Plantago ovata (Psyllium)

Description

Although true psyllium comes from the plant *Plantago psyllium*, the husk and seed of *Plantago ovata* (Plantaginaceae) is commonly referred to as psyllium. Psyllium is widely used as a fiber supplement for the treatment of constipation. Psyllium husk is obtained by milling the seed of *P. ovata* to remove the hulls. In some studies the seed has been used instead of the husk, and is also commercially available.

Active Constituents

Psyllium husk contains a high proportion of hemicellulose, composed of a xylan backbone linked with arabinose, rhamnose, and galacturonic acid units (arabinoxylans). The seed consists of 35-percent soluble and 65-percent insoluble polysaccharides (cellulose, hemicellulose, and lignin). Psyllium is classified as a mucilaginous fiber due to its powerful ability to form a gel in water. This ability comes from its role as the endosperm of the *P. ovata* seed, where it functions to retain water in order to prevent the seed from drying out.

Mechanisms of Action

Many studies have shown dietary fiber shortens gastrointestinal transit time and increases stool weight.[1] When given to healthy volunteers, 18 grams daily of psyllium husk increased fecal weight and the production of short chain fatty acids.[2] Most of the psyllium was shown to reach the cecum four hours after ingestion in an intact and highly polymerized form. The husk appears to be relatively resistant to fermentation. Psyllium husks also significantly increase the level of stool moisture, as well as wet and dry stool weight.[3]

Anaerobic fermentation of the soluble non-starch polysaccharides from psyllium seed results in the production of the short-chain fatty acids acetate, propionate, and butyrate in the intestines.[4] Psyllium husk contains only the epidermis of the seed, while the actual seed has a higher amount of fermentable fiber. Because of this fiber content, psyllium seed degrades more slowly than pectin and produces fairly large amounts of butyrate and acetate. Butyric acid exhibits antineoplastic activity against colorectal cancer, is the preferred oxidative substrate for colonocytes, and may be helpful in the treatment of ulcerative colitis. In a study of resected colorectal cancer patients, those given 20 grams of psyllium seed daily for three months exhibited an average increase of butyric acid production of 42 percent, which decreased to pretreatment levels within two months of cessation of supplementation.[5]

Psyllium also has hypocholesterolemic effects, although the exact mechanism by which psyllium husk brings about a reduction of cholesterol is not totally clear. Animal studies have shown psyllium increases the activity of cholesterol 7 alpha-hydroxylase (the rate-limiting enzyme in bile acid synthesis also referred to as cytochrome 7A [CYP7A]) more than twice that of cellulose or oat bran, but less than

cholestyramine.[6] In animals fed a high-fat diet, psyllium increased the activity of cholesterol 7 alpha-hydroxylase and HMG-CoA reductase.[7] This animal study also noted both pectin and psyllium reduced Apo B secretion and that LDL catabolic rates were 100-percent faster in animals fed psyllium. In a human study, psyllium lowered LDL cholesterol, decreased cholesterol absorption, and increased the fractional turnover of both chenodeoxycholic and cholic acids.[8] The authors' conclusion was that psyllium lowered LDL cholesterol primarily via stimulation of bile acid synthesis. Further research might show this action to be through the stimulation of cholesterol 7 alpha-hydroxylase in humans as well.

Clinical Indications

Constipation

The effectiveness of fiber, and psyllium in particular, on constipation depends on the main cause of the constipation. In a study of 149 patients with chronic constipation, the consumption of 15-30 grams daily of a psyllium seed preparation provided bowel relief in 85 percent of participants who had no known pathological cause for their constipation. Only 20 percent of individuals with slow transit responded to psyllium. A slightly greater percentage (37%) of those with disorders of defecation – including rectocele, internal prolapse, anismus, and rectal hyposensitivity – found improvement.[9]

Fecal Incontinence

Because of its ability to retain water, psyllium has also been shown to benefit individuals with fecal incontinence from liquid stools or diarrhea. A placebo-controlled trial of persons with liquid stool fecal incontinence was performed in which supplementation with both gum arabic and psyllium showed approximately a 50-percent decrease in the occurrence of incontinent stools. The psyllium group had the highest water-holding capacity of water-insoluble solids and total water-holding capacity of the stool.[10]

Hemorrhoids

With the known benefit of psyllium for both constipation and loose stools, it is not surprising it would also be of benefit for hemorrhoids. Fifty persons with internal bleeding hemorrhoids were given either a placebo of B vitamins or 11.6 grams of Metamucil® daily for 40 days. Individuals in the psyllium group had significant improvement in reduction of bleeding and a dramatic reduction of congested hemorrhoidal cushions. Bleeding on contact stopped after treatment in the psyllium group, while those in the control group experienced no difference.[11] It also appears psyllium treatment for this problem must be done for a minimum of one month, as a study of 30-day fiber supplementation failed to show improvement;[12] whereas, when taken for 40 days significant improvement was noted.[13]

Ulcerative Colitis

In an open label, randomized, multi-center trial of persons with ulcerative colitis, psyllium seed supplementation (10 grams twice daily) was as effective as mesalamine in maintaining remission.[14] This effect may likely be due to increased levels of butyric acid with psyllium supplementation.

Appetite

Psyllium may also have an effect on appetite. A triple-blind study on 17 women looked at the effect of taking 20 grams of psyllium seed three hours pre-meal and again immediately post-meal during three 3-day study periods. The subjects reported significantly increased feelings of fullness one hour after meals with the psyllium, and exhibited a significantly lower fat intake with those meals.[15]

Hyperlipidemia

Psyllium has been shown to reduce total cholesterol and LDL cholesterol in animals[16-18] and in humans. Sprecher et al demonstrated a 3.5-percent reduction in total cholesterol and a 5.1-percent reduction in LDL levels after consuming 5.1 grams of psyllium husk twice daily for eight weeks.[19] Another study began with individuals on

the American Heart Association Step-1 diet, then added eight weeks of psyllium, resulting in decreased total cholesterol (4.8%) and LDL (8.8%).[20] A meta analysis was performed on eight trials of psyllium husk in conjunction with a low-fat diet in the treatment of hypercholesterolemia. After an initial eight-week, low-fat diet run-in, 10.2 g psyllium were given per day, resulting in a four-percent reduction in serum total cholesterol and a seven-percent reduction in LDL cholesterol, compared to diet and placebo. A six-percent reduction in the ratio of apolipoprotein (apo) B to apo A-I was also noted.[21] Longer trials (16 weeks[22] and 26 weeks[23]) mirrored the above results.

A meta-analysis of 12 studies of psyllium-enhanced cereal product consumption on total and LDL cholesterol in 404 adults with mild to moderate hypercholesterolemia demonstrated a reduction of total cholesterol and LDL cholesterol of five- and nine-percent, respectively.[24] Researchers studied the effect of fiber-enhanced cookies on blood lipids in hypercholesterolemic men, using wheat bran-, psyllium-, or oat bran-containing cookies (wheat bran was used as the placebo since it has no demonstrated cholesterol-lowering effect). At the end of the eight-week study, plasma LDL cholesterol had decreased 22.6-percent in the psyllium group and 26-percent in the oat bran group.[25]

A four-month study of 12 elderly patients showed psyllium husk reduced total serum cholesterol by 20 percent, a figure much higher than the above-mentioned studies.[26] In another study, a significant reduction in total serum cholesterol was noted in 176 elderly persons who used psyllium for one year.[27] The authors found for every one-gram increase in daily psyllium dose there was a 0.022-mmol/liter (0.84mg/dl) decrease in serum total cholesterol concentration.

In the first study to examine age and gender differences in the effect of psyllium on blood lipids, men and pre- and postmenopausal women were given psyllium (15 grams daily) or placebo. Psyllium lowered plasma LDL cholesterol by 7-9 percent in all groups. Triglyceride levels were lowered by 17 percent in men, but were increased by 16 percent in postmenopausal women. Premenopausal women displayed no significant shift in triglycerides.[28]

Diabetes mellitus

The effect of psyllium husk was studied in 34 men with type 2 diabetes and hypercholesterolemia given either placebo or 5.1 g psyllium twice daily for eight weeks. Total cholesterol was lower by 8.9 percent and LDL by one percent. In addition, the postprandial rise of glucose was significantly reduced.[29]

Drug-Botanical Interactions

Changes in plasma drug levels have not been noted. One study in female rabbits showed that while guar gum reduced the absorption of ethinylestradiol, psyllium actually slightly increased the total absorption, but caused a slower absorption rate.[30]

Side Effects/Toxicity

No adverse effects of supplementation with either psyllium seed or husk were noted in any clinical studies noted in this paper. In many of the studies there were greater levels of adverse effects with the placebo. No changes in blood indices or in vitamin or mineral content were found in any of those studies (including both meta-analyses). A 52-week study of 93 healthy individuals did find there were some small but statistically significant changes in some measurements of mineral and vitamin levels and in some hematological and biochemical parameters. But the authors note that none were of clinical significance with the possible exception of reduced levels of vitamin B12.[31]

Dosage

Based on the above studies, the recommended dosage for psyllium husk ranges from 10-30 g daily, in divided doses. Starting with a lower dose and increasing gradually is often recommended. Keeping well hydrated while taking psyllium will prevent constipation.

Warnings/Contraindications

Several cases have been published of individual allergic and anaphylactic reactions to psyllium,[32-35] so caution must be exercised in this regard.

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