NUTRITION

Whole Grains and Dietary Fiber Continue to Win Honors in Preventing Various Diseases

Positive data on whole grains continue to accrue. The strength of the data increases as health benefits are documented in a variety of different cohorts and with a variety of different endpoints ranging from heart failure to asthma in humans to reduced breast cancer risk in experimental animals.

In terms of heart failure, men who ate two to six bowls of whole grain or bran cereals (cereals with 25% oat or bran) per week were ~22% less likely to develop heart failure than men who never consumed whole grain cereals, according to data collected as part of the Physician’s Health Study (1).

At baseline, 10,469 physicians said they ate breakfast cereals—8,266 said they consumed at least some whole grain cereals. Thirty-five percent said they ate them seven or more times a week; 39%, two to six times a week; and 26%, once a week. During the 18-year study, there were 898 cases of heart failure in the cohort. Those who consumed higher levels of whole grain foods had lower incidences of heart failure than nonconsumers. Furthermore, responses appeared to be dose-dependent. After correcting for age, body mass index, smoking history, alcohol consumption, vegetable consumption, physical activity, history of atrial fibrillation, and valvular heart disease, compared to non–whole grain consumers, the relative risks for heart failure were decreased 10% for those eating one serving of whole grain cereal per week, 21% for those eating two to six servings per week, and 26% for those eating seven or more servings per week. The authors felt that these responses could be generalized to all whole grain foods and would perhaps be more robust in populations not associated with medicine since the members of this cohort would be more likely to pursue heart-healthy lifestyles.

Another study looked at whole grain intake and an endpoint associated with heart health. Intake of whole grain–rich foods was inversely associated with heart failure than men who never consumed whole grain cereals, according to data collected as part of the Physician’s Health Study (1).

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Whole grains in the diet protected against asthma. In a study of nearly 600 8–13-year-old Dutch children, higher intakes of fish and whole grain foods were associated with reduced risks of developing asthma (9). Intakes of the youth enrolled in the International Study on Allergy and Asthma in Childhood 2 (ISAAC-2) were determined by parents who completed questionnaires about food intake and wheezing and other asthmatic symptoms. In addition to the parental surveys, medical records and tests were also evaluated. In the group with low fish and whole grain intake, the reported wheezing rate was 19.4% compared with 4.2% in children with a high intake of these foods. After adjusting for potential confounding factors, whole grains and fish were linked to a reduction of 54% and 66%, respectively, in the likelihood of having asthma, and similar reductions of 45% and 56% for wheezing.

Whole grains in the diet of children appear to be important, but an animal study indicates that whole grains in the diet during pregnancy may also have a positive health outcome. Offspring of rat dams fed diets containing whole wheat while pregnant had more effective DNA repair mechanisms (12). In this study, the female offspring of dams fed whole wheat during pregnancy were less likely to develop breast cancer when exposed to a known carcinogen. In contrast, offspring from dams fed defatted flax flour during pregnancy were more likely to develop the cancer. While oat flour consumption during pregnancy had no measurable effect on breast cancer development in the offspring, gene expression and mammary gland morphology were changed in offspring whose mothers had been fed either wheat flour or oat flour. Specifically, the number of terminal end buds, the main sites of cancerous transformation, were less numerous in the mammary glands of whole wheat and oat flour offspring compared to the cellulose control offspring. Offspring of mothers who ate whole wheat flour had significantly increased mRNA and/or protein levels of factors involved in repair of damaged tissue or suppression of tumors in their mammary glands. One of these genes is BRCA1, the breast cancer susceptibility gene. It produces a protein responsible for repair of damaged DNA. If there is not an adequate amount of the repair protein, then abnormal DNA may replicate leading to mutations and ultimately cancer. Another gene is p53, one of a family of tumor suppressor genes. These genes code for proteins that inhibit a mutated or damaged cell from reproducing. In addition, offspring of the whole-wheat-flour-fed dams had lower levels of 8-hydroxy-2-deoxyguanosine, a marker for DNA damage. Thus, whole grain flour in the diet may encourage several changes that would be protective against cancer.

Fiber and its role in colon cancer remains a matter of much debate and research. Animal studies consistently show that fiber reduces risk of induced colon cancer. However, human studies have not given the same degree of clarity. In terms of colon cancer, a recent prospective Japanese study showed that a diet rich in fiber could cut the risk of developing colon cancer by about...
40%. The findings are important as Japan has both a high incidence of cancer and has experienced a rapid increase in the incidence of colon cancer linked to the “westernization” of the diet. The Japan Collaborative Cohort Study followed 43,115 men and women who were 40 to 79 years at the start of the study (11). Colorectal cancer risk decreased with increasing intake of total dietary fiber, with the highest fiber intake associated with a 27% reduction compared to the lowest fiber intake. Further analysis showed that the trend applied only to colon cancer, with the highest fiber intake associated with a 42% reduction compared to the lowest fiber intake. Total dietary fiber was what mattered as no significant differences were observed when the researchers classified the fiber as soluble or insoluble.

**Delivering More Goodness of Whole Grain and Its Components**

Nutritionists and food scientists can apply several strategies to improve people’s diets. One is to help consumers make better choices; another is to change the food through altered processing techniques, breeding programs, or the addition of healthful ingredients such as dietary fibers. While some nutritional purists think that changing the food is giving up and does not help consumers eat more fruits and vegetables; others feel that the only real chance of success is to change the food itself as nutritionists and the health community have an abysmally poor track record at changing people’s dietary behavior. Improving food composition was a strategy that researchers at the University of Maryland applied to a very popular U.S. food in order to increase the whole grain antioxidants delivered in a whole grain pizza crust. They tried to alter the process in a number of ways to see how the changes would affect the level of antioxidants. They found that by using higher baking temperatures (290 vs. 209°C) or longer baking times (14 vs. 7 minutes), antioxidant levels increased. Higher baking temperature increased antioxidants by up to 82% and longer baking times increased them up to 60%, depending on the type of wheat flour and the antioxidant test used (5). Longer dough fermentation raised antioxidant levels up to 100%. This group is now looking at other varieties and breeding techniques in order to improve antioxidant levels in the whole grain crust.

In addition to increasing whole grain antioxidants, another strategy is to try to increase the intake of dietary fibers that have been shown to deliver documentable benefits, such as betaglucan. This can be accomplished by adding them to food or by using them as stand-alone supplements, but research must be done to show that these added fibers promote physiological benefits. A recent study showed the benefit of consuming oat betaglucan. Feeding 6 g of concentrated oat beta-glucan per day to 75 hypercholesterolemic individuals for 6 weeks reduced both total and LDL cholesterol by an average of 0.3 mmol/L (8). Cholesterol lowering was thought to be due to the production of short chain fatty acids, especially butyrate. Butyrate has been documented to inhibit a rate-limiting enzyme involved in cholesterol synthesis. In this study, the beta-glucan was compared with other fermentable soluble fibers, inulin and guar. All produced short chain fatty acids, but oat beta-glucan produced more butyrate than inulin, which produced more than guar. Thus, these fibers could be added to food products in order to increase the amount of total and fermentable fiber in the diet.

**Functional Components of Whole Grains and Plants**

Many components of whole grains and plant foods are involved in altering disease risk. One of these is the category of lignans. Plant lignans have long been recognized as phytoestrogens and their consumption has been associated with breast health. They are metabolized in the colon by microflora into the mammalian lignans enterodiol and enterolactone. A French prospective study indicates that a high intake of lignans could reduce the risk of invasive breast cancer by almost 30% in both hormone-sensitive, estrogen-receptor (ER) positive, and progesterone-receptor (PR) positive tumors. Specifically, the effects of dietary intakes of four plant lignans (pinoresinol, lariciresinol, secoisolariciresinol, and matairesinol) and estimated exposure to two enterolignans (enterodiol and enterolactone) were assessed regarding their effects on the incidence of invasive breast cancer in 58,049 postmenopausal French women not taking soy isoflavone supplements (10). Those women with daily intakes greater than 1,395 micrograms had a 17% reduction in breast cancer risk overall, compared to women with the lowest daily intake. However, if only those cancers that have been demonstrated to be affected by lignans are considered (i.e., ER- and PR-positive breast cancers), then those with the highest intake of total lignans are associated with a 28% reduction of these cancers. If the association is based on mammalian lignans, then there is a 23% reduction associated with the highest levels of intake versus the lowest intake levels of total enterolignans. These data are nearly the same as those in a study published last year that reported women with high plasma levels of enterolactone (>12.96 nanomoles/L), linked to high lignan intake, exhibited a 58% reduction of breast cancer risk (7).

**Cereals Contain Many Lignans**

The lignan 7-hydroxymatairesinol appears to be the dominant lignan in a wide range of cereals, according to studies carried out using a new methodology (6). In triticale bran, the proportion of 7-hydroxymatairesinol was almost 50% of total lignans, while in rye, oats, buckwheat, millet, and dhurra bran, the proportion was reported to be between 26% and 44%. In other words, the newly identified lignans are dominant in wheat, barley, corn, and quinoa bran and in amaranth. Previous studies had identified 7-hydroxymatairesinol in Norway pine. No studies to date had looked for it in cereals. The new methodology was applied to 16 species of cereal, including sesame, linseed, wheat, barley, corn, oat bran, and four species of nuts. In total, the study analyzed 24 different plant lignans. Eighteen of the 24 lignans had not previously been identified in cereals and nuts.

**Diet Information—One Size Does Not Fit All**

A low–glycemic-load diet proved to work better than a low-fat diet for weight loss in those who release more insulin in response to a standardized glucose tolerance test than those who release less, according to a randomized study of young obese adults (2). In this study, 73 subjects (aged 18–35 years) were assigned either to a low–glycemic-load or a low-fat diet for 6 months. The low–glycemic-load diet was comprised of nonstarchy vegetables, legumes, healthful nuts, and fruits, limiting intake of high glycemic index foods such as refined grains, starchy vegetables, and fruit juices. Forty percent of energy (E) was from carbohydrates, 35% from fat, and 25% from protein. The low-fat diet had 55% of E from carbohydrates, 20% from fats, and 25% from protein. The diet emphasized low-fat grains, vegetables, fruits, and legumes. Follow-up at 18 months showed that changes in body weight and body fat percentage did not differ between the two diet groups. However, for those with insulin concentrations above the median of 57.5 µIU/mL, the low–glycemic-load diet resulted in a 5.8 kg weight loss vs. 1.2 kg weight.

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loss for those with less insulin secretion. There was also a greater percentage of loss of body fat (2.6% vs. 0.9%) for the low-glycemic load, high-insulin group.

**Even with Convincing Evidence, Diet Change is Hard**

Over 10 years ago, convincing evidence touting the benefits of the DASH—Dietary Approaches to Stop Hypertension—diet on reducing hypertension and other chronic diseases was published. The DASH diet focuses on eating lots of fruits, vegetables, grains, and low-fat dairy. The diet results in preferred levels of nine nutrients: total fat, saturated fat, protein, cholesterol, fiber, calcium, magnesium, potassium, and sodium. Systolic and diastolic blood pressure in hypertensive patients in the DASH trial was lowered by an average of 11.4 mm Hg and 5.5 mm Hg, respectively. Based on these findings, the national guidelines included the DASH diet among the therapeutic lifestyle changes advocated for all patients with or at risk for high blood pressure, regardless of concomitant antihypertensive drug therapy.

While the diet was successful in reducing blood pressure and the need for blood pressure medication (either completely or decreasing the amount required), the success of getting dietary adherents is poor, according to an analysis of 4,000 surveyed hypertensive adults in the National Health and Nutrition Examination Survey (NHANES) data set. To be counted as following the diet, participants only needed to meet half the nutrient targets. Even with these nonstringent requirements, a recent study showed that only 22% of those who were supposed to be following the diet were doing so (3).

And these data show that the numbers have dropped by 8% in the most recent study over an earlier study. Older adults were more likely to follow the diet than those younger than 40 years, and African Americans were 39% less likely to follow the DASH diet than non-Hispanic whites. Those having more than a high school education were 80% more likely to follow the diet. Patients with diabetes were also more likely to follow the recommended eating plan in the DASH diet.

Reasons for nonadherence were cost, availability of shops with the required foods, time required to prepare the food, as not many items are readily available in many delis or restaurants, and the time required by physicians to work with the diet versus prescribing a medication. One article on this study noted that “hopes are DASHED in diet study.” Another noted that despite overwhelming success, the diet is simply not being chosen.

**References**

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