

Dietary Fiber

Dietary fiber is the class of compounds consisting of nondigestible polysaccharides found in plant cell walls. Different types of dietary fiber can be distinguished by viscosity, fermentability, and fecal-bulking or water-binding properties. Insoluble and soluble fibers are differentiated primarily by viscosity. Although dietary sources of fiber typically consist of both types of fiber, soluble or viscous fiber is more concentrated in oats, barley, soybeans, dried beans and peas, and citrus fruit while insoluble or nonviscous fiber is concentrated in whole wheat and most vegetables. Viscosity is important physiologically because it slows transit in the small intestines allowing nutrients to be absorbed more efficiently. This property is beneficial for regulation of blood glucose and of appetite, and may also reduce the quantity of bile acids reabsorbed. The primary health benefits of insoluble fiber relate to its water-binding capacity which reduces transit time in the large bowel. Reduced transit time promotes regularity and minimizes risk of colon cancer by decreasing the time that colonocytes are exposed to potentially carcinogenic wastes.

Both types of fiber may be fermentable by intestinal microflora, but soluble fiber usually has a higher fermentability. Fermentation benefits the intestines because it provides fuel for microbial proliferation. Rapidly proliferating microorganisms will utilize nitrogenous wastes that are potentially carcinogenic when allowed to accumulate in the colon. These increased numbers of microbes are added to fecal bulk and excreted with nonfermentable insoluble fiber. Fermentation also yields short chain fatty acids, propionate, butyrate, and acetate, which are absorbed by the colonocytes. Absorption of these polar acids facilitates the absorption of sodium and water thus improving fluid balance. Butyrate is utilized as a fuel source by the colonocytes, while propionate is transported to skeletal muscle and acetate is transported to liver where it participates in feedback inhibition of hepatic cholesterol synthesis.

A considerable amount of scientific data supports the relationship between viscous fiber and decreased intestinal absorption of cholesterol. Daily intakes of ≥ 3 grams of soluble fiber (and total fiber intake of ≥ 25 grams) can result in a modest reduction in blood cholesterol levels. Soluble fiber intakes are also associated with increased satiety by effects on stimulation of appetite regulating hormones in the ileum and stabilization of blood sugar and insulin levels. Prevention of gastrointestinal diseases such as diverticulitis and reduced risk of colorectal cancer risk appear to be more closely associated with intake of insoluble fiber.

Deficiency

Inadequate intake of dietary fiber can increase risk of constipation, bowel irregularities, hemorrhoids, diverticulosis, and colorectal cancer. Diets lacking in fruits, vegetables, nuts, and whole grains will not provide sufficient fiber. Approximately half of the recommended daily intake of fiber is currently being consumed in the US.

Toxicity

Excess amounts of fiber (> 50 grams daily) can promote constipation, diarrhea or spastic bowel disorder, particularly if not accompanied by adequate water intake. These problems are more likely to develop from consumption of fiber supplements. Although fiber has the capacity to bind minerals, this property does not interfere with mineral balances since most sources of fiber provide minerals in amounts that compensate for any binding that occurs. In addition, fermentation will release minerals such as calcium which can be absorbed in the colon. And finally, only foods containing fiber with unsubstituted uronic acid groups will bind minerals to any appreciable extent.

Requirements

An estimated 12 grams of fiber is consumed daily in the US, which is half of the recommended goal of 25-30 grams. Plant foods with low moisture content such as whole grains (whole wheat bread, wheat bran, oatmeal, and brown rice) and dried beans are the most concentrated sources of dietary fiber. For children, the amount of fiber recommended is 5 g plus the age of the child. For example, a four-year old child should consume 9 grams of fiber daily. About one-fourth of the total should be from sources rich in soluble fiber.

Dietary Sources

Whole grain cereals, dried beans, nuts, seeds, fruits, and vegetables are the only sources of dietary fiber. Consumption of fiber should always be accompanied by fluid intake to prevent constipation, especially when consumed from supplements or low moisture foods, e.g., whole grains and nuts. Changing from a low fiber to a high fiber intake should be done in increments to avoid gastrointestinal distress such as bloating and gas. A detailed listing of the fiber content of foods is listed in the table below.

Fiber Content of Selected Foods			
Item	Total (g)	Soluble (g)	Insoluble (g)
Legumes			
Black beans, 1/2 cup ckd			
Chick peas (garbanzo), 1/2 cup ckd	6.2	1.3	4.9
Kidney beans, 1/2 cup ckd	5.8	2.9	2.9
Lentils, 1/2 ckd			
Navy beans, 1/2 cup ckd	5.8	2.2	3.6
Northern beans, 1/2 cup ckd	5.6	1.4	4.2
Pinto beans, 1/2 cup ckd	7.4	1.9	5.5
Soybeans, 1/2 cup ckd	5.1	2.3	2.8
Tofu, 1/2 cup	1.4	0.9	0.6
Cereal Grains			
Barley, 1/2 cup ckd	4.2	0.9	3.3
Bulgar, 1/2 cup ckd	2.9	0.5	2.4
Couscous, 1/2 cup ckd	1.3	0.3	1.0
Kasha, 1/2 cup ckd	2.7	0.4	2.3
Millet, 1/2 cup ckd	3.3	0.6	2.7
Rice, brown, 1/2 cup ckd	1.7	0.1	1.6
Rice, white, 1/2 cup ckd	.2	0	.2
Rice, wild, 1/2 cup ckd	1.5	0.2	1.3
Noodles, white spaghetti, 1/2 cup	0.9	0.4	0.5
Noodles, whole wheat, 1/2 cup	2.3	0.5	1.8
Noodles, spinach, 1/2 cup	0.9	0.4	0.5
Bagel, white, 3.5" diameter	1.6	0.6	1.0
Bagel, whole wheat, 3.5" diameter	3.1	0.9	2.2
Breads (1 medium slice):			
Cinnamon swirl	0.6	0.3	0.3
Multigrain	1.8	0.3	1.5
Pumpernickel	1.5	0.8	0.7

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Raisin	1.2	0.3	0.9
Rye	1.5	0.8	0.7
White or sourdough	0.7	0.4	0.3
Whole wheat	1.9	0.3	1.6
Pita, 7" diameter, white	1.3	0.7	0.6
Pita 7" diameter, whole wheat	4.4	0.7	3.7
Tortilla, corn, plain, 6" diameter	1.4	0.2	1.1
Tortilla, flour, plain, 8" diameter	1.4	0.4	1.0
Cereal (1 cup):			
Cherrios	2.6	1.2	1.4
Cornflakes	0.7	0	0.7
Raisin bran	8.4	1.2	7.2
Rice Krispies	0.2	0	0.2
Farina	1.2	0.5	0.7
Grits, corn	0.4	0	0.4
Item	Total (g)	Soluble (g)	Insoluble (g)
Oatmeal	3.8	1.8	2.0
Crackers (1 oz):			
butter	0.5	0.3	0.2
cheese rounds	0.6	0.2	0.4
club	0.6	0.4	0.2
graham, 2_ " square	0.3	0.2	0.1
Ritz®	0.5	0.3	0.2
saltines/soda	1.2	0.4	0.8
Triscuits®	0.5	0.2	0.3
Wheat Thins®	1.2	0.3	0.9
Snacks:			
Cereal party mix, 1 cup	1.8	0.4	1.4
Cheese puffs, 1 cup	1.7	0	1.7
Corn chips, 1 cup	1.2	0	1.2
Popcorn, microwave, 3 cups	2.4	0	2.4
Popcorn, microwave light, 3 cups	2.3	0	2.3
Potato chips, 1 oz	1.4	0.8	0.6
Pretzels, 1 oz	1.1	0.3	0.8
Fruits (fresh)			
Apple, 3_ " diameter	5.7	1.5	4.2
Applesauce, 1/2 cup	1.6	0.5	1.1
Banana, 7" long	2.8	0.7	2.1
Blackberries, 1/2 cup	3.8	3.1	0.7
Blueberries, 1/2 cup	1.9	0.2	1.7
Cherries, fresh, 1/2 cup	1.7	0.5	1.2
Grapefruit, 4" diameter, half	1.5	1.2	0.3
Grapes, all kinds, , 1/2 cup	0.8	0.3	0.5
Kiwi, large	3.1	0.7	2.4
Mango, medium	3.7	1.5	2.2
Melon, cantaloupe, 1/5 of 6" Dia	0.7	0.2	0.5
Orange, 3_ " diameter	4.4	2.6	1.8
Peach, medium	3.2	1.3	1.9
Pear, 3_ " diameter	4.0	2.2	1.8

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Pineapple, 1/2 cup	1.0	0.1	0.9
Plum, large	1.7	0.9	0.8
Raspberries, 1/2 cup	4.2	0.4	3.8
Strawberries, 1/2 cup	1.9	0.5	1.4
Juice, orange, 6 oz	0.4	0.2	0.2
Juice, apple, 6 oz	0.2	0.1	0.1
Prunes, 3 medium	1.9	1.0	0.9
Raisins, 1/4 cup	1.5	0.4	1.1
Figs, 3 small	5.3	2.3	3.0
Vegetables:			
Artichoke, 1 medium, cooked	6.5	4.7	1.8
Asparagus spears, ckd	1.4	0.7	0.7
Beans, green, cooked, 1/2 cup	1.9	0.8	1.1
Beets, fresh or canned, 1/2 cup	1.5	0.7	0.8
Item	Total (g)	Soluble (g)	Insoluble (g)
Bok choy, raw, 1 cup	0.7	0.3	0.4
Bok choy, cooked, fresh, 1/2 cup	1.4	0.5	0.9
Broccoli, raw, chopped, 1/2 cup	1.3	0.5	0.8
Broccoli, cooked from fresh or frozen	1.4	1.2	1.2
Brussels sprouts, cooked, 1/2 cup	3.3	2.0	1.3
Cabbage, green, cooked from fresh	1.8	0.8	1.0
Cabbage, red, raw, shredded	0.8	0.3	0.5
Carrots, baby, raw, 6 carrots	2.8	1.4	1.4
Carrots, cooked, 1/2 cup	1.6	1.1	1.5
Cauliflower, raw, 1/2 cup chopped	1.3	0.5	0.8
Cauliflower, cooked, 1/2 cup	1.7	0.4	1.3
Celery, _ cup = 1 large stalk	1.1	0.4	0.7
Chiles, hot pepper, raw	3.0	1.5	1.5
Corn, whole kernel, 1/2 cup	2.0	0.3	1.7
Eggplant, cooked, 1/2 cup	1.3	0.4	0.9
Greens, (beet, collard, mustard), 1/2 cup cooked	0.4	0.1	0.3
Jicama, raw, sliced, 1/2 cup	3.2	1.7	1.5
Lettuce, iceberg, 1 cup	0.8	0.1	0.7
Lettuce, Romaine, 1 cup	0.9	0.3	0.6
Frozen mixed vegetables (1/2 cup)			
Broccoli/cauliflower/carrots	1.5	0.6	0.9
Corn/lima & green beans/carrots	4.0	1.9	2.1
Lima beans/ corn	4.9	1.8	3.1
broccoli/chestnuts/pepper/mushroom	1.8	0.7	1.1
Peas/ carrots	2.5	0.9	1.6
Mushrooms, cooked, sliced	1.8	0.2	1.6
Onions, _ cup cooked	2.0	1.2	0.8
Peas, green, cooked, 1/2 cup	4.3	1.2	3.1
Peppers, green/red, 1/2 cup	1.3	0.5	0.8
Potato, baked w/skin, medium	2.9	1.2	1.7
Potato, mashed, 1/2 cup	1.6	0.9	0.7
Pumpkin, 1/2 cup mashed	3.6	0.5	3.1
Spinach, 1/2 cup ckd	2.7	0.5	2.2

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Spinach, 1 cup raw	0.4	0.1	0.3
Squash, summer, 1/2 cup cooked	1.3	0.3	1.0
Squash, winter, cooked	3.3	1.9	1.4
Squash, butternut,	1.7	0.7	1.0
Sweet potatoes, 1/2 cup	3.8	1.4	2.4
Tomatoes, medium, raw	0.9	0	0.9
Water chestnuts, 1/2 cup	1.2	0.9	1.3
Zucchini, cooked, 1/2 cup	1.2	0.5	0.7