be all that effective.<sup>4</sup> With so many patients with diabetes unable to effectively control their blood sugars, there is clearly a medical need for a solution that can prevent hyperglycemia, preserve  $\beta$ -cell function and reduce cardiovascular risk without causing weight gain, edema or other negative side effects.

In order to effectively control blood sugar levels, significant changes must be made to a patient’s diet. Changing life-long eating habits and overcoming cravings can prove to be challenging for most patients as dietary alternatives are difficult to find. Functional foods – such as snacks, treats, protein powders and baking mixes – that offer superior nutrition, high levels of fiber, and low glycemic indices are an excellent solution. Silver Fern™ Brand specializes in functional foods that aim to make dietary alternatives and healthy eating easier.

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## Latest News on Diabetic Treatments

New research suggests that alterations in gut bacteria often precede the onset of T1DM, suggesting a potential causal relationship between gut microbiota and beta cell destruction.<sup>5</sup> Additionally, mounting evidence suggests that gut bacteria play a significant role in the onset of insulin resistance and T2DM by triggering low-grade inflammation.<sup>6</sup>

## Gut Health and Diabetes

As previously mentioned, the composition of gut microbiota can play a significant role in the pathogenesis of both type 1 and type 2 DM. New research suggests that gut bacteria play a significant role in the onset of insulin resistance and T2DM by triggering low-grade inflammation.<sup>7</sup> Additionally, disruption of gut bacteria may play a causal role in the development of T1DM by triggering  $\beta$ -cell autoimmunity.<sup>8</sup>

In healthy adults, roughly 80% of gut bacteria can be classified into three dominant phyla: *Bacteroidetes*, *Firmicutes*, and *Actinobacteria*.<sup>9</sup> In general, the most important ratio, in terms of gut health, seems to be that of *Firmicutes*:*Bacteroidetes*. An elevated ratio of *Firmicutes*:*Bacteroidetes* has been associated with obesity, while a decreased ratio is related to weight loss.<sup>10</sup>

When investigating subjects with T1DM, researchers noted a frequent pattern of elevated *Firmicutes*:*Bacteroidetes*. Furthermore, they found that this disruption of gut bacteria appeared to increase intestinal permeability, promoting the development of the pro-inflammatory markers that stimulate  $\beta$ -cell autoimmunity.<sup>11</sup>

These recent findings highlight the need for a diabetic solution that, not only preserves  $\beta$ -cell function, but also cooperates with gut bacteria in order to decrease

intestinal inflammation and damage. Fortunately, there are a few probiotic strains on the market that can reduce gut inflammation and repair intestinal damage, and they can be found in Silver Fern™ Brand probiotics. They contain a unique blend of powerful Bacillus strains, including *B. subtilis HU58*, *B. coagulans*, and *B. clausii*.

### Silver Fern™ Brand Probiotics

<i>Bacillus subtilis HU58</i>	Reduces gut inflammation <sup>12</sup> Decreases gut permeability <sup>13</sup>
<i>Bacillus coagulans</i>	Strengthens immunity by enhancing T-cell response <sup>14</sup>
<i>Bacillus clausii</i>	Strengthens intestinal lining with protective mucous <sup>15</sup>
<i>Saccharomyces boulardii</i>	Reduces gut inflammation by interfering with inflammatory cellular pathways <sup>16</sup>
<i>Pediococcus acidilacti</i>	Secretes natural antibacterial <sup>17</sup> Strengthens intestinal lining by adhering to epithelial cells <sup>18</sup>

This unique probiotic formula pairs perfectly with the prebiotic fiber used in Silver Fern™ Brand products to improve glycemic control, reduce gut inflammation, and repair intestinal damage.

## Glycemic Index

The glycemic index is a measurement of how rapidly glucose is absorbed in the bloodstream on a scale of 0 to 100 during a two-hour window. This scale has been used for decades to help quantify the impact that an individual food will have on postprandial blood glucose levels, in comparison to pure glucose. The consumption of pure glucose will quickly increase blood glucose levels, and then trigger the pancreas to secrete corresponding amounts of insulin to prevent hyperglycemia. As a result, consuming too much glucose in one sitting can lead to the commonly known, sugar rush, followed by a crash in energy levels.

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With the implementation of the glycemic index, food companies and medical experts began looking for glucose alternatives that were low on the glycemic index. Not surprisingly, fructose became a popular sugar substitute due to its low glycemic index score of 19. By the late 1970's, fructose was believed to improve glycemic control for diabetics, which paved the way for high-fructose corn syrup as a low-cost substitute for diabetic management.

However, there's an important difference in the way that the body metabolizes glucose and fructose. While every cell in the body is capable of utilizing glucose for energy, the liver is the only organ that can metabolize fructose in significant amounts. Though the mechanism is unknown, even relatively small amounts of daily fructose consumption have been linked to significant decreases in insulin sensitivity.<sup>19</sup> Additionally, fructose consumption does not appear to change circulating levels of ghrelin, the "hunger hormone" that tells your brain to eat.<sup>20</sup> Instead, ghrelin levels remain mostly unchanged with fructose consumption and can communicate strong hunger signals to the brain even after a large meal.

In recent decades, artificial sweeteners like aspartame (Equal), saccharin (Sweet N Low), sucralose (Splenda), and acesulfame potassium (Sweet One) took the food industry by storm. At first, these nonnutritive sweeteners were considered beneficial in the maintenance of diabetes since they were not metabolized as sugars. However, current research suggests that artificial sweeteners can actually increase the risk of T2DM by 121%, increase the motivation to eat, and disrupt the critical balance of gut bacteria.<sup>21,22,23</sup>

In light of the many drawbacks with most sugar substitutes, Silver Fern™ Brand provides the solution with natural, functional sweeteners. Kakato™, the primary sweetener used in Silver Fern™ Brand products, contains isomalto-oligosaccharides, D-tagatose, stevia extract, monk fruit extract and natural flavors. Like fructose and artificial sweeteners, Kakato™ also ranks low on the glycemic index (GI 32)<sup>24</sup>, but it can actually reduce blood glucose levels and functions as a prebiotic fiber. As can be seen in Figure 1, Kakato™ promotes a much steadier glycemic response, making it a superior sweetener for diabetic control.

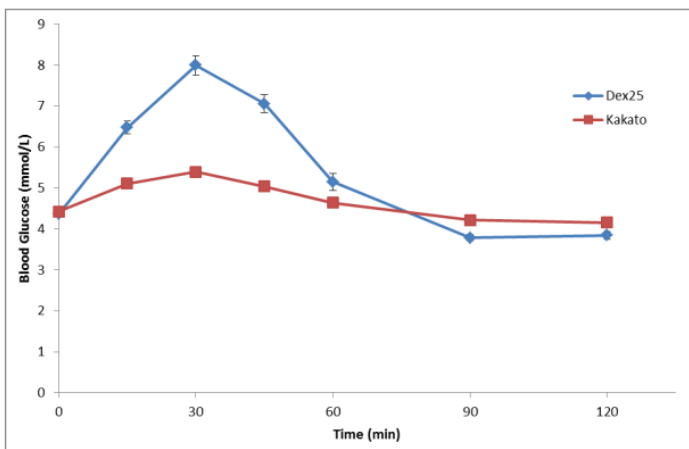


Figure 1: Postprandial glucose responses to Kakato and the Dextrose control (mean of 2 meals, 10 subjects each). All meals contained 25g of available carbohydrate. Data are expressed as Mean±SEM

Test Meal	Glycemic Index*	GI Category**
Dextrose 25g	100	High
Kakato	32±4	Low

\* The listed GI value(s) is/are only valid as long as product ingredients, formulation, processing, and/or any other material production factors remain unchanged.

\*\* Using the classification of ISO 26642:2010, products with a glycemic index (GI) less than or equal to 55 are classified as being low GI, those with a GI of 56 to 69 are classified as medium, while those with a GI equal to or greater than 70 are high GI.

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## Fiber and Diabetes

Although dietary fiber is a popular topic in the world of nutrition, the human body cannot actually digest it. Instead, dietary fiber aids in bowel movements and some serve as food for naturally occurring gut bacteria. The two main types of dietary fiber are soluble and insoluble fiber. Most foods contain both forms but tend to be richer in one type.

Soluble Fiber	Insoluble Fiber
Dissolves in water to form a gel	Does not dissolve in water
Fermented by gut bacteria (prebiotic)	Not fermented by gut bacteria
Firms loose stools	Softens hard stools

When soluble fiber forms a gel, it has the ability to slow down the absorption of fat and sugar, thereby resulting in steadier blood glucose levels. In fact, numerous controlled clinical trials involving both type 1 and type 2 diabetes have found that high-fiber diets (>20g/1000 kcal) reduced postprandial blood glucose concentrations by 13-21%, serum LDL cholesterol levels by 8-16%, and serum triglycerides by 8-13%.<sup>25,26</sup>

## Fiber Recommendations

Age	Men	Women
< 50 years old	38g/day	25g/day
> 50 years old	30g/day	21g/day

Source: Institute of Medicine.

## Benefits of a high fiber diet:

There are many benefits to a high-fiber diet, some of these include:

- Prevent constipation and diverticular disease
- Normalize serum glucose and insulin responses
- Reduce serum LDL cholesterol levels
- Reduce risk of cardiovascular disease and type 2 diabetes
- Improves satiety
- Feeds healthy gut bacteria

Some fibers can be fermented by naturally-occurring gut bacteria, resulting in the formation of gases and short-chain fatty acids (SCFAs) like acetate, propionate, and butyrate.<sup>27</sup> Fermentable fiber, also known as prebiotic fiber, can be found in plants like: whole grains, onions, garlic, bananas, Jerusalem artichoke, and chicory root. In addition to improving bowel movements, prebiotic fiber can also have a positive impact on gut bacteria, which can actually strengthen the intestinal wall, improve nutrient absorption, improve appetite and anxiety, enhance metabolism, and more.

## Summary

In conclusion, diabetes is a disease that affects nearly 10% of the American population and costs over \$100 billion in hospital care each year.<sup>28,29</sup> Current lifestyle and drug therapies remain mostly ineffective, as over 60% of diabetics were unable to maintain proper glycemic control in 2004. Therefore, there is a clear need for new therapies that offer improved glycemic control without unwanted metabolic side effects.<sup>30</sup>

The introduction of functional foods that are high in fiber, elicit low glycemic responses, and include the right strains of probiotics will greatly enhance the diabetic patient's treatment. Multifunctional products – such as those provided by Silver Fern™ Brand – have the ability to promote insulin sensitivity, improve satiety, reduce inflammation, and even encourage fat loss - making them the perfect solution for diabetics everywhere.

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