



## **Importance of Oats in Human Diet: A Review**

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### **ABSTRACT**

*The primary role of diet is to provide enough nutrients to meet metabolic requirements, while giving the consumer a feeling of satisfaction and well-being. Health awareness has grown to a greater extent among consumers and they are looking for food with healthy counterparts. Oat is becoming more popular as part of a healthy diet. Utilization of oats for human consumption has increased progressively, owing to its dietary and health benefits which relies mainly on the total dietary fibre and  $\beta$ -glucan content, which significantly reduces postprandial blood glucose, insulin and blood lipids and therapeutically active against diabetes, hyperlipidaemia, hypertension and inflammatory state. The major components of oats that contribute to its function include  $\beta$ -glucan, protein, oil, and starch, minor components including tocopherols and avenanthramides that have antioxidant properties. Keeping these things in view, the present review focuses the functional value of oats in human diet with their mode of action against various diseases.*

**Keywords:** Oat, Dietary fiber, Prebiotics, Functional foods, Health benefits.

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### **INTRODUCTION**

Oat (*Avena sativa*), a minor and cool season crop that has been used as a foodstuff for both humans and livestock for millennia. Russia, Canada, US, Finland and Poland are the leading oat producing countries. It is a staple crop of Germany, Ireland, Scotland, and the Scandinavian countries [8]. Oat is among the important crop of the world and ranks sixth in the cereal production after maize, wheat, rice, barley and sorghum [14]. In India, oat is locally known as "jau", major producers are Punjab, Haryana, West Bengal, Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Rajasthan and Maharashtra. The total area covered under oats cultivation in the country is about 5 lakh ha. The crop occupies maximum area in Uttar Pradesh (34%), followed by Punjab (20%), Bihar (16%), Haryana (9%) and Madhya Pradesh (6%) [31].

Oat is among the valuable functional crops with numerous nutritional, industrial and health benefits. It is an excellent source of dietary fiber  $\beta$ -glucan and are easily available food source that are incorporated into the diet. Oats along with soluble fiber  $\beta$ -glucan are rich in lipids, protein, B vitamins, minerals, plants, fats,  $\alpha$ -tocopherol [12, 18] and specific micronutrients and also it acts as a unique source of polyphenols (avenanthramides) [38, 10]. It is also an excellent source of energy, unsaturated fatty acids [16] and volatile compounds [18] and lower in carbohydrates than other whole grains.

Oats are well known for providing healthy nutrients to humans [26]. Healthier breakfast options such as oats are getting increasingly popular at the breakfast tables of Indian homes. As per a recent Nielsen India report on Indian breakfast consumption habits, oats occupies a 26 per cent share in the Rs.720-crore breakfast cereal market. Indian oat market has shown the growth of 38% in the last one or two years. Nutritionally oats are an excellent source of soluble fiber  $\beta$ -glucan and the content of  $\beta$ -glucan in oats is in the range of 2-6 % [7].

Oat  $\beta$ -glucan have high therapeutic properties like it acts as anti-carcinogen, it has anti-atherogenic activity, it maintains the blood sugar/diabetes, it helps in regulating bowel movement regularly, it reduces the hypertension, it improves the gut health etc. results in the prevention and treatment of

various types of diseases. These  $\beta$ -glucan have received considerable attention from the medical community for its role in reducing blood cholesterol, which helps in prevention of heart diseases. Nutritionists recommend increased daily intake of fiber, such as an oat bran, because it assists in regulating gastrointestinal function. Administration of oat may also help to reduce appetite and weight gain. Various studies have shown  $\beta$ -glucans reduces body weight [34].

Other than therapeutic and nutritional properties of oats, it is also used in the preparation of different types of oat based products like oat flakes, pastes, bakery products, beverages etc. several breakfast cereals and bakery products. It also helps in the controlling the texture of various food products and have been used as a fat replacers in dairy, meat and bakery products [15]. Another use of oats is in the dairy industry as an antioxidant and stabilizer in ice cream and other dairy products. Many workers used oat  $\beta$ -glucan in the manufacture of cheddar and white-brined cheeses [39]. Oat  $\beta$ -glucan due to its thickening and/or gelling properties is used in the food industry; it may also influence the sensory quality of beverages.

### **OAT IN FUNCTIONAL FOODS**

Today's fast life style is changed from the previous one in which people used to consume natural food products. Now-a-days the trend has been changed, due to the lack of time people used to consume more and more convenient food products that are not always good for their health like refined food products, junk foods, fast foods etc., so for fulfilling the nutritional demand and for providing healthy food a need of new generation of food products i.e. functional foods has been created. In simple words, functional foods are those which provide health benefits beyond basic nutrition [17]. A food can be regarded as a 'functional' if it is satisfactorily demonstrated to effect beneficially one or more target functions in the body, beyond adequate nutritional effects [1], in a way that is relevant to either an improved state of health and well-being and/or reduction of risk of diseases.

Oats are used in the functional foods due to their increased attention for their beneficial health aspects and as it is a good source of  $\beta$ -glucan, essential amino acids, antioxidants and other essential nutrients [32] is of immense importance in human nutrition. Recent studies suggests that  $\beta$ -glucan plays a vital role in human physiological processes such as moderating the effect of hypertension, regulating blood glucose as well as insulin levels, weight managements and promoting gastrointestinal health which indicates the usefulness of oats in food products. Oats have various health and nutritional benefits and due to this various types of new oat products emerge as the functional food market [33]. Most of the probiotic food products at the markets worldwide are milk based and very few attempts are made for developments of probiotic foods using other food substrates such as cereals like oats, barley etc. as a raw material due to their high nutritive value for using in functional foods [2]. In India, there is acute shortage of healthy milk foods obtained from oat. The large distribution and important nutrition value of oats have increased the attention on their use as raw materials for the development of fermented functional foods.

### **OAT AS A PREBIOTIC**

Cereals are one of the most suitable substrates for the developments of foods containing probiotic microorganisms [22]. Oats have prebiotic properties due to the presence of non-digestible components of cereal matrix [23], which makes it as a good substrates for the growth of probiotic bacteria. Prebiotics are non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon thus improve host health [3]. Oats are found to be the good substrates for the growth of probiotic microorganisms due to the presence of non-digestible components  $\beta$ -glucan which serves as a prebiotics [16]. Oat  $\beta$ -glucans acts as a prebiotic, are indigestible in the small intestines but are fermented by intestinal microflora in the colon [14] and stimulates the growth of some beneficial residential colon microorganisms [19], and has a positive influence on the health of the host. Prebiotics are being added to the food products to stimulate the colonic microflora to get health benefits to the consumers, besides providing textural attributes to the foods. Oats are used as a suitable substrate for fermentation with lactic acid bacteria after appropriate processing [27, 21].

Some workers developed the enzymatically treated oat bases as substrates for lactic acid bacteria fermentation with dairy starter cultures [28]. Functional dairy products offer benefits to health that are strengthened by the addition of probiotics as well as by certain types of soluble fibers. Established amount of dietary fibers for claiming health benefits are at least 3-6 % (w/w) in solid foods and 1.5- 3 % (w/w) in liquid foods. When oats as a prebiotics are used in combination with probiotics or live bacteria, the resultant has synergistic effects, referred to as synbiotic product, this is because in addition to the action of probiotics that promote the growth of existing strains of beneficial bacteria in the colon. As prebiotics promote the growth and activity of probiotics so it has an obvious potential for synbiotic effect

of probiotics and prebiotics. Synbiotics are the combination of the effects of prebiotic and probiotic for promoting health benefits [37]. Prebiotics such as  $\beta$ -glucan also act to improve the survival, implantation and growth of added probiotics strains. As prebiotics promote the growth and activity of probiotics so it has an obvious potential for synbiotic effect of probiotics and prebiotics.

Prebiotics beneficially affect the series of intestinal functions by modulating the structure, composition and metabolic activity of mucosa and microflora in the colon. The end products formed from prebiotic fermentation in the colon are short chain fatty acids, e.g. butyric acid, which provides nutrition to mucosal cells [26]. In the gastrointestinal tract, oat  $\beta$ -glucan as a prebiotic that is selectively fermented by butyrate producing microorganisms.

## OATS AND HEALTH

Eating oats in our daily diet provides a wide range of important health benefits and due to this oats is becoming popular as a part of the healthy diet [2]. Oat grains are packed with nutrients and impart valuable health benefits. Oat bran is a valuable source of  $\beta$ -glucans [5] and reported to be effective in lowering the plasma cholesterol and postprandial serum glucose levels and also helps in the reduction of risk of coronary heart diseases. The recommended daily intake of oat  $\beta$ -glucan by FDA for achieving health effects is 3g/day or 0.75% per portion should be consumed [32].

Oat have been reported for its several beneficial effects in patients of diabetes mellitus [8, 9], hypertension [25], infection [40, 29] and cardiovascular diseases [13]. The low glycaemic index of oat products is especially important for diabetes and the ingestion of  $\beta$ -glucan containing viscous foods is reported to affect the level of fat emulsion in the gastrointestinal tract and reduces lipase activity. When the  $\beta$ -glucan fermentation occurs in the colon, low molecular fatty acids releases which preconditions its potential anti-carcinogenic effect [35, 2]. Some of the health beneficial properties of oats are described below:

### 1. Cholesterol and oats

Oats are the significant sources of dietary fiber (both soluble and insoluble) [36, 8] and other important nutrients which are essential for human body. One components of the soluble fiber found in oats is  $\beta$ -glucan, which has proven effective in lowering blood cholesterol [4]. Consumption of oat  $\beta$ -glucan may reduce total blood and low-density lipoprotein (LDL) cholesterol levels [6]. Oat soluble fiber  $\beta$ -glucan break down as it passes through the digestive tract, forming the gel that traps some substances related to cholesterol-rich bile acids. This entrapment reduces the absorption of cholesterol into the blood stream. A major proposed mechanism is that dietary oat  $\beta$ -glucan forms a viscous layer in the small intestine. The viscous layer attenuates the intestinal uptake of dietary cholesterol as well as the reabsorption of bile acids (which the body makes from cholesterol). In response, the body draws upon the pool of circulating cholesterol to produce new bile acids. Lower uptake of cholesterol from the gut combined with more bodily cholesterol used for bile acid production results in reduced levels of cholesterol circulating in the blood. Daily consumption of  $\beta$ -glucan of at least 3g may reduce total plasma and LDL cholesterol levels [30] by 5-10 % respectively.

Oats grains are also one of the best sources of compounds called tocotrienols. These are antioxidants which together with tocopherols form vitamin E. These tocotrienols inhibits the cholesterol synthesis and have found in lowering the blood cholesterol. The accumulation of cholesterol is implicated in many types of cardiovascular disease. Oats are more effective as cholesterol lowering agents when consumed as a part of a low-fat, high fiber diet. New research has also discovered that the antioxidants found in oats reduce cholesterol by reducing the ability of blood cells to stick to the inside of artery walls.

### 2. Diabetes and oats

Oat  $\beta$ -glucan has beneficial effects in diabetes or blood sugar as well [9]. Oat fiber rich foods when given to diabetes patients, shows much lower rises in blood sugar. Thus, eating oats can reduce the blood sugars over a longer period of time. It is essential to control blood glucose and insulin levels for preventing many of the problems associated with diabetes. Oat  $\beta$ -glucan slows the rise in blood glucose levels following a meal and delays its decline to pre-meal levels. As the  $\beta$ -glucan is soluble fiber of oats is digested, it forms a gel, which causes increase in the viscosity of the contents of the stomach and small intestine [20]. This results in slows down digestion and prolongs the absorption of carbohydrates into the blood stream [14]. This means dramatic changes in blood sugar levels are avoided.

### 3. Cancer and oats

Oats having the certain hundreds of phytochemicals (plant chemicals), that can reduce the risk of cancer when consumed. Many organizations associated to cancer recommends oatmeal as a beneficial part of healthy diet for controlling the risk of cancer. Fiber present in the oats reduces the risk of colon cancer, phytoestrogen compounds (called lignans) present in oats have been linked to decreased risk of diabetes, hypertension, obesity [14], hormone-related diseases such as breast cancer and many more

compounds are present in oats which prevents from different types of cancers and acts as anti-carcinogenic agents. The vitamins and minerals contained in oats will fight against the cancer cells in the body. According to Harvard study, consumption of oats will reduce the polyps count in the colon cancer patients. International research has shown that women with a higher intake of dietary fiber have lower circulating oestrogen levels, a factor associated with a lower risk of breast cancer. The insoluble fibers in oats are also thought to reduce carcinogens in the gastrointestinal tract.

#### **4. Blood Pressure and oats**

High blood pressure (BP) is defined as having a systolic BP greater than 140 mm Hg or a diastolic BP greater than 90 mm Hg. Oats also helps in maintaining the blood pressure of the host. Consumption of oat soluble fiber can reduce hypertension or high blood pressure and so reduce the need of hypertensive medication. Oats may help maintain healthy blood pressure by improving the glycaemic and insulinemic profiles [14]. Addition of oat cereals to the normal diet of the persons suffering with hypertensive significantly reduces both systolic and diastolic blood pressure. Soluble fiber-rich whole oats may be an effective dietary therapy in the prevention and treatment of hypertension. Dietary consumption of oats is associable with the DASH (Dietary Approaches to Stop Hypertension) recommendations, and may confer a health benefit due to its fiber content [11].

#### **5. Oat improves bowel function**

Oats are rich in dietary fiber and these fibers are necessary in keeping bowel movements regular. Oats are high in both soluble and insoluble fiber. The insoluble fibers does not dissolve in water but it is spongy and absorbs many times its own weight of liquid. These insoluble fiber makes stools heavier and speeds their passage through the gut, relieving constipation.

#### **6. Oat helps in Weight Control**

Satiety is a type of sensation which gives signal to the stomach that it is full and it is time to stop eating. When oat soluble fibers  $\beta$ -glucans is digested in the stomach, it forms a gel which increases the viscosity of the contents in the stomach and small intestine that stimulates the sensation of satiety and helps limits appetite. The gel delays stomach emptying making you feel full longer which helps with weight loss. When the desire for food intake is reduced, this helps in the control of weight when consume with a healthy, balanced diet with adequate exercise [14]. It have been reported that the children who ate oatmeal were 50% less likely to become overweight, when compared to those children that did not eat it. Few research's suggests that children between ages 2-18 years old who have a constant intake of oatmeal lowered their risk of obesity. Like other cereal grains, oats are also valued primarily as a source of carbohydrates which provide calories for energy needs. Oats have positive effects on the performance of the athletes when consumed regularly. Oat protein has also been found to be more satiating than isoenergetic amounts of carbohydrate or fat [24]. Oats have been shown in scientific studies to favourably alter metabolism and enhance performance when ingested 45 min to 1 h before exercise of moderate intensity.

#### **7. General Health and Longevity**

Oats have a higher concentration of well-balanced protein than other cereals, it also contains a good balance of essential fatty acids, which have been linked with longevity and general good health. Oats contain phytochemicals which have been associated with protection from chronic disease such as cancer. Oats also contains the best amino acid profiles of any grain, these amino acids are essential proteins that helps in facilitating optimum functioning of the body. Oat  $\beta$ -glucan also appears to help speed up retardation response against infection, which may result in faster healing.

### **CONCLUSION**

Oats are considered as the biggest contender in the category of super-food for providing numerous health-facilitating properties and nutritional benefits. Oats are considered as the 100% whole grain food, as it provides carbohydrates, protein, vitamins, minerals, several antioxidants and is also one of the richest dietary sources of the soluble fiber  $\beta$ -glucan. Oats are high in fiber and have low GI it means that they can help in weight reduction by maintaining the feeling of being "full" for longer. Consumption of oats in the recommended amount provide any number of health benefits to the host. Oats has a great potential for use in functional foods for their beneficial approved health claims to the human health and these oat related health claims could likely to rise in the future.

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