OatWell® oat bran: Proven and advanced nutrition for your heart

ingredients

Oat (Avena sativa L.) is a typical northern cereal. As such, it prefers a wet, cold climate, with rain during the growing phase and sunshine and long hours of daylight during the harvest season. For approximately 2,000 years, oats and barley were staples of the diet in Nordic countries. Only at the beginning of the 19th century were oats partially replaced by other cereals and potatoes. The greatest virtue of oats is its 100% naturalness – the only grain not affected by the controversy around GMOs- and that the benefits are many. Oats not only contain the beta-glucans, but also antioxidants, plant sterols, protein and polyunsaturated fatty acids. Today, interest in oats is increasing, and it retains a strong image as a nutritious, health-promoting ingredient in food applications due to its high bioactive and functional component contents.

Significant positive health effects have been attributed to oat products, including cholesterol control, modulation of glucose and insulin responses, weight management, and improved gastrointestinal function. Probably the most well-recognized health-promoting ingredient from oats is ß-glucan, a soluble fiber[25,43]. Most consumers today are aware of proven and advanced nutrition and the specific benefits they provide in improving well-being and lowering risk factors for diseases such as coronary heart disease. The approvals in Finland and the Netherlands, Sweden and UK of health claims for oat beta-glucans is expected to stimulate NPD activity and begin to lever open the door to a Europe-wide health claim [4,13,18,31,40].

Chemistry of oat ß-glucans

Oat ß-glucans are nonstarch polysaccharides. Like starch, they are composed of glucose molecules in long chains, but the binding between glucose monomers differs from starch. In starch, the glucose monomers are connected by α-bonds: amylose has α-(1➛4) bonds, whereas amylopectin, in addition to long glucose chains with α-(1➛4) bonds, also has α-(1➛6) bonds that initiate side chains. The two α-bonds in starch are easily digested by enzymes in the intestine.

Cellulose is also a polysaccharide and is composed of long chains of glucose molecules bound by ß-(1➛4), which produces a straight molecule. The intestine does not contain enzymes that can digest these ß-(1➛4) links. Cellulose is a nonsoluble fiber, because the long, straight chains are closely packed and water molecules cannot penetrate and dissolve the fibers.

Oat ß-glucans, like cellulose, are linear glucose polymers, but oat ß-glucans have both ß-(1➛4) and ß-(1➛3) links, creating a cellulose chain with ß-(1➛4) links interrupted by ß-(1➛3)–linked glucose units. Approximately 70% of the links are ß-(1➛4), and the rest are ß-(1➛3). The distribution is not random: the (1➛3) linkages always occur singly, and most of the (1➛4) linkages occur in groups of three or four. The intestine does not contain enzymes that can digest oat ß-glucans, so they are by definition a fiber[41].

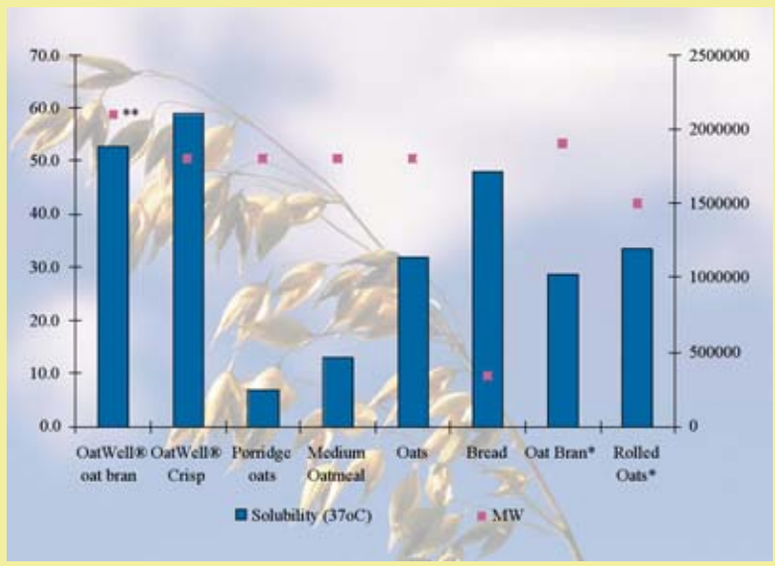
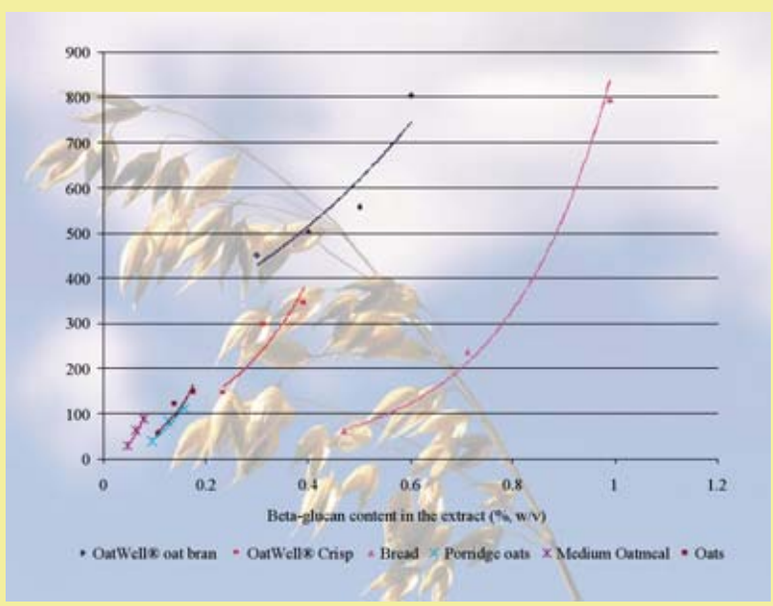


*Fig. 1. Molecular weight (MW) and solubility of ß-glucans extracted by digestive enzymes at 37°C and hot water from OatWell® oat bran / commercially available oat products / oat bran, and rolled oats. *, Data from Beer and coworkers (6); **, MW and solubility[2,3,6,37]. ß-Glucans were analyzed according to AACC Approved Method 32-33 and AOAC Official Method 995.16.*

Fig. 2. Apparent viscosity of soluble fiber extract physiological 37°C after in vitro digestion[2,6] from OatWell® oat bran and commercially available oat products at increasing ß-glucan concentration in the extract.



Physical properties of oat ß-glucans

The mixed linkages that form oat ß-glucans are important for their physical properties, such as viscosity and solubility. The presence of two types of linkages prevents compact folding of oat ß-glucan chains, making them soluble in water. The (1➛3)–linked residues result in kinks in the otherwise ribbon-like shape of the molecule, allowing water to penetrate and solubilize the fiber[11]. The longer (1➛4) sequences are believed to be responsible for the partial water insolubility properties of oat ß-glucans, because they provide surfaces that are capable of forming junction zones[42]. Oat ß-glucans are asymmetric molecules that assume an extended conformation in aqueous solution, best described as worm-like chains[16]. One theoretical model[10] describes ß-glucans in solution as an extended random coil.

Oat ß-glucans are large molecules. Available data on molecular weight distribution vary between 2.68×10^4 and 3×10^6 g/mol[33,35,37]. These variations probably depend on differences in raw materials, processing, and methods of determination[1,3,6]. Even at low concentrations in water solutions, oat ß-glucan molecules interact, causing marked resistance in water flow and creating a viscous solution. If the concentration is high enough, a gel is formed through associations between molecules.

Increased viscosity is a fundamental character-istic of oat ß-glucan solutions and has an important impact on their physiological behavior in the intestine and, thus, their physiological function. Viscosity plays an important role in cholesterol-lowering effects and glycemic response. Solubilisation and the molecular weight of ß-glucans influence viscosity and bioavailability[2,3,6,45]. Viscosity is mainly determined by molecular weight but also by molecular structure, resulting from the distribution of (1➛3) and (1➛4) links. In conclusion: To maintain functional attributes, the food containing oat ß-glucan must be controlled during processing and in food matrices. The physiological effects of oat ß-glucan glucan depends at least in part on the viscosity and not only on the amount of ß-glucans. Therefore it is critical not only to know the ß-glucan concentration, but also the solubility, viscosity and molecular weight of ß-glucans in the product[2,3] (Figs. 1 and 2).

Effects of oat ß-glucans on glycaemic response

Rapidly Digested Carbohydrates. Many of the foods we eat today contain carbohydrates that

are digested and absorbed very rapidly from the intestine into the blood stream, causing a high glycemic response or glycemic index (GI) and rapid secretion of insulin from the pancreas. Increased insulin levels are believed to be a key factor in the development of several diseases. Studies show positive metabolic effects of diets containing carbohydrates that are slowly digested in the intestine and have a low GI. Epidemiological data suggest that a low-GI diet may help prevent type II diabetes[38,44], cardiovascular disease[22], and metabolic syndrome[27] and may reduce insulin resistance[27].

The World Health Organization (WHO) and Food and Agriculture Organization (FAO) recommend that people in industrialized countries base their diets on low-GI foods in an effort to reduce some of the diseases associated with high-GI diets, such as coronary heart disease, diabetes, and obesity[42].

Soluble Fiber. Fibers can be classified into two groups based on water solubility. In contrast to insoluble fibers, which have no significant effect on viscosity in the small intestine, water-soluble oat ß-glucans exert their effects mainly by increasing viscosity in the small intestine. In the intestine, oat ß-glucans absorb fluids and contribute to viscosity during digestion, resulting in an extended digestion period. When digestion is delayed, blood sugar in-creases more slowly, causing a low insulin response. The effect has been established[5,9,17], but the course of events causing the effect is not fully understood. One hypothesis is that in the intestine food is "incorporated" in the viscous oat ß-glucan solution making it more difficult for enzymes in the intestine to degrade the food components and causing digestion to take longer. Another hypothesis is that oat ß-glucans form a protective layer along the intestinal wall that acts as a viscous barrier, slowing food uptake from the intestine.

Blood cholesterol and oat ß-glucans

Substantial clinical evidence from the last 40 years has documented that oat ß-glucans have an effect on blood cholesterol levels and control of lipoprotein metabolism[8,34,39]. At the level of statistical significance, biological relevance can be attached to very small changes in a marker. This is exemplified by reference to blood cholesterol levels (total cholesterol, LDL-cholesterol) in which, at the population level, a few percent change has large implications on the risk of coronary heart disease[31]. Oat ß-glucans are believed to favorably affect blood cholesterol and lipoprotein metabolism mainly by increasing viscosity in the small intestine. There are different theories concerning the mechanisms of the blood cholesterol lowering effect of oat ß-glucans. One theory[26] proposes that the viscous oat ß-glucans encapsulate bile acids, resulting in their excretion in the feces. Bile acids generally are recycled, i.e., they are taken up in the lower part of the intestine and used again. Through excretion in feces, the body loses bile acids and has to synthesize new ones, which is done in the liver. The building block for bile acids is cholesterol, which the liver extracts from the blood, decreasing blood cholesterol levels. Another hypothesis[20] is that fermentation of soluble fiber by bacteria in the large intestine produces propionate. The propionate is then absorbed by the colon cells and goes to the liver, where it is thought to have an effect on cholesterol synthesis. A third theory is that oat ß-glucans interfere with the absorption of lipids, probably by reducing or delaying the emulsification and lipid hydrolysis process.

Oat ß-glucans as prebiotics

The lower part of the intestine, the colon, has been identified as a key organ affecting general health. The growth and metabolism of the many individual bacterial species inhabiting the colon depend primarily on the substrates available to them, most of which come from the diet. Oat ß-glucans, which are indigestible in the small intestine but are fermented by bacteria in the colon, are prebiotics[24].

Prebiotics are nondigestible food ingredients that selectively stimulate the growth or activities of bacteria in the colon. They beneficially affect a series of intestinal functions by modulating the structure, composition, and metabolic activity of mucosa and microflora in the colon. The end products created from prebiotic fermentation in the colon are short-chain fatty acids, e.g., butyric acid, that serve as nutrients for mucosal cells.

Oat ß-glucans and weight management

Satiety is a complex bodily sensation that signals that the stomach is full and it is time to stop eating. When consumed 20–30 min before eating a meal, oat ß-glucans form a thick viscous fluid in the stomach and small intestine that stimulates the sensation of satiety and helps limit appetite. By reducing the desire for food intake, the effect can help in weight control when combined with a healthy, balanced diet and adequate exercise. As a result of the extended period of digestion, nutrients are utilized by the body over a longer period and, thus, may contribute to a longer period of satiety in weight management programs[23,36].

OatWell® oat bran

High-quality oats are grown in Scandinavia and Canada. Highly selective technology and careful processing controls are used to produce natural, consistent OatWell® oat bran ingredients with high total dietary fiber (44%) and ß-glucan (up to 22%) contents. To maintain functional attributes, it is important that the processing of oat kernels into oat bran, which has an elevated concentration of ß-glucans, does not destroy the ß-glucan structure[15,28,29]. The level of oat ß-glucans is significantly higher compared with other oat and oat bran products. Viscosity, solubility and molecular weight are important production control parameters [1,36]. Over the last 10 years, numerous clinical trials have proven the physiological effect of OatWell® oat bran on cholesterol reduction and blood sugar response[5,7,14,17,19,21,30,32,38,46] (Figs. 3 and 4). Applications for the functional attributes of OatWell® oat bran include fiber applications for cardiovascular health, energy enhancement, moderation of GI, and weight management.

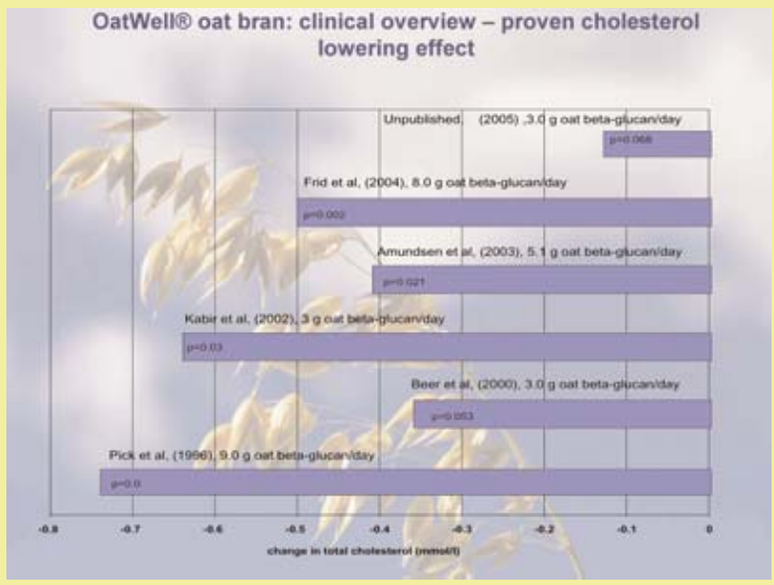


Figure 3

OatWell® oat bran: clinical overview – glycemic response

References	Study Design	Conclusions / Results
Björck et al, 2002	Glucose and insulin response in healthy subjects, following a bread-based breakfast with and without muesli containing OatWell®	Blood-glucose level: lower peak-concentration (- 36%) blood-insulin level: lower peak-concentration (- 44%)
Jenkins et al, 2002	Depression of the glycemic index by high levels of beta-glucan OatWell® fiber in two functional foods tested in type 2 Diabetes	In a 50g carbohydrate portion each gram of OatWell® ß-glucan reduces the GI by 4 units
Kabir et al, 2002	Four-week low-glycemic index breakfast with a modest amount of soluble fibers in type 2 diabetic men	Intake of a low GI OatWell® breakfast lowered postprandial plasma glucose peaks, as well as glucose and insulin response
Battilana et al, 2002	Mechanism of action of beta-glucan OatWell® in postprandial glucose metabolism in healthy men	OatWell® mechanism of action was shown as the result of delayed and reduced carbohydrate absorption
Ribordy et al, 1997	Effect of pre-exercise cereal bar rich in oat bran OatWell® on gastrointestinal transit and glycemia	Pre exercise bar rich in OatWell® dispenses glucose slowly and does not induces hypoglycemia
Tappy et al, 1996	To determine the effect of increasing doses of OatWell® in extruded cereals	A 50% decrease in glycemic response is estimated to occur with 5 g ß-glucan from OatWell®
Pick et al, 1996	OatWell® oat bran bread products improve long-term control of diabetes	Reduction of 46% in the total glucose response from OatWell®

Figure 4

Innovative uses for OatWell® oat bran in food applications

Compliance with existing dietary guidelines would be greatly improved if common food products rich in oat ß-glucans were available. Primaliv® a new product has been introduced to the Swedish market, a 200-mL cup of low-fat yogurt with müsli in a top cup. The müsli contains 4 g of oat ß-glucans from OatWell® oat bran per serving. The effect of yogurt and müsli containing oat ß-glucans on blood sugar and insulin responses to a mixed breakfast meal was determined in clinical studies performed at Lund University (Sweden)[7]. The test meal significantly lowered blood sugar and insulin responses (GI) compared with a reference meal without oat ß-glucans. The difference was 36% and 44%, respectively. Primaliv® containing ß-glucans eaten together with high GI-foods, like white bread, produce a favourable blood sugar response to the whole meal.

The effect of Primaliv® on cholesterol and other blood parameters were also tested in a clinical study by Öresund Diabetes Team (Lund). The results showed a significant lowering of both total cholesterol (9.4%) and LDL (10.8%) compared with a control product[14]. The primary target group for the yogurt and müsli product is health-conscious consumers.

A new product will soon be launched to the Dutch market. The multi grain bread Vitaalbrood Pró-FIT® has successfully received the Code of Practice of the Voedingscentrum in the NL (40). 4 slices of Pró-FIT® bread per day containing 3 gr oat beta-glucan from OatWell® oat bran has proven to reduce the cholesterol significantly in comparison to commercial available bread. It means that the Voedingscentrum acknowledges that this Vitaalbrood Pró-FIT® has a positive effect on heart health. Vitaalbrood Pró-FIT® is the only bread that can make this scientifically proven cholesterol lowering claim. In general bread is a very important component of the Dutch daily food intake. Therefore the Pró-FIT® bread with its cholesterol lowering effect considerably adds heart health in comparison to commercial available bread.

A cholesterol lowering bread contributes to increasing awareness of the importance of a healthy diet and can have large implications on the risk of coronary heart disease at the population level[31,34].

Health claims for oats and OatWell® oat bran products

Approved Health Claims in the Netherlands. Since 1998 there has been an agreement for a Code of Practice in the Netherlands, concerning the scientific support for health benefits for food- and drinking products. This Code indicates guidelines that have to be satisfied for the scientific support of a health claim. The Code of Practice has been created by the Voedingscentrum, in close cooperation with consumer organisations, business organisations, institutes and the government[40]. The producers of food and drinking products can voluntary use this Code of Practice to scientifically prove the health benefit of the claim of their product. In 2005 The multi grain bread Pró-FIT® containing OatWell® oat bran has successfully received the Code of Practice of the Voedingscentrum.

Approved Health Claims in the United Kingdom. A scientific dossier was submitted to the U.K. Joint Health Claims Initiative (JHCI) on behalf of CreaNutrition-Swedish Oat Fiber concerning the use and application of oat ß-glucans in oat-based products and their association with reduced risk of cardiovascular disease. The JHCI Expert Committee and the JHCI Council confirmed 2004, that the totality of the evidence substantiated a health claim: whole oats, oat bran, OatWell® oat bran, rolled oats, and whole-oat flour, as part of a diet low in saturated fat and a healthy lifestyle, can reduce cholesterol. The soluble oat fiber, ß-glucans, may serve as a marker for oat products that are the subject of the claim. Products carrying the claim should contain at least 0.75g of soluble oat fiber (ß-glucans per serving), which is one-quarter of the suggested daily intake of 3g[18].

Approved Health Claims in Sweden. Today, both generic and product-specific claims are allowed. In 2001 regulatory guidelines were established that allow product-specific claims[4]. Product-specific claims must be based on scientific studies, the quality of which is guaranteed through a review process involving international experts.

In the Swedish market, a product-specific claim, that the product balances or evens out blood glucose levels (GI) after a meal, has been approved for Primaliv® a yogurt containing OatWell® oat bran. A generic claim in two steps about the blood cholesterol-lowering effect of oat beta-glucans has also been approved. The following statement is used on the product: "Soluble fibers may, as part of a healthy diet, contribute to healthy cholesterol levels. This product is rich in soluble oat fibers."

Approved Health Claims in the United States. In 1997, the U.S. Food and Drug Administration (FDA) reviewed 37 clinical studies concerning the effect of oat ß-glucans on blood cholesterol, especially the significance and dose-response of the effect. Based on the findings, the FDA approved the first food-specific claim for oat bran, authorising the use of a health claim that states "Soluble fiber from foods such as oat bran, as part of a diet low in saturated fat and cholesterol, may reduce the risk of coronary heart disease." The claim is based on a daily intake of 3g of oat ß-glucans, and the food product must contain at least 0.75 g per serving[13].

Summary

Oat products have a strong image as nutritious, health-promoting ingredients in food applications due to their high bioactive and functional component contents. Probably the most well recognised health-promoting ingredient from oats is ß-glucan, a soluble fiber. Significant positive health effects have been attributed to oat ß-glucans, including cholesterol control, modulation of glucose and insulin responses, weight management, and improved gastrointestinal function. As a component of oats, ß-glucans can be incorporated into a wide variety of innovative food products.

A significant lowering of plasma LDL (up to 10 %) cholesterol may be achieved with daily consumption of approximately 3g of ß-glucans[34]. A 30–50% reduction in blood glucose peak can be achieved when ß-glucans constitute 8–10% of the carbohydrates in a food product[46].

Approved claims differ from country to country but are permitted in the United States. At the EU level the concept of enhanced function claims (such as may lower cholesterol levels) and disease risk reduction claims (such as reduced risk of CVD) has started to gain wider acceptance and is included in some national guidelines such as those of Belgium, Finland, Netherlands, Sweden and the UK. A proposal for a regulation on nutrition and health claims on foods is under discussion. This regulation is intended to harmonise provision/action on Member States related to health claims and consumer protection. Furthermore a European commission concerted action – the Process for the Assessment of Scientific Support for Claims on Foods (PASSCLAIM) had the following principal objectives:

- to evaluate existing schemes which assess scientific substantiation;
- to produce a generic tool for assessing the scientific support for health claims for foods;
- to establish criteria for markers which can be used to explore the links between diet and health. The scientific substantiation of claims according to the PASSCLAIM [31] criteria might require substantial studies in humans. This may be particularly true for oat product specific claims (NL, SE) but the criteria are also applicable to the substantiation of generic claims (SE, SF, UK,) that can be made on a range of products containing oat ß-glucans.

Nature has created

an excellent grain product. we don't need to change it. just use it. It has been in our diets for hundreds of years and we have survived eating it – that should be a very good sign.

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