Quality is in our nature

Canada

Courtesy of Western Grain Research Foundation

Oat and Barley ß-Glucans

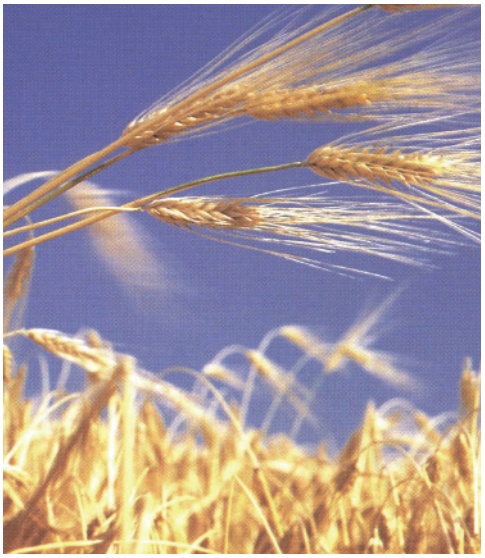
Healthy Canadian Ingredients

Canada's climate and long hours of daylight result in the production of high quality oats and barley. With a strong image as nutritious, health-promoting ingredients in foods due to the high bioactive and functional component contents, oats (Avena sativa) and barley (Hordeum distychum) can be viewed as functional foods or nutraceutical products.[1]

Oats and barley contain beneficial components to health including tocopherols, phenolics, phytosterols and soluble and insoluble fibers. The most recognized ingredient is beta-glucan (ß-glucan), a soluble fiber. Cereal ß-glucans play a role in cardiovascular disease risk by reducing blood lipids levels and blood pressure, and a role in diabetes by lowering blood glucose levels.

Of the common cereals (wheat, rye, oats and barley) grown in Canada, the largest (seed) amounts of ß-glucan are found in barley (3-11%) and oats (3-7%).[2] Oat ß-glucans are found in the endosperm and its wall. Dehulling and fractionation of the whole grain is required to produce commercial brans containing enriched levels of ß-glucan. With hull-less barley, the ß-glucan is evenly distributed throughout the entire barley kernel and even refined products, like barley flour, contain ß-glucan soluble fiber. Natural, consistent oat bran with high total dietary fiber (44%) and ß-glucan (up to 22%) can be produced through technology and processing controls.[3]

Purified ß-glucan is a linear, unbranched, non-starch polysaccharide composed of ß-(1-4) and ß-(1-3) linked glucose molecules. These mixed linkages are important for physical properties such as viscosity and solubility. The molecular weight and solubility of ß-glucans must be preserved during processing to maintain its desirable high viscosity properties.[4]



Courtesy of Alberta Barley Growers

Health Benefits

Consumption of diets low in saturated fat and cholesterol, which include soluble fiber from certain foods, reduces the risk of coronary heart disease (CHD).[5] The first clinical trials, more than 40 years ago, showed the relationship between oat consumption and reduced serum total cholesterol levels. Recent studies have definitively identified oat ß-glucan as the physiologically active component responsible for the cholesterol-lowering effect.[6-8] Additional studies have resulted in a food-specific health claim for an association between diets high in whole oat foods and reduced risk of CHD.[9]

In 2005, the U.S. Food and Drug Administration published an amendment to its health claim for soluble oat fibre and coronary heart disease to include barley. "Like oat ß-glucan, 3 g per day of barley ß-glucans is a sufficient daily dietary intake to achieve a reduction in serum total and LDL cholesterol."[10]

Several mechanisms of action are thought to be responsible for the hypocholesterolemic effect of ß-glucan including increased excretion of bile acids and cholesterol, decreased insulin secretion–leading to reduced cholesterol synthesis, production of short chain fatty acids–which may inhibit cholesterol biosynthesis, reduced fat absorption rates, and inhibition of pancreatic lipase or reduced activity of gastric lipase.[2]

Both oat and barley ß-glucans are being studied for their impact on glycemic index (GI).[11] GI refers to the blood glucose raising potential of carbohydrate foods. Cereal ß-glucans reduce the GI response. There is accumulating evidence that diets containing a higher level of foods that elicit low glycemic responses may improve the metabolic control of diabetes.[12] Incorporating these ingredients into functional foods may result in lowered GI responses.

While still under investigation, the cholesterol-lowering activity of products rich in oat ß-glucan may depend on factors like its viscosity in the intestinal tract, the food matrix and the processing regime.[13] Further research is needed to determine the effect of oat soluble fibre on reducing the risk of hypertension.

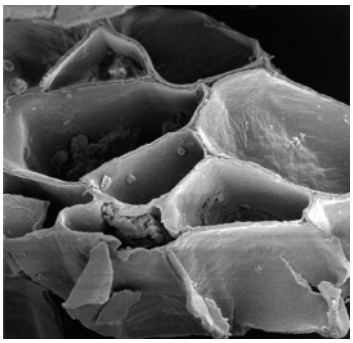
In addition to health effects, oat ß-glucan has new uses as a cosmetic ingredient in the care and maintenance of healthy skin and treatments for aging skin.[14]

Courtesy of G. Gingera, University of Saskatchewan

Innovative Applications

Unlike oats, the use of barley in human foods was limited due to its long cooking time. Commercially available barley products include pot and pearl barley, grits, flakes and malt flour. Current research to reduce cooking times will lead to new quick-cooking products like puffed barley cereals and extruded barley products for consumers,[15] providing new vehicles for ß-glucan incorporation.

Technological advances in oat and barley ß-glucan extractions have led to commercial, purified ß-glucan products. These ß-glucans have good dispersion in solutions, a neutral flavour, offer flexibility in food textures, act as a stabilizer in liquid products (i.e. dressings and beverages) and may be used as a fat substitute in meat products.



Courtesy of Vasanthan and Temelli 2002, University of Alberta

Processing significantly affects the physicochemical properties (e.g. molecular weight, concentration, temperature, shear rate) of ß-glucan. Extensive research to correlate processing effects and health benefits of ß-glucans is ongoing in Alberta. This research includes cell culture tests, *in vitro* intestinal tissue uptake studies and rat feeding trials to investigate diabetes response, lipid metabolism, immune response and impact on gut microflora.

Extracted ß-glucan ingredients can be incorporated into a wide variety of innovative food products beyond traditional uses. These include nutritional bars and chews, breakfast cereals, beverages (e.g. sports drinks, juices, smoothies, shakes), baked products (e.g. bread, muffins, cakes), yogourt, ice cream, pasta and dietary supplements.

Canadian Research Expertise

Agriculture and Agri-Food Canada

• Food Research Program (Guelph, ON) in collaboration with Guelph and Toronto Universities

– Developing products to determine the effect of processing/storage methods on the cholesterol lowering ability of oat ß-glucans; studying the effect of ß-glucans on glycemic response; and, determining relationships between physicochemical characteristics and functional properties and physiological effects of ß-glucan and other non-starch polysaccharides (P. Wood, T. Wolever)

• Cereal Research Centre (Winnipeg, MB)

– Developing quality criteria for food oats, optimizing hull removal, and working towards innovative product development incorporating oats and beta glucans (N. Ames)

• Eastern Cereal and Oilseed Research Centre (Ottawa, ON)

– Researching separation technology and value-added phytochemistry (W. Collins)

University of Alberta (Edmonton, AB)

– Investigating cost efficient technologies for ß-glucan extraction, use of ß-glucans as a food additive to increase the fibre levels of low fibre foods, and food and non-food applications of the by-products after ß-glucan extraction (T. Vasanthan, F. Temelli)

University of Manitoba (Winnipeg, MB)

– Investigating bioactive components in oats and barley, specifically ß-glucans and their affect on the immune system (modulation of tumor necrosis factor alpha: TNFalpha) (G. Fulcher)

University of Saskatchewan (Saskatoon, SK)

Crop Development Centre

– Focused on breeding oats and barley, developing hull-less barley varieties and varieties with increased concentrations of beta glucans, and determining quality measurements for enhanced quality for product development (B. Rossnagel)

University of Toronto (Toronto, ON)

– Studying effect of ß-glucans on glycemic response (T. Wolever)

Canadian Suppliers

Oat and barley ß-glucans

1. *Cevena Bioproducts Inc* (Edmonton, AB)
   http://www.cevena.com
2. *Ceapro Inc.* (Edmonton, AB)
   http://www.ceapro.com
3. *Parrheim Foods* (Saskatoon, SK)
   http://www.parrheimfoods.com/

Oat and barley dry milled products

1. Can-Oat Milling (Portage La Prairie, MB)
   http://www.can-oat.com
2. FarmPure Inc. (Regina, SK)
   http://www.farmpure.com
3. Hamilton's Barley Inc. (Olds, AB)
   http://www.hamiltonsbarley.com/
4. Grain Millers Canada Corporation (Yorkton, SK)
   http://www.grainmillers.com
5. Quaker Oats Company (Peterborough, ON)
   http://www.quakeroats.ca

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Courtesy of Alberta Barley Growers

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