Bhartiya Krishi Anusandhan Patrika, 36(4): 350-352 DOI: 10.18805/BKAP366

Oats as a Functional Food

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Received: September 2021 Accepted: December 2021

ABSTRACT

Oat (*Avena sativa*) belongs to the grass (Poaceae) family. It has been recognized as a healthful and nutritious cereal containing high concentration of soluble fiber compounds such as β-glucan, which are beneficial for digestive system and preventive against colon rectal cancer help to maintain an optimal weight due to high fiber content. It also contains antioxidants, vitamins, phenolic acids sterols and phytic acid which has essential role in our body functioning. The key cholesterol lowering ingredient in oats is soluble fiber. β-glucans, the most important cereal non-starch. β-glucan, is abundant in oat kernels and exhibits a high viscosity at relatively low concentrations. Viscosity is an important rheological property of β-glucan and is associated with beneficial physiologic responses that mediate appetite regulation. Oats were traditionally eaten as porridge with salt or sugar were added recent modern product innovation has created an array of oat products (Oat breads, oat cakes and oats milk *etc*.). Oats are used as an additive in cereal breakfast, baked goods, oat milk and oat powder is incorporated in many dairy products like (low-fat ice creams, yoghurts, cheese and other fermented drinks). It is stated that 3 g/day oat β-glucan reduced the total and LDL cholesterol by five to ten per cent.

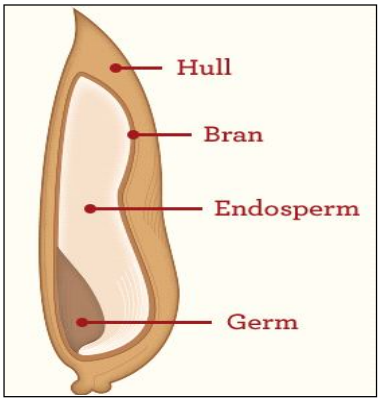
Key words: β-glucan, Cholesterol, Oat, Oat kernels.

There has been an increasing interest in the health enhancing role of specific foods or physiologically active food components, so-called functional foods. Actually, all foods are functional, as they provide taste, flavor or nutritive value. Recently, the term functional when applied to food has adopted a different connotation, which of providing an additional physiological health benefit beyond that of meeting basic nutritional needs (Ahmad *et al.,* 2014).

The present report reviews about the nature of oats as related to the properties that might alleviate or reduces the blood total cholesterol, diseases such as diabetes and cardiovascular diseases *etc.*

Oat ranks around sixth in the world cereal production statistics following wheat, maize rice, barley and sorghum. Oats are grown on the foothills of Himalayas, such as Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Haryana, Rajasthan, Bihar, Gujarat, Andhra Pradesh and Tamil Nadu (Bhagmal and Chaubey, 2006). Oats belongs to the family of *Poaceae*its botanical name is *Avena sativa.* About 6% of oats grains are used for human nutrition. Food uses for oats include oatmeal, oat flour, oat bran and oat flakes for use as breakfast cereals and ingredients in other food stuffs. In India, oats have a wider adaptability, particularly in western and north western regions of the country because of its excellent growing habitats, quick re-growth and better nutritional value (Ahmad *et al.,* 2014).

Oat grain structure



Composition of oats

Oats have many therapeutic properties and are best known for their high protein and fiber content along with cholesterol plummeting abilities. The nutritional value of oats proteins is higher than that of other cereal protein due to the lower prolamine protein (Hamad and Fields, 1979). Compared to other cereals, oats are known to contain high amount of lipids. Most of the oat fatty acids are unsaturated (Sahashtrabudhe, 1979). The oleic acid portion of oat lipid is exceptionally high among cereal lipids (Saastominen *et al.,* 1989). The three most abundant fatty acids - palmitic ($C^{16:0}$), oleic ($C^{18:1}$) and linoleic ($C^{18:2}$) acids accounts for 90-95% of the total fatty acids in oats (Table 1).

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Health benefits

Oat (*Avena sativa*) is an excellent source of different dietary fiber components of mixed-linkages (1→3),(1→4)-β-D-glucan arabinoxylans and cellulose. The neutral cell wall of polysaccharide β-glucan has outstanding functional and nutritional properties. It achieves high viscosities at relatively low concentrations and is of particular importance in human nutrition. In nature β-glucans naturally occur as cellulose in plants, the bran of cereal grains (oats, barley), the cell wall of yeast, certain fungi, mushrooms and bacteria.

In 2010, the European Food Safety Authority (EFSA) has also authorized health claims according to which oat β-glucan ingestion leads to reduction of blood plasma cholesterol concentrations, which is a major risk factor for the development of coronary heart disease and the recommended daily intake was 3 g oat β-glucan and the claim can be used for the food products (portion) containing at least 1 g.

Reduces cholesterol level

Food and drug administration (FDA) in the USA allows the use of a generic health claim for oat and oat products mentioning the cholesterol lowering effect of soluble fiber (β-glucan) and the reduction in the risk of coronary heart disease (FDA, 2004).

Controls blood sugar level

The positive effects of β-glucan on post-prandial blood glucose have been reported in several studies (Tapola *et al.,* 2005). The potential physiological mechanism behind the efficacy of β-glucan are suggested to be its ability to retard the absorption rate of food in the intestine due to increased viscosity.

Reduces weight

Oatmeal adds volume to the food by absorbing the liquid around it. The fiber slows down the digestion process and gives a feeling of being full for longer periods of time.

Improves quality of sleep

Oatmeal contains higher amounts of essential amino acid tryptophan. It is a source material for creating melatonin (as well as serotonin). A lack in melatonin causes sleeping problems while an increase in tryptophan will prolong the deep sleep (Dallarie and Ruckbusch, 1974).

Anti-HIV activity

Anti-HIV activity of β-glucan is also reported. Sulfated β-glucan derived from oat bran exhibits anti-HIV activity (Wang *et al.,* 2008). This would reduce HIV-1 transmission by preventing virus cell entry.

Other bioactive compounds

Besides β-glucan, the most well-known health promoting compounds such as fatty acid, sterols in lipids and other minor bioactive compounds like phenolic compounds are also present, which enhances the healthy image of oats phenolic compounds and tocols. They are mainly regarded as responsible for antioxidant activity (Forssell *et al.*, 1990). The main focus is on the hydroxycinnamic acid, avenanthramides and tricin. Various epidemiological studies have suggested that consumption of plant food products containing high concentrations of phenolic compounds can prevent cancers, stroke and coronary heart diseases (Steinmetz and Potter, 1996).

Traditional commercial oat products

Oats are used as ingredients in many food products. Traditional commercial oat products include Rolled oats, steel-cut groats, Quick oat flakes, Baby oat flake, Instant oats, Oat bran and Oat flour (Norja and Lehtinen, 2008).

- **Rolled oats:** By flaking whole groats and thickest of the standard oat-flake products.
- **Steel-cut groats:** By sectioning groats into several pieces; they are used in the preparation of flakes and flour.
- **Quick oats:** Flakes produced from steel-cut groats.
- **Instant oat flakes:** Produced from steel-cut groats, but the flakes are thinner and have fine granulation than quick oats.
- **Oat flour:** Produced by grinding flakes or groats into flour for use as an ingredient in wide variety food products.

Innovative oats products

Typically oat products are rolled oats, oat bran and oat flour. At present the new oat lines with high levels of β-glucan are being evaluated (Yoa *et al.,* 2006).

Cereal breakfast

Cereal preparations for breakfast, or various cereal delicacies with fruit flavour as well as the products with coffee, cocoa and chocolate flavour in the shape of flakes have already experienced a great success in the market. There are 10-12 varieties of breakfast cereals available in India, that contain oat as a major ingredient.

Porridge

Porridge is well known product to enjoy the pleasant, mild taste of oats. A new type of porridge mixture consisting oat flake blends with berries and fruit, is available in market.

Baked goods

Oats are added to many baked goods such as bread and biscuits, pasta, snack bars. In these products oats are often added to introduce the cholesterol-lowering effect, to affect

Table 1: Chemical composition of oats (Gopalan *et al.,* 2007).

Composition	% per 100 gm
Protein	13.6
Fat	7.6
Minerals	1.8
Fiber	3.5
Carbohydrate	62.8
Calcium	50 mg
Phosphorous	380 mg
Iron	3.8 mg

the absorption of glucose, to introduce technological functionality such as water binding or to provide oat flavour.

Oat milk

Oat milk is free of lactose, provides minerals and vitamins like potassium, phosphorous, B-group vitamins, vitamin E, vitamin A and phytochemicals which can protect against diseases including cardiac arrest and cancer (Chu *et al*., 2013). Oat milk is the second most common vegetable milk in Europe. It provides about 4% fiber and 0.4% of β-glucan.

Dairy products

Oats fractions have also been added to milk based products. Oats β-glucan fractions have especially been used in low-fat milk products such as low-fat ice creams, yoghurts and cheeses (Brennan *et al.,* 2002). The β-glucan fractions seems to be beneficial on the structure and mouth feel of these products beside providing fibre which the milk products lack.

Other products

Active research and development has already created new liquid or high moisture oat based foods, oat ice cream, oat pancake mix and meal replacement drinks (Mikola, 2004). Oats are widely used in infant powders, cereal bars, chocolate bars and many more.

CONCLUSION

Oats is major sources of β-glucan, recognized as the main functional component of cereal fibers. Numerous scientific studies proved the hypocholesterolaemic effect of this compound and to an overall effect of reduced cardiovascular disease risk. Oat flavour is highly accepted by customers; thus oat ingredients can be considered to be ideal for delivering the health promoting properties in variety of consumer products. The consumption of oat β-glucans at 3 g/day reduced total and LDL cholesterol by five to ten per cent.

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