

LE Magazine July 2007

REPORT

Controlling Blood Sugar to Regulate Body Weight

By Debra Fulghum Bruce, PhD

Those who struggle with obesity often suffer from dangerously elevated glucose (blood sugar) levels.

Beta-glucans (derived from oats and barley) slow the absorption of carbohydrates—enabling one to control blood sugar levels and induce the satiety needed to achieve healthy weight management.

Side benefits of controlling blood glucose include lowering harmful blood fats and C-reactive protein. When blood sugar levels are stabilized, metabolic syndrome and diabetes can be averted.

In this article, we explore how beta-glucans can protect against degenerative disease while offering a decisive advantage for those looking to take control of their blood sugar and their waistline.

FIBER-DEFICIENT DIET ELEVATES DISEASE RISK

A number of health problems that plague aging adults—from high cholesterol to diabetes—can often be traced to inadequate levels of dietary fiber.¹ Plant-derived fibers play many useful roles in the body, including binding with water to help propel partially digested foods through the intestinal tract. Principal dietary sources of fiber include whole grains, legumes, nuts, fruits, and vegetables.

Americans consume an average of about 14 grams of fiber each day—less than half the amount recommended by the American Diabetes Association for disease prevention and wellness.² In recent decades, as consumption of processed food has greatly increased, fiber intake has similarly decreased. The result is that most Americans are severely deficient in dietary fiber, and thus at much higher risk of contracting disease. In fact, a diet rich in fiber—particularly from cereal grains—is associated with a 40-50% lower risk of coronary heart disease and heart attack.³

BETA-GLUCANS: A FIBER POWERHOUSE

Beta-glucans, soluble fibers found in the cell walls of oats, barley, yeast, bacteria, algae, and mushrooms, have remarkable physiological health benefits.

Studies show that when taken with meals, beta-glucan fibers markedly blunt post-meal elevations in blood sugar and insulin levels. Like other foods rich in soluble fiber, beta-glucans help improve blood glucose metabolism while also lowering serum lipid levels and improving colon health.⁴

About 30-40% of ingested soluble fiber is digested before reaching the colon, while the rest is fermented by bacteria in the large intestine to short-chain fatty acids, which may protect colon mucosa.⁴⁻⁶

Soluble beta-glucan fibers from oats and barley are notable in their ability to bind with water, thus increasing the volume and viscosity (thickness) of the intestinal contents. This leads to the slower absorption of carbohydrates into the bloodstream and decreased blood cholesterol levels.⁵

FIBER MODULATES POST-MEAL BLOOD SUGAR RESPONSE

The meager amounts of fiber that characterize the modern Western diet are a potent contributor to aberrant blood sugar metabolism and the growing epidemic of insulin resistance, metabolic syndrome, and type II diabetes.

Currently, about 35 million Americans between the ages of 40 and 74 have impaired fasting glucose, and 16 million have impaired glucose tolerance. Because so many people have both conditions, the total number of adults aged 40 to 74 with pre-diabetes in the United States is estimated to be an astounding 41 million!⁷

We now know there is a direct link between ingesting carbohydrates and the resultant postprandial (after-meal) blood sugar response.⁸ After eating a large meal containing ample amounts of quickly absorbed carbohydrates and little soluble fiber, an individual may experience significant postprandial (after-meal) hyperglycemia, or high blood sugar.



How quickly blood sugar rises sometimes depends on the glycemic index of the food consumed. The glycemic index is a numerical system that ranks foods on a scale of 0 to 100, according to how quickly their ingestion increases blood glucose levels relative to pure glucose itself. Although different foods may supply the same amount of carbohydrates per serving, they can have very different glycemic indexes.

For example, highly processed foods such as white bread and doughnuts send blood sugar levels soaring, and have glycemic indexes of approximately 73-76.⁹ By contrast, naturally fiber-rich foods such as beans and raw pears slowly increase blood glucose and thus have far lower glycemic indexes, of approximately 29-38.⁹ Harvard studies suggest that the carbohydrate composition of foods plays a large role in their ability to promote or impair one's health. High-glycemic-index foods that rapidly increase blood sugar contribute to the risk of heart disease and diabetes.¹⁰

However, not all fiber is created equal, especially when it comes to favorably influencing the glycemic index of foods. Scientists from the Agricultural Research Service found that barley fiber containing soluble beta-glucan fiber was more effective in regulating peak glucose response than wheat, a whole grain that contains no beta-glucans. They also noted beneficial reductions in glucose and insulin levels when oat-derived beta-glucans were ingested at mealtime.¹⁰ Other scientists have found that adding soluble fiber such as oat and barley beta-glucans to the diet helps modulate the after-meal rise in blood sugar, along with the insulin response to a meal containing carbohydrates.¹¹⁻¹³

The low glycemic index values of oats or barley, both rich in beta-glucans, may stem from their ability to form a viscous gel with water in the gastrointestinal tract. This thick, gelatinous mixture delays the release of the stomach's contents into the small intestine for further digestion. This contributes to slower production and release of insulin by the pancreas,¹⁴ as well as a slower rate of glucose uptake from the small intestine.¹⁵ Thus, the high viscosity of beta-glucans may play a critical role in reducing the more dangerous aspects of the glycemic response to a meal.

FIBER MAY HELP AVERT METABOLIC SYNDROME, DIABETES

Growing evidence suggests that soluble dietary fiber may play an important role in averting the dangers of metabolic syndrome, a precursor to diabetes associated with an elevated risk of cardiovascular disease.¹⁶ Metabolic syndrome refers to the constellation of metabolic abnormalities that includes abdominal obesity, high blood pressure, high blood sugar, high triglycerides, and low levels of beneficial high-density lipoprotein (HDL).

A study of the prevalence of metabolic syndrome in the Framingham Offspring Cohort found that it was significantly less common among those who ingested the most whole grains and cereal fiber.¹⁷ Given both the high fiber content and a low glycemic index attributed to whole-grain foods, increasing one's intake of whole grains may reduce the risk of developing metabolic syndrome. Since metabolic syndrome commonly precedes full-blown type II diabetes, dietary intervention with whole-grain fibers may help keep diabetes at bay.

Dietary fibers also benefit those who already have type II diabetes. When diabetic patients consumed a healthy diet that substituted oat beta-glucans for some dietary fat, they exhibited notable improvements in metabolic parameters such as weight, HDL, and long-term blood sugar control.¹⁵

BETA-GLUCANS LOWER CHOLESTEROL, IMPROVE LIPIDS

Many physicians have long advised their cardiac patients to consider adding soluble fiber to their meals in order to reduce cholesterol levels. According to both the Third Report of the Expert Panel on Detection, the Evaluation, and Treatment of High Blood Cholesterol in Adults (ATP III) and the American Heart Association,^{18,19} the gel-forming characteristic of soluble fiber has been shown to improve lipid profiles.²⁰ In one meta-analysis, researchers determined that for every 1-gram increase in soluble dietary fiber, potentially dangerous low-density lipoprotein (LDL) was reduced by 2.2 mg/dL on average.²¹

In particular, beta-glucan fibers are thought to lower cholesterol by increasing the bulk, volume, and viscosity of the intestinal tract's contents, thus altering cholesterol and lipoprotein metabolism in the liver. Beta-glucans increase the excretion of bile acids released from the gall bladder. These bile acids are made up of oxidized cholesterol. The liver uses cholesterol to make more bile, which has the net effect of decreasing the amount of harmful LDL circulating in the blood.⁴ Thus, beta-glucans not only lower cholesterol, but also help to maintain already-normal levels of cholesterol.

In a recent study in Venezuela, investigators set out to determine the effect of bread formulated with 6 grams of beta-glucans (oat-derived soluble fiber) on serum lipids of overweight men with mild to moderate hypercholesterolemia (high cholesterol). After eating a low-fat diet for one week, the men were divided into two groups. One group stayed on the American Heart Association (AHA) Step II diet with whole-wheat bread, while the other group remained on the AHA Step II diet containing high levels of monounsaturated fatty acids plus bread made with 6 grams of beta-glucan. It was suggested that all men exercise 60 minutes each day.²²

After eight weeks, both groups of men reduced their body weight significantly. Those who ingested bread containing 6 grams of beta-glucans saw an impressive increase in their levels of beneficial HDL, which remained unchanged in the other group. Non-HDL cholesterol decreased in the beta-glucans group, and the total cholesterol/HDL ratio was reduced. While the diet with whole-wheat bread had no effect on fasting plasma glucose, the beta-glucans diet resulted in a decrease in fasting blood glucose. All of these improved lipid profiles reduced the risk of cardiovascular disease in the beta-glucans group.²²

BETA-GLUCANS: WHAT YOU NEED TO KNOW

- Fiber is an essential but often neglected constituent of a healthy human diet. While the recommended daily allowance of dietary fiber is 25-30 grams, Americans on average consume about half that amount.
- Scientists believe that inadequate dietary fiber contributes to some of the most prevalent health problems today, ranging from heart disease to metabolic syndrome and type II diabetes.
- Natural dietary fibers known as beta-glucans have been shown to be highly effective in helping to maintain healthy blood sugar control. By slowing the digestion and absorption of carbohydrates, beta-glucans help promote a feeling of fullness that effectively supports efforts to attain and maintain a healthy body weight.
- Other benefits of beta-glucans include modulating levels of harmful blood lipids and preventing metabolic syndrome. These plant-derived fibers may also help to quell dangerous inflammation in the body. Emerging research suggests a role for dietary fibers in preventing breast cancer and cancer metastasis.
- Incorporating a nutritional supplement rich in beta-glucans in one's diet provides a convenient way to capture the numerous health benefits associated with optimal fiber intake.

REPORT

Controlling Blood Sugar to Regulate Body Weight

By Debra Fulghum Bruce, PhD

FIBER PROMOTES SATIETY, AIDS WEIGHT MANAGEMENT

Diets high in fiber may protect against unwanted weight gain via several mechanisms that involve effects on satiety and glucose and insulin responses.²⁵ For example, research has shown that vegetarians weigh significantly less than non-vegetarians, whether measured by body mass index or body weight.²⁶ Some experts believe that vegetarians' lower average body weight is linked to one factor: the high fiber content of the plant foods consumed.²⁷ Plant fiber fills you up quickly, and studies indicate that this results in less snacking and binging later in the day.

The transnational Seven Countries Study provides additional evidence linking a high-fiber diet with lower body weight. Researchers found that people living in countries with high fiber intake weighed less than those living in countries where fiber intake is low.²⁸ Higher fiber intake is also associated with lower average body weight in the US. In the Nurses Health Study, a prospective observational cohort study of female nurses aged 38 to 63 without known cardiovascular disease, cancer, or diabetes at baseline, those who ingested more dietary fiber consistently weighed less than did those who consumed less fiber.²⁵

Finally, in the Coronary Artery Risk Development in Young Adults (CARDIA) Study examining how heart disease develops in adults, researchers linked dietary fiber intake with body weight and waist-to-hip ratios, along with various markers of heart disease risk. Higher fiber consumption predicted less weight gain more strongly than did total or saturated fat consumption.²⁷

FIBER LOWERS CRP, REDUCES CARDIAC RISK

C-reactive protein (CRP) is a special type of protein whose levels are increased in the blood in response to inflammation. People who smoke, have high blood pressure, are overweight, or have sedentary lifestyles often have elevated CRP, whereas lean, active people usually have lower levels. Like high serum cholesterol, high levels of C-reactive protein carry an increased risk of cardiovascular disease. Diets high in soluble fiber can help reduce CRP and thus lower the risk of heart disease.²³

One review article noted a 28% reduction in CRP levels when volunteers consumed a whole-foods diet rich in soluble fiber.²³ In another trial, ⁵⁵ healthy adults were assigned one of three diets: a diet low in saturated fat; the same diet plus a cholesterol-lowering statin drug; or the same diet plus increased amounts of plant sterols, viscous fiber, soy protein, and nuts. After one month, serum C-reactive protein levels fell in all three groups. In the low-fat diet group, CRP dropped 10%, a difference not considered statistically significant. However, those who consumed a low-fat diet enriched with plant sterols and fibers achieved a statistically significant 28% reduction in CRP—nearly equaling the 33% drop seen in those taking a powerful statin drug.²⁴

SUPPLEMENTING WITH BETA-GLUCANS

Adults seeking an effective way to manage their fluctuating blood glucose levels and stabilize their weight should consider supplementing with highly viscous beta-glucan fibers. Nutritional scientists have now made these beneficial fibers available in a pleasant-tasting drink mix that provides 5 grams of fiber per serving, or one fifth of the recommended daily fiber intake of 25 grams.

According to the FDA, foods containing soluble fiber from whole oats (oat bran, oat flour, and rolled oats) may reduce the risk of heart disease when used in conjunction with a diet low in saturated fat and cholesterol. To qualify for the health claim, foods containing whole oats must provide at least 750 milligrams of soluble fiber per serving.³⁰

To achieve cholesterol-lowering effects, doses of 3-6 grams of oat beta-glucans per day may be indicated.³⁰

Oat beta-glucans are generally considered safe and well tolerated. The Physician's Desk Reference reports no contraindications or precautions for using beta-glucans, and the only noted adverse effect is occasional intestinal gas.³⁰

NEW STUDY: BETA-GLUCANS SUPPLEMENT PROPELS WEIGHT LOSS

A recent trial demonstrates the ability of a high-viscosity fiber supplement containing beta-glucans to promote satiety and weight loss.

Scheduled for publication in late 2007, this trial examined seven overweight or obese adults (with body mass indexes ranging from 25 to 35) who consumed 4 grams of a fiber blend containing beta-glucans each day for 16 weeks.

CONCLUSION

Supplementing your daily diet with beta-glucan fibers derived from oats and barley is an ideal way to capture the abundant health benefits of optimal dietary fiber intake.

When taken with meals, viscous beta-glucan fibers offer a convenient way to modulate the body's response to carbohydrate-containing foods. In addition, these beta-glucan-rich grains can help lower potentially harmful blood lipids and avert the myriad dangers of metabolic syndrome. By promoting a feeling of satiety or fullness, beta-glucans can also contribute powerfully to healthy body weight management.

The combination of the fiber supplement with a calorie-restricted diet and healthy lifestyle led to significant weight loss in the participants. In addition, the study participants reported a decrease in hunger and an earlier onset of fullness when eating.²⁹

References

1. Suter PM. Carbohydrates and dietary fiber. *Handb Exp Pharmacol.* 2005;(170):231-61.
2. Hendry J. Healthful fiber findings often forgotten. *DOC News.* 2006 Mar 1;3(3):16.
3. Wolk A, Manson JE, Stampfer MJ, et al. Long-term intake of dietary fiber and decreased risk of coronary heart disease among women. *JAMA.* 1999 Jun 2;281(21):1998-2004.
4. Queenan KM, Stewart ML, Smith KN, et al. Concentrated oat beta-glucan, a fermentable fiber, lowers serum cholesterol in hypercholesterolemic adults in a randomized controlled trial. *Nutr J.* 2007;66.
5. Knudsen KE, Jensen BB, Hansen I. Oat bran but not a beta-glucan-enriched oat fraction enhances butyrate production in the large intestine of pigs. *J Nutr.* 1993 Jul;123(7):1235-47.
6. Lund EK, Johnson IT. Fermentable carbohydrate reaching the colon after ingestion of oats in humans. *J Nutr.* 1991 Mar;121(3):311-7.
7. Harris MI, Flegal KM, Cowie CC, et al. Prevalence of diabetes, impaired fasting glucose, and impaired glucose tolerance in U.S. adults. The Third National Health and Nutrition Examination Survey, 1988-1994. *Diabetes Care.* 1998 Apr;21(4):518-24.
8. Nuttall FQ. Carbohydrate and dietary management of individuals with insulin-requiring diabetes. *Diabetes Care.* 1993 Jul;16(7):1039-42.
9. Available at: <http://lpi.oregonstate.edu/infocenter/foods/grains/gigl.html>. Accessed April 18, 2007.
10. Available at: http://www.ars.usda.gov/research/publications/publications.htm?SEQ_NO_115=181996. Accessed April 17, 2007.
11. Franz MJ, Bantle JP, Beebe CA, et al. Evidence-based nutrition principles and recommendations for the treatment and prevention of diabetes and related complications. *Diabetes Care.* 2002 Jan;25(1):148-98.
12. Poppitt SD, van Drunen JD, McGill AT, Mulvey TB, Leahy FE. Supplementation of a high-carbohydrate breakfast with barley beta-glucan improves postprandial glycaemic response for meals but not beverages. *Asia Pac J Clin Nutr.* 2007;16(1):16-24.
13. Björklund M, van Rees A, Mensink RP, Onning G. Changes in serum lipids and postprandial glucose and insulin concentrations after consumption of beverages with beta-glucans from oats or barley: a randomised dose-controlled trial. *Eur J Clin Nutr.* 2005 Nov;59(11):1272-81.
14. Behall KM, Scholfield DJ, Hallfrisch JG, Liljeberg-Elmstahl HG. Consumption of both resistant starch and beta-glucan improves postprandial plasma glucose and insulin in women. *Diabetes Care.* 2006 May;29(5):976-81.
15. Reyna NY, Cano C, Bermudez VJ, et al. Sweeteners and beta-glucans improve metabolic and anthropometrics variables in well controlled type 2 diabetic patients. *Am J Ther.* 2003 Nov-Dec;10(6):438-43.
16. Citrome L. Metabolic syndrome and cardiovascular disease. *J Psychopharmacol.* 2005 Nov;19(6 Suppl):84-93.

17. McKeown NM, Meigs JB, Liu S, et al. Carbohydrate nutrition, insulin resistance, and the prevalence of the metabolic syndrome in the Framingham Offspring Cohort. *Diabetes Care*. 2004 Feb;27(2):538-46.
18. Anon. Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. *Circulation*. 2002 Dec 17;106(25):3143-421.
19. Lichtenstein AH, Appel LJ, Brands M, et al. Diet and lifestyle recommendations revision 2006: a scientific statement from the American Heart Association Nutrition Committee. *Circulation*. 2006 Jul 4;114(1):82-96.
20. Fernandez ML. Soluble fiber and nondigestible carbohydrate effects on plasma lipids and cardiovascular risk. *Curr Opin Lipidol*. 2001 Feb;12(1):35-40.
21. Brown L, Rosner B, Willett WW, Sacks FM. Cholesterol-lowering effects of dietary fiber: a meta-analysis. *Am J Clin Nutr*. 1999 Jan;69(1):30-42.
22. Reyna-Villasmil N, Bermudez-Pirela V, Mengual-Moreno E, et al. Oat-derived beta-glucan significantly improves HDLC and diminishes LDLC and non-HDL cholesterol in overweight individuals with mild hypercholesterolemia. *Am J Ther*. 2007 Mar;14(2):203-12.
23. McCarty MF. Low-insulin-response diets may decrease plasma C-reactive protein by influencing adipocyte function. *Med Hypotheses*. 2005;64(2):385-7.
24. Jenkins DJ, Kendall CW, Marchie A, et al. Effects of a dietary portfolio of cholesterol-lowering foods vs lovastatin on serum lipids and C-reactive protein. *JAMA*. 2003 Jul 23;290(4):502-10.
25. Liu S, Willett WC, Manson JE, et al. Relation between changes in intakes of dietary fiber and grain products and changes in weight and development of obesity among middle-aged women. *Am J Clin Nutr*. 2003 Nov;78(5):920-7.
26. Appleby PN, Thorogood M, Mann JI, Key TJ. Low body mass index in non-meat eaters: the possible roles of animal fat, dietary fibre and alcohol. *Int J Obes Relat Metab Disord*. 1998 May;22(5):454-60.
27. Ludwig DS, Pereira MA, Kroenke CH, et al. Dietary fiber, weight gain, and cardiovascular disease risk factors in young adults. *JAMA*. 1999 Oct 27;282(16):1539-46.
28. Kromhout D, Bloemberg B, Seidell JC, Nissinen A, Menotti A. Physical activity and dietary fiber determine population body fat levels: the Seven Countries Study. *Int J Obes Relat Metab Disord*. 2001 Mar;25(3):301-6.
29. [No authors listed]. Pilot study shows Cevena's Viscofiber®, combined with diet and lifestyle program, promotes significant weight loss. Unpublished study submitted for publication. Cevena Bioproducts, Inc.
30. Available at: http://www.pdrhealth.com/drug_info/nmdrugprofiles/nutsupdrugs/oat_0323.shtml. Accessed April 18, 2007.
31. Cade JE, Burley VJ, Greenwood DC. Dietary fibre and risk of breast cancer in the UK Women's Cohort Study. *Int J Epidemiol*. 2007 Jan 24.
32. Murphy EA, Davis JM, Brown AS, et al. Effects of moderate exercise and oat beta-glucan on lung tumor metastases and macrophage antitumor cytotoxicity. *J Appl Physiol*. 2004 Sep;97(3):955-9.