Nutritional Benefits of Barley

Barley foods, like oat products, are an excellent source of beta-glucan soluble fiber. The beta-glucan content of whole-grain barley is equivalent to or greater than that found in whole-grain oats (Table 1). In a weight-for-weight comparison, whole-grain barley is lower in fat, protein and calories, and higher in total dietary fiber than whole-grain oats (Table 1). Consumption of whole-grain barley products is consistent with the 2005 Dietary Guidelines for Americans that recommend eating at least three servings of whole grains daily. A comprehensive review of the scientific evidence suggests that increasing whole-grain consumption can reduce the risk of coronary heart disease and diabetes, and can help with weight maintenance.1

Table 1. Macronutrient Comparison of Barley and Oat Whole Grains*

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Barley (per 100g)</th>
<th>Oats (per 100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories (Kcal)</td>
<td>354</td>
<td>389</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>12.48</td>
<td>16.89</td>
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<tr>
<td>Fat (g)</td>
<td>2.30</td>
<td>6.9</td>
</tr>
<tr>
<td>Total Carbohydrate (g)</td>
<td>73.48</td>
<td>66.27</td>
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<tr>
<td>Total Dietary Fiber (g)</td>
<td>17.3</td>
<td>10.6</td>
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<tr>
<td>Beta-Glucan (g)</td>
<td>4.3-5.5</td>
<td>2.2-6.6</td>
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</table>

1 Range specified is for common North American varieties. Some varieties such as waxy hullless cultivars not included in this range, can have beta-glucan contents ranging from 5.1 to 16.6%.
2 Range specified for U.S. oats; Average content is 4.2%.

FDA Approved CHD Risk Reduction Health Claim for Beta-Glucan Soluble Fiber from Barley

The Food and Drug Administration (FDA) recognizes that certain food sources of soluble fiber can reduce the risk of CHD based on their effects on total and LDL blood cholesterol. In 1997, FDA authorized CHD risk reduction health claims for beta-glucan soluble fiber from whole oats, oat bran, and whole oat flour, followed by approval of a similar claim for an oat extract (oatrim) containing up to 10% beta-glucan in 2003.6-9 Most recently a health claim petition for CHD and beta-glucan soluble fiber (from dehulled or hullless whole or pearl barley, barley flakes, barley grits, barley meal, barley flour, barley bran, and beta-glucan enriched barley meal or flour) was submitted by the National Barley Foods Council and is likely to be authorized by FDA in the upcoming months.

Reducing Risk of CHD and Elevated Blood Cholesterol Levels in the U.S.

Coronary heart disease (CHD) continues to have a significant impact on the morbidity and mortality of the adult American population. For more than 50 years, CHD has been the leading cause of death in the United States and is responsible for as many as one in five deaths.4 Elevated total and LDL blood cholesterol are major modifiable risk factors for CHD. When total cholesterol exceeds 200 mg/dl and LDL cholesterol rises above 130 mg/dl, the risk for developing CHD increases significantly. About 51% of the U.S. population has a total cholesterol of 200 mg/dl or higher, and about 46% has an elevated LDL cholesterol of 130 mg/dl or higher.4 Dietary modifications to lower high blood cholesterol including reduced intakes of saturated fat, total fat and cholesterol are recommended by the National Cholesterol Education Program (NCEP).5 The inclusion of viscous soluble fiber from grains is also recommended by the NCEP to enhance blood cholesterol reduction.4
Reducing Blood Cholesterol with Barley

Results from published clinical studies have shown a consistent reduction in total and LDL cholesterol with no change in HDL cholesterol in subjects with elevated serum cholesterol levels who included beta-glucan containing barley products in their diets. Two randomized controlled studies have examined the effect of barley consumption after subjects were stabilized on a baseline low-fat diet. In the first study, 18 moderately hypercholesterolemic men consumed a NCEP Step 1 diet for 2 weeks, then followed each of 3 successive diets containing varying levels of barley soluble fiber (BSF): low BSF (<0.4 g, control), mid BSF (3 g), and high BSF (6 g) for 5 weeks each. Subjects ate barley as a hot cereal, in pancakes, granola, pilafs, muffins, cakes, and cookies prepared from a combination of pearl barley, pearl barley flakes and pearl barley flour. During the high BSF phase, total cholesterol and LDL cholesterol were significantly reduced by 8.8% (p < 0.05) and 11% (p < 0.05), respectively, compared to when subjects consumed the low BSF control diet.

The second investigation by Behall et al utilized the same design and protocol as the first, but was conducted in 18 pre- and postmenopausal women and 7 men who were mildly to moderately hypercholesterolemic. Total and LDL cholesterol were significantly reduced in subjects consuming both the mid (3 g) and high (6 g) BSF diets compared to those consuming the low beta-glucan control diet. The mid BSF diet lowered total cholesterol by 4.9% (p < 0.05) and LDL by 6.5% (p < 0.05); the high BSF diet lowered total cholesterol by 5.8% (p < 0.05) and LDL cholesterol by 8.4% (p < 0.05).

Two studies have examined the effect of barley consumption in subjects eating their usual diet. McIntosh et al conducted a randomized crossover study in 21 hypercholesterolemic men who consumed barley or wheat (control) based foods for 4 weeks. The barley foods provided 8 g of barley beta-glucan daily and included bread, muesli, spaghetti, and biscuits made from barley bran and barley flakes. Total and LDL cholesterol were lowered by 6% (p < 0.05) and 7% (p < 0.02), respectively, in subjects eating barley foods compared to wheat foods.

In another study, 22 hypercholesterolemic subjects were fed barley or oat-based foods for 6 weeks. Barley and oat flours were used in weight equivalent amounts in breakfast cereal, bran muffins, and flatbread recipes. Compared to baseline levels, both the barley and oat diets lowered total cholesterol by about 4.7%. LDL cholesterol was reduced by 13.9% in subjects fed the barley diet and by 7% in those fed the oat diet. Statistical values were not reported in this study but the researchers noted there was no significant difference in response between the barley and oat groups. The beta-glucan contents of the two diets were also not reported, but total dietary fiber intake of the barley diet was significantly higher (40 g) than for the oat diet (27 g).

Overall, the clinical data indicates that a minimum of 3 g of beta-glucan from specified barley products is effective in lowering elevated cholesterol. This observation is consistent with data from oat studies that indicate 3 g of beta-glucan from specified oat products is the minimum effective dose in lowering blood cholesterol.

Reducing Blood Glucose with Barley

The incidence of type 2 diabetes is rising rapidly in the U.S. and in many areas of the world. According to the Centers for Disease Control and Prevention, more than 18 million Americans have this disease. Diabetes is a primary risk factor for CHD, blindness, end-stage renal disease, and lower-limb amputations. Aging and genetics play key roles in the development of diabetes, but rising rates of obesity, physical inactivity, and an unhealthy diet are also associated with the dramatic increase in this condition. Yet, certain dietary practices may provide protection. Several large-scale, prospective epidemiologic studies suggest that whole grains and cereal-fiber containing products may reduce the risk of developing type 2 diabetes. The epidemiologic findings have been supported by clinical studies in which the intake of whole-grains and cereal-fiber containing foods have had favorable effects on intermediate markers for diabetes, namely blood glucose and insulin levels in non-diabetics and diabetics.

To date, only one published study has evaluated the effect of chronic barley consumption in type 2 diabetics. Subjects consumed a barley bread providing 5.2 g of beta-glucan, or a control white bread for 12 weeks. During the barley phase, mean blood glucose responses were reduced and mean insulin responses were elevated.
which required some subjects to lower their doses of oral hypoglycemics. Not only did barley bread products improve glycemic response, but they were well accepted by type 2 diabetics. Results are hopeful, yet additional research is necessary to confirm these findings.

**Increasing Satiety with Barley**

Over the last decade there has been a dramatic rise in obesity in both American adults and children. Increasing obesity is associated with the increased prevalence of related co-morbidities including type 2 diabetes, hypertension, CHD, osteoarthritis, respiratory problems, and some cancers. Since high-fiber foods induce a greater feeling of satiety than refined, low-fiber foods, it is suggested that high-fiber foods can be useful tools for weight loss and weight maintenance.

Barley products are high-fiber, low-fat foods that appear to promote satiety. When the satiety values of four barley-based breakfasts were compared to white bread, it was observed that the barley breakfast with the highest beta-glucan and dietary fiber content received the highest satiety score (p < 0.05). In another study, a group of diabetics rated the satiety of whole-grain barley bread, pearled barley bread, and white bread. The highest satiety rating was awarded to the whole-grain barley bread, which contained the highest amount of dietary fiber per serving. Additional research is required to clarify other factors such as food form, food preparation, and flavor that may interfere with favorable satiety perception.

**Conclusions**

Barley foods are healthful additions to the diet. Most barley ingredients are whole-grain, low fat, and high in fiber, which make them ideal choices for individuals following the recommendations of the 2005 Dietary Guidelines for Americans. Barley foods have many health-enhancing attributes, in addition to providing sound nutrition. Their beta-glucan soluble fiber content confers barley products with cholesterol-lowering properties similar to oats. Emerging data also suggest benefits beyond cholesterol reduction, including lowered post-prandial blood glucose and insulin levels, and an increased feeling of satiety following barley consumption.

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**References**


