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A Review of Glucomannan (Konjac Fiber)

By Judith L. Balk, MD

Dr. Balk is Assistant Research Professor, University of Pittsburgh; she reports no consultant, stockholder, speaker's bureau, research, or other financial relationships with companies having ties to this field of study.

GLUCOMANNAN IS A SOLUBLE FIBER OBTAINED FROM THE TUBERS of the Japanese konjac plant, *Amorphophallus konjac*. One report notes that it has been safely consumed as food for more than 1,000 years in the Orient.[1] The Massachusetts General Hospital web site lists high cholesterol as the principal indication for glucomannan, with other proposed uses being constipation, diabetes, high blood pressure, and weight loss.[2] Given the prevalence of these conditions in the United States, glucomannan may prove to have public health significance.

Properties

Glucomannan is a pectin-like gel fiber composed of a polysaccharide chain of repeating units of β-1,4-linked glucose and mannose.[1] Glucomannan particles, derived from the konjac root, are tasteless, odorless, and white, consisting of long thread-like macromolecules tangled together.[3]

The factor that makes glucomannan different from other types of soluble fiber is its ability to retain water. On contact with water glucomannan particles swell to roughly 200 times their original volume, turning glucomannan into a viscous liquid.[3] Put another way, 1 g of glucomannan will absorb about 100 mL of water in vitro.[1]

Because of its high absorptive properties, lower doses are needed for glucomannan than for other fiber supplements. Lower doses may lead to improved adherence to a fiber regimen.

Cholesterol

High-fiber diets are often recommended for patients with hypercholesterolemia due to the cholesterol-lowering properties of water-soluble fiber such as oat. However, the mechanism of action is controversial; promotion of bile-acid excretion in the stool and/or blockage of cholesterol absorption are possible mechanisms.[3]

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Dr. Hardy (peer reviewer) reports no consultant, stockholder, speaker's bureau, research, or other financial relationships with companies having ties to this field of study.

Serum cholesterol concentrations decreased in healthy men with hypercholesterolemia when taking glucomannan compared to placebo.[3] After a two-week baseline, subjects were given either 3.9 g glucomannan or placebo daily for four weeks, then were crossed over to the opposite treatment after a two-week washout period. Total cholesterol lowered by 10%, LDL by 7.2%, triglycerides by 23%, and systolic blood pressure by 2.5%. Each of these changes was statistically significant. HDL did not change, and no adverse effects were observed.

In another study assessing weight loss, cholesterol levels were also measured.[1] At baseline, serum cholesterol in all subjects averaged 198 mg/dL, which is high normal. At eight weeks, both total and LDL cholesterol had decreased significantly in the glucomannan group compared to the placebo group, by 26.2 mg/dL and 20.9 mg/dL, respectively. In a study of subjects with insulin resistance, serum cholesterol improved with glucomannan compared to wheat bran, changing the classification of eight of 11 subjects into normal cholesterolemia.[4] Apo-B also fell significantly, but neither Apo-A-1 nor triglycerides decreased. HDL decreased significantly in both treatments, but the decreases in total cholesterol were sufficient to improve lipid ratios.

Similarly, in overweight, normocholesterolemic subjects fed a supplement containing both chitosan and glucomannan, total, HDL, and LDL cholesterol concentrations were significantly lower at the end of the four-week study period than at baseline.[5]

Insulin Resistance and Diabetes

Fiber may have benefit in prediabetic metabolic conditions such as insulin resistance. Vuksan et al investigated the effect of glucomannan on metabolic control in subjects with insulin resistance in a double-blind, placebo-controlled crossover design.[4] All subjects had an eight-week baseline following the NCEP Step 2 program to eliminate possible effects of dietary change on metabolic parameters. After the baseline, there were two successive three-week experimental phases, separated by a two-week washout interval of the NCEP Step 2 diet. Five subjects were on glucomannan for the first phase and six were on the control supplement. Both treatments consisted of a three-day rotating Step 2 diet with three meals per day provided, for consumption at work or at home. The two treatments differed only in the type of fiber: glucomannan vs. wheat bran. Weight decreased in both treatment periods, but not statistically significantly. The glucomannan group had an improvement in glycemic control compared to the wheat bran group, as determined by serum fructosamine levels. No changes were seen in blood pressure.

Eleven hyperlipidemic and hypertensive Type 2 diabetics were enrolled in a trial with the same methodology as the previous study.[6] Compared with placebo, glucomannan significantly reduced the primary outcomes: serum fructosamine, total/HDL cholesterol, and systolic blood pressure. The authors concluded that glucomannan may help to improve the effectiveness of conventional treatment in Type 2 diabetes. Similarly, compared with placebo, glucomannan reduced total and LDL cholesterol, total/HDL ratio, ApoB, and fasting glucose in Type 2 diabetic subjects.[7] Triglycerides, HDL, LDL/HDL ratio, postprandial glucose, and body weight did not differ. Fecal neutral sterol and bile acid concentrations were increased with glucomannan compared to placebo.

A letter in the *Lancet* discussed the use of glucomannan in both diabetics and healthy men.[8] When 13 diabetics supplemented their diets with glucomannan for 90 days, fasting glucose fell by 29%. Five healthy men underwent a 50 g glucose tolerance test with and without glucomannan. The glucomannan reduced blood glucose and serum insulin levels by 7.3% and 13%, respectively, at 30 minutes.

Obesity

Glucomannan could potentially affect obesity via several mechanisms. One mechanism would be to

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Questions & Comments

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increase satiety, if taken with water prior to meals. Another mechanism would be to lower the glycemic index of food, causing slower release of sugars and fats, leading to less hyperinsulinemia. Other potential mechanisms would be to lower the absorption of fats in the gut, and to decrease transit time. On the other hand, differences in postprandial availability of food may in turn lead to changes in energy expenditure.[9]

Glucomannan has been shown to delay gastric emptying, increase bile acid excretion in the stool, and lower postprandial glucose concentrations.[10] Keithley and Swanson reviewed the role of glucomannan in obesity, concluding that, at 2-4 g/d, glucomannan was well tolerated and resulted in significant weight loss in overweight and obese individual, and that further investigation of safety, efficacy, and mechanisms of action is needed to determine whether glucomannan can help to decrease the high prevalence of overweight and obesity in the United States.[10]

In a double-blind, randomized, controlled trial, 20 obese women were randomized into two groups, one receiving two capsules of 500 mg of glucomannan three times daily before each meal, and the other group receiving the same dosage and schedule of a placebo starch capsule.[1] Both groups were identical at baseline, averaging about 184 pounds and 64 inches tall. Acceptance of the supplement was high, with many subjects subjectively noting that they had a "full" feeling after taking glucomannan, and some reported that the supplement had relieved mild constipation. No adverse effects were noted in either group. At the end of the eight-week period, the subjects in the glucomannan group had lost 5.5 pounds, whereas those in the placebo group had gained 1.5 pounds ($P < 0.005$).

A series of placebo-controlled trials investigated different fiber agents that each included glucomannan vs. placebo.[11] While each supplement included glucomannan, one was glucomannan only, and the other two had additional types of fiber, such as guar and alginate. The dosage in the fiber supplements ranged from 420 mg to 4,320 mg glucomannan. All subjects followed a 1,200 kcal/d diet. Subjects in both the placebo and fiber groups lost weight, but all three fiber supplements resulted in increased weight loss compared to placebo ($P < 0.01$). Over the five-week observation period, the fiber groups lost roughly 4 kg, whereas the placebo group lost roughly 2.4 kg. There were no differences between fiber groups, demonstrating that glucomannan alone is equally effective as glucomannan plus other types of fiber. The large range of glucomannan dosages limits the utility of this study.

In contrast, 90 children, mean overweight 46%, were placed on either glucomannan or placebo, 1 g twice per day for two months.[12] During this time period, the children followed a normocaloric diet and were evaluated every two weeks. At the end of the study period, the mean overweight of the glucomannan group decreased from 49.5% to 46.1%, and that of the placebo group from 43.9% to 41.7%. Both decreases were significant, but the difference between groups was not statistically significant. The only significant difference concerned lipid metabolism; the children under glucomannan treatment had a significant decrease of α-lipoprotein and an increase in pre-β-lipoprotein and triglycerides, whereas the children in the placebo group had a decrease in triglycerides and apo-β-lipoprotein. The authors suggest that the metabolic alteration may derive from a primary decrease in α-lipoprotein, causing an accumulation of pre-β-lipoprotein and triglycerides. The cause for the decrease in α-lipoprotein was postulated to be most likely a result of inadequate water intake. The authors question the use of glucomannan in childhood obesity, as it could have a potentially atherogeneous effect.

Constipation

Because glucomannan is a fiber supplement, it can relieve constipation. Fiber can promote defecation by three mechanisms: increasing colonic contents, stimulating colonic motility, and promoting the growth of certain bifidobacteria and lactobacilli.[13] One study investigated the mechanisms of action of glucomannan.[13] Subjects in this placebo-controlled trial ingested 1.5 g/meal of glucomannan, and their stools were collected on days 15-21 of the study period to determine fecal mass, components, microflora, and short-chain fatty acid contents. The glucomannan supplement significantly increased the mean defecation frequency, wet and dry stool weight, and daily fecal output of lactobacilli, bifidobacteria, and total bacteria. The supplement also increased fecal short-chain fatty acid concentrations. No adverse effects were noted. The authors summarize the incorporation of 4.5 g/d of glucomannan to a low-fiber diet could improve colon health by enhancing bowel movement and stool bulk, and improving the colonic ecology without causing gastrointestinal side effects.

Safety

A case report of a 31-year-old man with cholestatic hepatitis questioned whether glucomannan was involved.[14] The man had used glucomannan, along with two other botanical agents, and had stopped the glucomannan four weeks prior to developing jaundice. The reason that glucomannan was implicated was that the other botanicals had been found to be safe, and that one

"potential, but speculative mechanism may be related to the presence of serotonin and its derivatives." The reference cited is a Japanese article noting that a byproduct in the manufacturing of konjac jelly (80% glucomannan) is called tobiko, which "has an irritant taste and unpleasant smell. Therefore it cannot be disposed of as such as industrial waste."[15] This byproduct was found to have serotonin in it, but it is not clear that glucomannan itself has serotonin in it. In addition, it is not clear if the subject was consuming botanicals, including glucomannan, that were contaminated with liver-damaging chemicals.

Another case report describes esophageal obstruction from a pharmacobezoar containing glucomannan.[16] A bezoar is a concretion of partly or wholly undigested material formed in the alimentary canal, and a pharmacobezoar is made of medication. In this case, a 37-year-old female took a diet pill containing glucomannan with a glass of water, and had the initial feeling of a lump in her throat. As the day progressed, this sensation had worsened. She presented to the emergency department, where she forcefully vomited, and dislodged the pill. The tablet had a firm gelatinous texture with an intact gelatin coating, but it had formed a large cast of the patient's esophagus. On taking the patient's history, she had experienced transient partial obstruction of the esophagus several times in the past, and endoscopy did note an esophageal web. This case illustrates that glucomannan and other hygroscopic medications are contraindicated in patients with a history of upper gastrointestinal pathology, difficulty swallowing, or inability to drink adequate fluid. Glucomannan bottles have the warning, "Taking this product without adequate fluid may cause it to swell and block your throat or esophagus, and may cause choking. Do not take this product if you experience difficulty in swallowing." This warning is based on information reported to the FDA MedWatch program.

If glucomannan is effective in increasing bile acid excretion, it may also be able to remove fat-soluble vitamins. This was studied by giving a control test meal with added vitamin B_{12} and vitamin E, with and without glucomannan.[17] The absorption rate of vitamin E was reduced when glucomannan was added, but absorption of B_{12} was not affected. It is thus suggested that glucomannan can reduce fat-soluble vitamin absorption, but not water-soluble vitamin absorption. The dosage of glucomannan was high, however, at 3.9 g per meal; usual dosage is 1.5 g per meal.

Patients may also note excess gas, abdominal distention, or diarrhea. These symptoms usually resolve within several days, or they can be managed by a reduction in dosage.

Conclusion

Although the published research reports have some inconsistencies, the majority of studies do find that total cholesterol, LDL, fasting glucose concentrations, weight, and constipation are improved with glucomannan. Dosage is not standardized, but many research studies use 2-4 g per day in divided dosages, taken about one hour before meals. This appears to be safe in patients without gastrointestinal tract pathology, but more research is indicated. To be safe, fat-soluble vitamins should be taken at a separate time to assure vitamin absorption. ❖

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CAM Use by Women in Midlife

By Russell H. Greenfield, MD

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Source: Brett KM, et al. Complementary and alternative medicine use among midlife women for reasons including menopause in the United States: 2002. *Menopause* 2007;14:300-307.

Abstract: Data from the Alternative Health/Complementary and Alternative Medicine supplement of the 2002 National Health Interview Survey, or NHIS, was analyzed to obtain nationally representative estimates of recent complementary and alternative medicine (CAM) use among midlife women (ages 45-57 years, n = 3,621). In the survey, specific questions were asked about individual CAM therapies including use within the past 12 months, whether a given modality was used to treat a specific health condition, and the self-reported importance placed on the use of CAM for the respondent's health. Information was also obtained on whether respondents told their doctor(s) about CAM use, and the reason behind CAM use. Demographic information and self-assessed health status was also queried.

Results showed that almost half (45%) of respondents had used some form of CAM within the prior 12 months, with approximately one-fourth using herbs, one-fourth using mind/body therapies, and 14% using body work (massage and chiropractic). Whereas 55% did not use any CAM in the prior 12 months, 12% had used two different forms of CAM, and 9% had used three or more. Use of CAM did not vary by age, but white race, higher education, and residence in the West were associated with increased use. Less than half (45%) of CAM users mentioned their use to a conventional medical provider. The majority of respondents utilized CAM to address pain (either specific or general recurring in nature), with only 3% mentioning CAM use specifically for menopause (being the 11th most common condition for which CAM was used). However, the odds ratio for use of CAM in the past year was 1.9 for women with menopausal symptoms.

Geographic region was significantly associated with CAM use, with higher rates in the West and lowest rates in the South. The demographic variable most highly association with CAM use, however, was level of education achieved—for every CAM grouping studied, women with less than a high school education were half as likely to report using CAM as women who had received a college degree or higher. The most commonly reported CAM types used by respondents were herbs/natural products and relaxation techniques (26% and 22%, respectively). Almost half (45%) of recent users of CAM considered it to have been very important to their health. The authors conclude that CAM use among midlife women in the United States is high, although not specifically for menopausal concerns.

Comments

The NHIS has been conducted continuously since 1957, and is a nationally representative household survey that uses a national sample of the civilian, non-institutionalized U.S. population, sampling approximately 30,000 adults each year (with over-sampling of both black and Hispanic populations). These 2002 data coincide with announcement of the Women's Health Initiative (WHI) findings that traditional hormone therapy may increase health risks. Since that time, rates of hormone therapy for the treatment of menopausal symptoms have declined considerably, while an increasing number of women have explored CAM therapies for relief. The results of this study are somewhat surprising in that regional studies of CAM use for menopausal symptoms have suggested a higher prevalence than the 3% noted here, but a deeper look tells a different tale. The rate of CAM use among midlife women with menopausal symptoms was almost twice that of midlife women without such symptoms, but for reasons other than menopause.

Unlike many other survey reports, this study excluded data on the use of special diets, prayer, and spiritual healing. As the authors note, inclusion of traditional therapies commonly employed by women of South

American or Caribbean descent could have had a significant impact on findings, and one would hope that future investigations would include questions on curanderos and faith healing, to name but two.

This study emphasizes the importance of asking our patients about the use of CAM therapies, a point that has been borne out in a number of trials, but it is another finding that should draw our attention. The fact that CAM was primarily employed among midlife women to aid in relieving pain should be a wake-up call to all health care practitioners. ❖

You Can't Bone Up on Colas—Osteoporosis Study

By Russell H. Greenfield, MD

Source: Tucker KL, et al. Colas, but not other carbonated beverages, are associated with low bone mineral density in older women: The Framingham Osteoporosis Study. *Am J Clin Nutr* 2006;84:936-942.

Abstract: Subjects were drawn from a large population-based cohort (the Framingham Offspring Cohort) to determine whether regular carbonated beverage consumption, including both cola and non-cola types, is associated with lowered bone mineral density (BMD) in men and pre- and post-menopausal women. BMD was measured at the spine and three hip sites in 1,413 women and 1,125 men using dual-energy X-ray absorptiometry. Diet was assessed using a validated, semiquantitative food-frequency questionnaire. Each BMD measure was regressed on the frequency of soft drink consumption after adjustment for a number of potential confounding factors (including body mass index, height, age, energy intake, physical activity score, smoking, alcohol use, total calcium intake, total vitamin D intake, caffeine from non-cola sources, and, for women, menopausal status and estrogen use). Participants were found to be generally overweight, former smokers, and moderate users of alcohol. More than three-quarters of the women in the study were postmenopausal, of whom 29% were using estrogen.

No significant association between non-cola carbonated beverage intake and BMD was observed for either gender. In men, no significant association was found between cola intake and BMD. Cola intake was, however, associated with a significantly lower BMD at each hip site, but not the spine, in women after adjustment for potential confounding factors. Similar results were seen for diet cola, and a weaker association identified with decaffeinated cola. For women, greater intake of cola was not associated with a significantly lower intake of milk, but was associated with a lower intake of dietary calcium. Total daily phosphorous intake was not significantly higher in daily cola consumers than in non-consumers. The authors conclude that regular intake of any type of cola drink, but not of other carbonated soft drinks, is associated with lower BMD in women.

Comments

Previous studies in adolescent girls have raised the specter of carbonated drinks having a negative impact on fracture rates, perhaps by displacing healthier beverages (including sources of calcium, like milk) from the diet. As the authors of this study rightly point out, little attention had been paid to the potential impact of carbonated beverages on bone health in adults.

Colas often contain both caffeine (increases calcium excretion) and phosphoric acid (interferes with calcium absorption), both of which might adversely affect bone

health. Results of this study suggest the negative effect of cola on BMD appears stronger with caffeinated forms; however, a significant, albeit weaker, negative effect was found with decaffeinated cola intake as well, essentially negating the possibility that caffeine alone explains the harmful effects of regular cola ingestion. The findings are striking for the fact that risk was identified only in women, and that risk was associated with relatively conservative cola intakes: women who enjoyed three or more servings of cola per week had an increased risk of lowered BMD compared to those who enjoyed less than one cola per week. With an aging population and increasing lifetime fracture rates in both women and men, identification of modifiable risk factors that can easily be acted upon takes on supreme importance. At present, it appears that counseling women to lessen their intake of carbonated colas would be prudent. ❖

News Briefs

Nearly One in Five Americans Uses Herbs for Health Conditions or Promotion

A study examining patterns of herbal therapy use among adults in the United States and the factors associated with herbal therapy use found that almost 20% of adults use herbs for health treatment or promotion. More than half did not report this use to a conventional medical professional.

To conduct the study, the researchers examined the use of natural herbs from the 2002 National Health Interview Survey (NHIS). They then analyzed factors associated with herb use and reasons for herb use with logistic regression.

They found that factors associated with herb use included: age (45-64 years old), being uninsured, being female, having a higher education, living in the West, using prescription medications or over-the-counter (OTC) medications, and identifying oneself as "non-Hispanic other." Factors associated with no herb use include being non-Hispanic black and living in the South or Midwest.

Seventy-two percent of those who used herbs used prescription medications, and 84% of those who used herbs also used an OTC medication in the past 12 months. Among adults who used herbs, the most commonly mentioned were echinacea (41%), ginseng (25%), ginkgo (22%), and garlic (20%). The most frequent conditions for herb use were head or chest cold (30%), musculoskeletal conditions (16%), and stomach or intestinal illness (11%). Among those who used herbs in the prior year, the factors associated with using herbs because conventional medical treatments were too expensive included being uninsured, having poor health, and being 25-44 years old.

For more information on this study, see the March/April issue of *Alternative Therapies in Health and Medicine*.

Iowa Center to Study Botanicals Used in Dietary Supplements

The Office of Dietary Supplements, a component of the National Institutes of Health (NIH), has announced a grant to Iowa State University (ISU) in Ames to study botanicals used as ingredients in dietary supplements. A multidisciplinary research team will study hypericum (St. John's wort), prunella (Self-heal), and several types of echinacea (such as purple coneflower) for their antiviral and anti-inflammatory properties.

The center will be headed by Diane Birt, PhD, Distinguished Professor at ISU, and will bring together researchers from ISU, the University of Iowa in Iowa City, and Yale University in New Haven, CT. The National Center for Complementary and Alternative Medicine (NCCAM) at NIH will co-fund the center.

NIH currently funds six dietary supplement research centers focused on botanicals. Scientists at these centers emphasize basic and preclinical research of potential benefit to human health. Studies at ISU will focus on identifying compounds and chemical profiles for antiviral and anti-inflammatory activities and complement research at other centers that are studying botanicals and inflammation. In recent years, inflammation has

been identified as a common denominator of a number of chronic diseases, such as heart disease.

Study Detects Substantial Number of Potential Herb/Drug Interactions

A recent study found a substantial number of potential adverse interactions in patients taking herbal medicines along with prescription medications. The researchers also observed a small number of adverse herb-drug interactions. Screening for herbal medicine usage, however, did not uncover any serious adverse interactions with prescription medications.

The study, which appeared in the March/April issue of *Alternative Therapies in Health and Medicine*, looked at the incidence of potential and observed adverse herb-drug interactions in patients using herbal medicines with prescription medications.

The researchers questioned consecutive patients in six outpatient clinics about their use of herbal medicines. Patients reporting use of these products provided a list of their prescription medications, which were reviewed for any potential adverse herb-drug interactions using a comprehensive natural medicine database. Any potential adverse herb-drug interactions prompted a review of the patient's chart for evidence of an observed adverse herb-drug interaction.

Of the 804 patients surveyed, 122 (15%) used herbal medicines. Eighty-five potential adverse herb-drug interactions were found in 49 patients (40% of users). The researchers also observed 12 possible adverse herb-drug interactions in eight patients (7% of users). In all 12 cases, the severity scores were rated as mild, including eight cases of hypoglycemia in diabetics taking prickly pear cactus. ❖

CME Objectives

After reading *Alternative Therapies in Women's Health*, the health care professional will be able to:

1. evaluate alternative medicine and complementary therapies for women's health concerns;
2. identify risks and interactions associated with alternative therapies;
3. discuss alternative medicine options with patients;
4. offer guidance to patients based on latest science and clinical studies regarding alternative and complementary therapies.

CME Instructions

Physicians participate in this continuing medical education program by reading the article, using the provided references for further research, and studying the questions at the end of the article. Participants should select what they believe to be the correct answers, then refer to the list of correct answers to test their knowledge. To clarify confusion surrounding any questions answered incorrectly, please consult the source material. After completing this activity, you must complete the evaluation form provided and return it in the reply envelope provided at the end of the semester to receive a certificate of completion. Upon receipt of your evaluation, a certificate will be mailed.

CME Questions

20. Glucomannan 's principal indication is for high cholesterol. It is also used for:

a. constipation.
b. diabetes.
c. high blood pressure.
d. weight loss.
e. All of the above

21. Upon contact with water, 1 g of glucomannan will absorb approximately how much water in vitro?

a. 50 mL.
b. 100 mL.
c. 150 mL.
d. 200 mL.

22. Glucomannan can reduce the absorption of fat-soluble vitamins, but no water-soluble vitamins.

a. True
b. False

23. Although the negative effect of cola on bone mineral density appears stronger with caffeinated forms, a significant effect was also found with decaffeinated cola intake.

a. True
b. False

Answers: 20. e, 21. b, 22. a, 23. a.

In Future Issues:

DHEA for Menopause

Diet and Breast Cancer