All Fibers Are Not Created Equal

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It is important for patients to select the right dietary fiber to deliver the desired health benefit. Not all dietary fibers provide the same physiologic benefits. Thus, the goal of this commentary is to aid physicians and other healthcare professionals in guiding their patients to make appropriate selections in dietary fiber supplementation.

Dietary fiber may be defined as the nondigestible carbohydrates and lignin present in plants and isolated nondigestible carbohydrates that have physiologic effects in humans.[1,2] When differences between the physiologic effects of wheat bran (eg, increasing fecal bulk) and pectins (eg, decreasing serum cholesterol values) were recognized, distinctions between insoluble and soluble fibers were made.[3] Traditional dietary fibers are nondigestible carbohydrates that occur naturally and are intact in foods. The definition of dietary fiber has been expanded in recent years to include two additional groups of nondigestible carbohydrates termed functional fibers, namely resistant starches (RS), and oligofructoses, such as inulin.[4,5] Jenkins[6] introduced the term "viscous" fiber to underscore the important physiologic effects of gel-forming fibers that include glycemic and hypocholesterolemic effects. Including RS and oligofructoses under the fiber umbrella illustrates the importance of delineating "soluble" fibers as "viscous" or "nonviscous," since fibers in these categories are soluble but nonviscous. These different types of dietary fibers are available from foods and as fiber supplements.

High levels of consumption of traditional dietary fibers are associated with lower risks for coronary heart disease, stroke, diabetes, obesity, hypertension, some gastrointestinal diseases, and certain cancers.[7] Clinical trials indicate that certain dietary fibers can produce the following effects: decreased serum cholesterol values,[8,9] lower postprandial blood glucose values (glycemic effects),[10] decreased blood pressure,[11] enhanced weight loss,[7] improved laxation,[12] improved gastrointestinal health,[7] and prebiotic effects that enhance immune function.[7,13] Prebiotics foster the growth of Lactobacillus and Bifidobacteria bacteria—health-promoting microflora[14]—in the colon. The term "bifidogenic" also is used to describe these indigestible carbohydrates.[15] It is tempting to attribute the cardioprotective health benefits to those fibers that have favorable effects on serum cholesterol and glucose values, blood pressure, and food intake, since these are risk factors for cardiovascular disease.[7] Oat bran as well as psyllium, for example, have been documented to lower serum low-density lipoprotein (LDL) cholesterol values, lower blood pressure, improve postprandial glycemia, decrease food intake, and promote weight loss.[7] It is appealing to suggest that these fibers might reduce risk for cardiovascular disease and to recommend that consumers increase intake of these protective fibers.

Some of the specific health benefits or physiologic effects of different dietary fibers can be summarized as follows. Wheat bran appears to produce no hypocholesterolemia, no glycemic effects, probable hypotensive effects, probable weight management effects, laxation and gastrointestinal effects, and no prebiotic effects[7] (Table 1). Oat bran appears to produce hypocholesterolemia, glycemic effects, hypotensive effects, weight management effects, laxation and gastrointestinal effects, and prebiotic effects.[7,16]

For this analysis, dietary fibers can be classified as "soluble and viscous" (eg, B-glucan); "soluble and nonviscous" (eg, partially hydrolyzed guar gum); "largely soluble and viscous" (eg, psyllium); insoluble (eg, cellulose); RS; and oligofructoses. The follow-

Table 1
Clinical Responses to Different Fibers

Health Benefits	Chol Reduct	Glycemic	BP Reduct	Weight Mgmt	Laxation	Immune-enhancing
Traditional Dietary Fibers						
Wheat bran	N	N	Prob	Prob	Y	Poss
Oat bran	Y	Y	Y	Y	Y	Y
Soluble: Viscous						
B-Glucan	Y	Y	Prob	Prob	Min	Y
Soluble: Nonviscous						
Partially Hydrolyzed Guar Gum	N	N	N	N	N	Poss
Methylcellulose	Min	N	N	N	Y	N
Largely Soluble: Viscous						
Psyllium	Y	Y	Y	Y	Y	Poss
Insoluble						
Cellulose	N	N	Poss	Prob	Y	Poss
Calcium polycarbophil	N	N	N	N	Y	N
Resistant Starch						
Wheat dextrin	N	Uncert	N	N	N	Poss
Resistant maltodextrin RS3	N	Y	N	N	N	Poss
High amylose corn starch (RS2)	N	Y	N	N	Min	Poss
Oligofructoses						
Inulin	N	Min	N	Min	N	Y

Chol Reduct, hypocholesterolemic; Glycemic, decreases glycemic index; BP Reduct, decreases blood pressure; Weight Mgmt, enhances weight loss; N, no; Y, yes; Uncert, uncertain; Min, minimal; Prob, probable; Poss, possible

ing assessments were based on availability of several randomized, controlled trials and the use of well tolerated doses of the fiber products. There are no well established criteria for prebiotic effects and enhancement of immune function, but inulin is the prototype,[7,13,17] and many experts assign this property to the B-glucans.[7] Since most studies using traditional dietary fibers—viscous and insoluble fibers but not RS and inulin—have used doses of 10 g/day–15 g/day,[7] dietary fibers were considered to have the purported benefits if they were observed with doses of ≤ 5 g for meal testing and ≤ 15 g/day. For glycemic assessments, the test materials and control (placebo) materials were required to be added to the test meal rather than substituted for available carbohydrates in the test meal.

Soluble and viscous fibers like oat and barley B-glucans in divided doses at 6 g/day–10 g/day appear to produce hypocholesterolemia,[9,18] glycemic effects,[19] probable hypotensive effects,[20,21] probable weight management effects,[7] laxation and gastrointestinal effects,[7] and prebiotic effects.[7,16] Consumption of nonviscous soluble fibers (eg, partially hydrolyzed guar gum) in divided doses at 15 g/day appears to result in no hypocholesterolemia,[22] no glycemic effects, no hypotensive effects, no weight management effects,[22] minimal laxation effects but gastrointestinal effects, and no prebiotic effects. Consumption of methylcellulose has minimal hypocholesterolemic effects and laxation effects but does not have documented effects on glycemia, weight management, or bifidogenicity.[7] The largely soluble and viscous psyllium in doses of 6 g/day–10 g/day appears to produce hypocholesterolemia,[8] glycemic effects,[23] hypotensive effects,[7] weight management effects,[7] laxation and gastrointestinal effects,[7] and possible prebiotic effects.[7] Consumption of insoluble fibers, such as cellulose, at doses of 6 g/day–10 g/day appears to result in no hypocholesterolemia, no glycemic effects, possible hypotensive effects, probable weight management effects, laxation and gastrointestinal effects, and possible prebiotic effects.[4,7] Calcium polycarbophil, a synthetic fiber-like supplement, has documented laxation effects but does not have documented effects on other health measures.[7]

Resistant starches—starches that are not digested in the small intestine and are fermented in the colon—are present in many foods, and average consumption for US adults is about 5 g/day.[24] There are many different types of RS, and they are classified into 4 categories, RS1 to RS4.[25] This summary of available studies of certain RS provides an overview of the potential effects of these RS but may not reflect the effects of other RS. High amylose corn starch has been the most extensively studied.[25] This RS2, at doses up to 15 g/day, does not appear to have hypocholesterolemic effects, has glycemic effects, has not been documented to lower blood pressure, does not appear to have weight management benefits, has minimal laxation effects but has gastrointestinal benefits, and may have prebiotic effects.[15,25] A retrograded high amylose corn starch (RS3) at doses of 30 g/day did not have hypocholesterolemic effects.[26] Other RS, at doses of 6 g as part of a tolerance test, have important glycemic effects.[27] Another RS3 has documented bifidogenic properties,[14] but most RS have not been adequately studied.

Thus, available data from clinical trials using up to 15 g/day of various RS document these effects or lack of effects: no hypocholesterolemia;[26,28,29] glycemic effects;[25,27] no hypotensive effects; possible weight management effects;[30–32] mild laxation effects;[29,33] gastrointestinal health effects;[33] and possible bifidogenic properties.[14]

Inulin and other oligofructoses have important prebiotic properties and appear to enhance immune function.[7,13,17] Weight management benefits have not been documented with ≤ 15 g/day of inulin, but favorable effects of inulin at 16 g/day–21 g/day include weight loss[34,35] and increased satiety.[36] Inulin may have minimal glycemic effects[35] but does not appear to have hypocholesterolemic[35] or hypotensive effects. The glycemic effects of inulin require further evaluation.

When health professionals counsel patients about increased dietary fiber intake, they need to communicate that all fibers are not created equal so that consumers are not selecting ineffective fiber supplements or foods with fiber additives for the hypocholesterolemic or laxation health benefit. ■

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