

Quality
is in our nature



Oat and Barley β -Glucans

Unique soluble fibres



For decades, Canada's natural environment and farming practices have produced nutritious, high quality oats and barley. However, oats and barley have now moved out of the cereal bowl and soup pot into a variety of food products including nutrition bars, beverages and even ice cream.

Oats (*Avena sativa*) and barley (*Hordeum distychem*) contain many natural compounds beneficial to health. These include tocopherols, phenolics and phytosterols as well as soluble and insoluble fibres; however, beta-glucan (β -glucan), a unique soluble fibre, is the most recognized health promoting compound.

Of the common cereals (wheat, rye, oats and barley), the largest (seed) amounts of β -glucan are found in barley (3-11%) and oats (3-7%).¹ In oats, the β -glucan is in the endosperm and its wall, making dehulling and fractionation of the whole grain necessary to produce commercial β -glucan enriched brans. Using technology and processing controls, natural oat bran with high dietary fibre content (44%) and β -glucan content (up to 22%) can be achieved.² In hull-less barley, the β -glucan is distributed more evenly throughout the kernel so that even refined products like barley flour contain β -glucan.



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The ability of β -glucans to form highly viscous solutions at fairly low concentrations in the human gut is thought to form the basis of its health benefits. Purified β -glucan has the ability to form highly viscous solutions because it is a linear, unbranched, non-starch polysaccharide composed of β -(1-4) and β -(1-3) linked glucose molecules which provide the physical properties of viscosity and solubility. Therefore, it is critical to preserve the molecular weight and solubility of β -glucans during processing to ensure these physical properties are maintained.³

Extensive research to correlate processing effects and health benefits of β -glucans is ongoing in Alberta. Research includes cell culture tests, *in vitro* intestinal tissue uptake studies and rat feeding trials to investigate diabetic response, lipid metabolism, immune response and the impact on gut microflora.

Health Benefits



Diets which include soluble fibre from certain foods, and are low in saturated fat and cholesterol, can reduce the risk of coronary heart disease (CHD).⁴ While it has been more than 40 years since the first clinical trials showed the relationship between oat consumption and reduced serum total cholesterol levels, more recent studies have definitively identified oat β -glucan as the physiologically active component responsible for the cholesterol-lowering effect.^{5,6,7} Accumulation of additional studies also resulted in a food-specific health claim for an association between diets high in whole oat foods and reduced risk of CHD.⁸ Later, 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 which reads: "Like oat β -glucan, 3 g per day of barley β -glucan is a sufficient daily dietary intake to achieve a reduction in serum total and LDL cholesterol."⁹

Several mechanisms of action are thought to be responsible for the hypocholesterolemic effect of β -glucan. These include 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.¹

While still under investigation, the cholesterol-lowering effect of products rich in oat β -glucan are thought to depend on factors like its viscosity in the intestinal tract, food matrix, and processing regime.¹⁰ Further research is still needed to determine the effect of oat soluble fibre on reducing risk of hypertension and how β -glucan may play a role in this effect.

Both oat and barley β -glucans are currently being studied for their impact on glycemic index (GI).^{11,12,13} GI refers to blood glucose raising potential of carbohydrate foods.

Cereal β -glucans have been shown to reduce glycemic response and there is accumulating evidence that diets containing a higher level of foods that elicit low glycemic responses may improve metabolic control of diabetes.¹⁴ Therefore, incorporating ingredients, such as oat and barley β -glucans, into functional foods may result in lowered GI responses.

Consuming β -glucans reduces risk of coronary heart disease.

In addition to eliciting positive health effects, oat β -glucan is also used as a cosmetic ingredient in the care and maintenance of healthy skin and treatments for aging skin.¹⁵

Canadian Suppliers

Oat and barley β -glucans

- **Ceapro Inc.**
Edmonton, AB | www.ceapro.com
- **Natraceuticals Canada Inc.**
Edmonton, AB | www.viscofiber.com
- **Parrheim Foods**
Saskatoon, SK | www.parrheimfoods.com

Oat and barley dry milled products

- **Can-Oat Milling**
Portage La Prairie, MB | www.can-oat.com
- **Grain Millers Canada Corporation**
Yorkton, SK | www.grainmillers.com
- **Hamilton's Barley Inc.**
Olds, AB | www.hamiltonsbarley.com
- **Quaker Oats Company**
Peterborough, ON | www.quakeroats.ca

Applications

Commercially available barley products for the food market include pot and pearled barley, grits, flakes and malt flour. Unlike oats, the use of barley in human foods has been limited by its long cooking time. Current research to reduce cooking times will lead to new quick-cooking products like puffed barley cereals and extruded barley products for consumers,¹⁶ providing new vehicles for β -glucan incorporation.

Technological advances in oat and barley β -glucan extractions have led to commercial, purified β -glucan products. These β -glucans have a neutral flavour, good dispersion in solutions, 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. Extracted β -glucan ingredients have been successfully incorporated into a wide variety of innovative food products that go beyond

traditional uses. These include nutrition 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.

Currently, three Canadian companies are proving to be leaders in the development and commercialization of β -glucan ingredients. Natraceuticals Canada Inc. markets oat and barley β -glucans to the food and natural health product industry; Ceapro's extracted oat ingredients have applications in medical, veterinary, personal care and cosmetic products worldwide; and Parrheim Foods offers a barley β -glucan concentrate for use in baked goods, beverages and pasta.



Canadian Research Expertise

Agriculture and Agri-Food Canada Cereal Research Centre

Winnipeg, MB

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

Eastern Cereal and Oilseed Research Centre Ottawa, ON

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

Guelph Food Research Centre Guelph, ON

(in collaboration with the Universities of Guelph and Toronto)

- Developing products to determine effect of processing/storage methods on cholesterol lowering ability of oat β -glucans; studying effect

of β -glucans on glycemic response; and, determining relationships between physicochemical characteristics and functional properties and physiological effects of β -glucan and other non-starch polysaccharides (**P. Wood, T. Wolever**)

University of Alberta Edmonton, AB

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

University of Manitoba Winnipeg, MB

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

University of Saskatchewan Crop Development Centre

Saskatoon, SK

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

University of Toronto

Toronto, ON

- Studying effect of β -glucans on glycemic response (**T. Wolever**)

The Canadian Advantage in the Global Marketplace

Quality
is in our **nature**

Natural Resources • Canada's abundant natural resources are proven building blocks for a high tech industry that produces an array of high quality agri-food products.

World-Class Standards • Canada's regulatory and food inspection systems are internationally recognized, resulting in world-class standards and products that are safe, nutritious and high quality.

Innovative Research • Canada has developed a strong network of research facilities across the country where scientific innovators are focused on developing leading-edge products and new technologies.

Collaborative Teamwork • Collaboration among governments, health institutions, universities and industry has helped this vibrant sector prosper by encouraging innovation and manufacturing of diverse agri-food products with proven health benefits.

To learn more about Canada's functional food and natural health products industry, visit: www.agr.gc.ca

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The Pathfinders Research & Management Ltd.

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