

Beans and Diabetes

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Introduction

In the first three parts of this series we reviewed the relationship between bean intake to cancer, obesity, and cardiovascular disease. The potential adverse consequences of hyperglycemia and hyperinsulinemia to regulation of food consumption as well as cancer risk were also discussed. In this review, evidence linking low glycemic index diets to improvements in diabetes management as well as diabetes risk will be addressed. As in previous sections, few studies have looked directly at bean consumption. However because beans have a low glycemic index relative to other carbohydrate starches they will be discussed in this context.

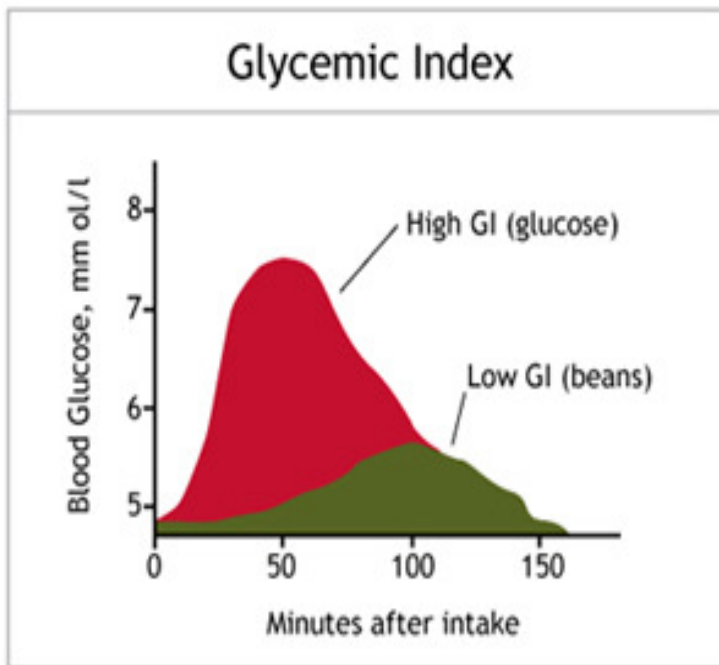


TABLE 1. GLYCEMIC INDEX (GI) OF SELECTED FOODS*

FOOD ITEM*	GI
 CHICKPEAS	39
 LENTILS	42
 NAVY BEANS	43
 SPLIT PEAS	45
 PINTO BEANS	55
 WHITE RICE	80
 WHITE BREAD**	100
 POTATOES	121

*150 g cooked except for white bread

**White bread was used as the reference food in an amount equal to the carbohydrate available in the test food

Low Glycemic Index Diets for Diabetes Management

It has long been recognized that components present in food, particularly soluble dietary fiber and the nature of the starch can influence the rate by which glucose is absorbed from the small intestine (reviewed in 1& 2). In the mid-1970's, research began to focus on manipulating dietary fiber and carbohydrates to help individuals with diabetes manage their blood glucose. In several clinical trials, it was shown that incorporation of very high amounts of fiber in the diet improved parameters associated with hyperglycemia and even lowered exogenous insulin requirements in some diabetics (3-8). However, it is very difficult for most individuals to consume such a high level of dietary fiber on a regular basis. Around the same time, several groups began to focus their attention on glycemic and insulin responses to different carbohydrate sources (9-13). Jenkins et al. later introduced the concept of glycemic index to characterize these differences (11). The glycemic index, defined in a previous section, is the ability of different sources of carbohydrates to increase blood glucose over a period of time compared to either glucose or white bread. Legumes in particular were found to produce relatively low glycemic responses in both healthy individuals (11) and in diabetics (12-13).

Eating low glycemic index diets may be one mechanism to minimize the normal rise in blood glucose that occurs following meals and therefore aid in the management of diabetes. Diabetes is a chronic condition associated with many metabolic abnormalities including elevated blood glucose and triglycerides. Individuals are instructed to lower blood glucose levels to help reduce the potential for complications associated with the disease. Many of these complications, including vascular disease and death are related to the long-term effects of hyperglycemia (14). Several feeding studies have shown improvements in glycemic control in both type 1 and type 2 diabetics when low compared to high glycemic index diets are consumed (summarized in 15-16; 17-26). In a recent study with type 1 diabetic children, dietary advice about how to consume a low glycemic index diet was reported to be more beneficial and less of a burden than utilization of the traditional carbohydrate exchange diet (18). In this study, improvements in glycosylated HbA1C and a reduced number of excessive hyperglycemic episodes were reported in children instructed to consume low glycemic index foods. Glycosylated proteins reflect blood glucose levels over long periods of time. Chronic elevations of blood glucose increase the amount of glycosylated blood proteins in blood and vice versa. In feeding studies with type 2 diabetics (adult-onset), lower fasting blood glucose (17), glycosylated proteins (17,20-22,25), insulin secretion (17,22), and lipoproteins (14,21,22,25) have been reported by lowering dietary glycemic index. Although still relatively few in number, these studies provide evidence that simply substituting low glycemic index carbohydrates such as beans for more processed starches can modestly improve glycemic control in diabetics. We acknowledge that some health scientists prefer to not use the concept of glycemic index, but instead emphasize high fiber foods with low caloric density. Regardless of the approach, beans are a highly desirable food since they have a low glycemic index and at the same time they are a high fiber, low caloric dense food.

High Glycemic Index Diets and Risk of Type 2 Diabetes

Consumption of complex carbohydrates and increasing soluble dietary fiber intake was originally advocated for individuals with diabetes and hyperlipidemia. However, two large epidemiological studies have now indicated that long-term consumption of high glycemic index, starchy foods may also increase the risk of developing type 2 diabetes (27-28). In these studies, individuals were followed for a period of time (6 years) and dietary comparisons were made between individuals diagnosed with diabetes and non-diabetics. In both studies, the researchers found a 37% increase in diabetes in individuals with the highest glycemic index intake compared to those having the lowest glycemic index intake after adjustment for known risk factors and cereal fiber. Foods most associated with diabetes risk included French fries, carbonated beverages, white bread, and white rice (27-28).

The exact reason why consumption of high glycemic index foods leads to an increased risk for type 2 diabetes is not known but may be due to an increase in insulin demand (2,15-16,29). High glycemic index foods are known to cause rapid elevations in blood glucose and insulin following a meal. Chronic consumption of high glycemic index diets may in turn lead to down-regulation or desensitization of receptors for insulin, eventually contributing to insulin resistance (2). The body initially adjusts to higher circulating glucose by increasing insulin secretion from the pancreas. However, in susceptible individuals over time insulin resistance combined with exhaustion of insulin producing cells will eventually lead to type 2 diabetes (15-16). Current research (30-31) also suggests that hyperglycemia and hyperinsulinemia stimulate fat cells and possibly cells that line blood vessels (endothelial cells) to secrete pro-inflammatory cytokines called tumor necrosis factor alpha (TNF- α) and interleukin-6 (IL-6). These cytokines promote insulin resistance and other clinical and

biochemical symptoms associated with type 2 diabetes. In addition, these cytokines are predictive of risk for cardiovascular disease.

In conclusion, eating a diet rich in low glycemic index foods may help prevent development of diabetes. For diabetics and individuals with impaired glucose tolerance, a low glycemic index diet is important to help control hyperglycemia and hyperinsulinemia and reduce complications of diabetes such as atherosclerosis and kidney failure.

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