Nutritional and Medicinal Benefits of Oats (*Avena sativa*)

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Abstract

Oats (*Avena sativa*), a high-nutritional cereal grain, have become a global superfood due to their adaptability and disease resistance. They have been used for medicinal purposes since ancient times, treating skin ailments, relaxing nerves, and energizing people. Scientific research supports these claims, leading to its increased use in cosmetic and nutritional supplements. Oats are also used in functional foods due to their heart-healthy properties. They come in various forms, including whole groats, rolled oats, and steel cut oats. Oats are popular in vegan and plant-based diets due to their mineral content and adaptability. They are also used in various foreign cuisines, including South Asian and Middle Eastern recipes. Some challenges include cross-contamination, allergies, and insufficient research on their healing properties, making their use difficult. Future research should focus on modern techniques of genetic engineering to create allergic and contaminated free oat varieties to strengthen its nutritive value.

Keywords: Oats, Nutritious, Therapeutic, Gluten-free, Global consumption

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Introduction

Oats (*Avena sativa*) have been cultivated for centuries as a robust cereal grain, initially used for animal fodder and later appreciated for human consumption due to their high nutritional value. Originating from Eurasia, oats have evolved from being a humble crop to a superfood recognized worldwide. Their adaptability to diverse climates and resistance to disease make them a reliable dietary staple (Sterna et al., 2016). Originally it was considered as the third innovations in agricultural technology, for example, higher yield varieties of seeds, better quality of irrigation equipment, pesticides, herbicides, fungicides all have cumulatively helped the world cereals during the last few decades and made oats valuable crop as winter crop in cooler and less fertile soil. Its cultivation is thought to have begun in Asia Minor around 1000 BC before migrating to Europe and other temperate climates where it proved indispensable as a human and animal food source. Originally, oats were used and considered only as a staple food but due to their increasing value in today's society, they are considered as superfoods (Alemayehu et al., 2023).

Oats today are an acknowledged functional food staple across many countries with health-bringing values for the consumers. Incorporation in diets is not restricted by the culture or geographical location being a benefit with more flexibility in use when cooking (Mao et al., 2021). As a part of general health promoting foods and as medicinal food, oats have been used from time immemorial in Ayurveda and traditional Chinese medicine. Other ailments for which they have been used include skin diseases, digestive disorders, and stress related complaints, hence the non-energy role of fats. In traditional medicine, oats were employed for their calming, anti-inflammatory, and nourishing properties, while modern scientific research has substantiated many of these claims (Kumar et al., 2021).

This chapter provides a thorough insight into the nutritional and medicinal importance of oats and their significance as functional food. Using its bioactive compounds like β-glucans, antioxidants and nutrients of concern, this chapter seeks to appropriately explain how beneficial oats is to health. Furthermore, their involvement as preventive and alternative treatments for chronic disorders including cardiovascular diseases, diabetes and obesity will be explained to illustrate their relevance in contemporary diets and pharmacological uses.

2. Nutritional Composition of Oats

Oats are well accepted as a nutritious cereal grain offer major macronutrients, micronutrients and bioactive compounds that play a vital role in human nutrition. Because of their profound harmony in all diets, they are used as a source of energy, and possess therapeutic qualities. Subsequently, the present chapter cast light on macronutrient, micronutrient, and phytochemical content in oats (Singh et al., 2012).

Macronutrients

- **Carbohydrates**

Food rich in carbohydrates is present in oats and its macronutrient content shows that about 60–70% of the oats dry weight is composed of carbohydrates. Interestingly, while simple sugars are found simply in refined grains, oats contain largely complex carbohydrates which not only ensures slow digestion but gradual release of energy. Among the various aspects of the carbohydrate fraction of oats, the high content of

dietary fibers makes oats functional food that positively impacts human health (Kivelä et al., 2011).

This fiber forms a gel-like substance in the gut, which has following benefits:

Promotes Satiety: Beta-glucan slows down the rate at which the stomach empties, meaning that a consumer feels full for a longer time and therefore reduces the likelihood of taking other unhealthy meals (Chu et al., 2013).

Stabilizes Blood Sugar Levels: It helps minimize postprandial glucose rise, thus making oat great for use by people with diabetes or poor insulin sensitivity (Getaneh et al., 2021).

Reduces Cholesterol Absorption: Beta-glucan interacts with bile acids in the gut hence increasing its elimination while reducing LDL cholesterol concentration. Scientific research has shown that the lowering of total and, in particular, LDL cholesterol is possible if an individual takes in between three grams of beta-glucan each day (Angelov et al., 2018).

- **Proteins**

Oats have 10-15% protein, which is higher than that of rice, wheat or most other grains. The protein in oats is also the better kind, due to its moderate profile for essential and non-essential amino acids. It consists of vital amino acids including lysine which is usually scarce in other grains. This special property improves the solubility and utilisation of oat proteins that will make them even more attractive for vegetarians and vegans aiming to get protein from plant sources. While it is quite similar to gluten, avenin – the principal protein in oats, is considered to be slightly less allergenic; thus, oats should be considered safe for those with mild gluten intolerance. However, those with celiac disease, to reduce health risks, must take certified gluten-free oats as cross-contamination may occur during processing (Chen et al., 2020).

- **Fats**

Surprisingly, oats are low in fat, but contain an average of 5-7% fat that is mainly un-saturated fatty acids. These include; monounsaturated fatty acid known as oleic acid and polyunsaturated omega-6 fatty acid known as linoleic acid. Saturated and unsaturated fats are vital for cardiovascular health and their role includes participation in cell use and energy support. Oats also contain some of the essential fatty acids in trace and these are useful in skin health, brain incidents and response to inflammatory. The fat stability in oats is further helped by natural antioxidant present, to avoid rancidity and increase shelf life (Martínez-Villaluenga & Peñas, 2017).

Micronutrients

Oats are a rich source of essential vitamins and minerals that support various physiological functions.

- **Vitamins**

There is availability of thiamine (B1), riboflavin (B2), niacin (B3) and pantothenic acid (B5) in oats. These vitamins play vital roles in energy production metabolism where carbohydrates, protein and fats are broken down to usable energy. Thiamine is also needed for nerve function and for the brain. One of the peculiarities of the oat product is that as an antioxidant vitamin E is providing the memorized structures of cells and skin (Getaneh et al., 2021).

- **Minerals**

Oats are rich in Magnesium, Zinc, Iron and Selenium which are involved in 300 or more enzymatic reactions including muscular contraction, metabolism, bone formation, immune function, protein synthesis particularly for wound healing, DNA synthesis, making of hemoglobin, and the prevention of anemic condition in the body. Selenium acts as antioxidant and is involved in supporting thyroid function and defending cells from damage (Ratnasari et al., 2017).

- **Phytochemicals and Bioactive Compounds**

Phytochemicals are chemicals that are present in plants and bioactive compounds are those which are biologically active, in all natural systems, there are tens of thousands of such phytochemical/bioactive compounds. Oats have several other phytochemicals that make them a functional and medicinal food apart from the beta-glucan. These compounds include antioxidants; anti-inflammatory; and other benefits that have put these foods in the realm of functional foods (Martínez-Villaluenga & Peñas, 2017).

1. Avenanthramides

Avenanthramides are polyphenolic reported exclusively in oats that possess considerable antioxidant and ant-inflammatory potentials. These compounds help by reducing oxidative stress that preserve cellular structures from damage, lowering inflammatory markers that reduces the probability of diseases such as cardiovascular diseases and type two diabetes and Improve skin health by reducing the inflammation, also aids in the alleviation of dry skin disease including eczema. They also contribute to vascular health by increasing nitric oxide synthase activity leading to improved blood flow and reduced arterial stiffness. They have also been associated with increased exercise capacity by lowering muscle inflammation and damage and overall faster recovery after working out (Tripathi et al., 2018).

2. Alkaloids, Cardenolides and Glycosides, Flavonoids and Catechins

Both of these, combined with its soluble fiber content, give oats its saponin and phenolic acid content and boosts its antioxidant potential. These compounds have been linked to Cancer prevention by reducing the number of tumor cells and act in preventing DNA oxidation. Saponins display antibacterial and antiviral properties that help to enhance the immune protection machinery of the human body. Phenolic acids present in oats fed and promoted the growth of favorable gut microorganisms improving digestion and absorption of nutrients (Punia et al., 2020).

The enhancement of these bioactive compounds positively and complementarily, contributes to enhancing the general health value of oats. There are newer studies which show signs that they can also have neuroprotective effects and lower the likelihood of neurodegenerative

diseases including Alzheimer's. These nutritive and functional properties make this cereal grain a staple in functional and medical nutrition therapy for everything from heart to diabetes to neurological disorders (Rebello et al., 2016).

Medicinal Benefits of Oats

Today, oats have become familiar all over the world as a rich food the provides many medicinal values that have been research and proven. Due to their affordably and high nutritious value, they should be viewed as a healthful food (Kumar et al., 2021). It has several benefits for human health

Cardiac Health

Research evidence suggests that oats, particularly via their beta-glucan fractions, are central to the maintenance of healthy hearts. Beta-glucan is a fiber that dissolves in water to form a 'gel' in the gastrointestinal tract. It forms a complex with cholesterol contained in bile and decreases its absorption in the intestines. Because oats help promote the elimination of bile acids, it is useful in reducing both total cholesterol of the LDL variety while at the same time enhancing the levels of the HDL cholesterol. Also, oats have other useful elements such as antioxidants which lowers oxidative stress and inflammation, which are the leading factors of cardiovascular diseases. Blood pressure is another factor that keeps the heart healthy, and research has demonstrated that oat consumption three or more times a week lowers blood pressure. Therefore, adding oats into a heart- healthy diet can be very helpful for people with risks of atherosclerosis, myocardial infarction and other heart afflictions (Sandhu et al., 2015).

Digestive Health

Oats benefit the digestive system by containing a large amount of fiber and are also prebiotic. Oats have been postulated to be prebiotic since they feed only positive bacteria in the colon thus maintaining balance. The gut microbiome is vital for maintaining good health since it influences the ability of the body to break nutrients, have an improved immune system, and even have a healthy mind. An interesting feature of oat's fiber is insoluble one, it helps to provide the formation of hard stools as well as to regulate the movement. This makes oats especially recommendable for persons with constipation problems. Furthermore, since oats are loaded with soluble fiber, it aids in the control of ill effects relating to IBS wherein the fiber makes a gel-like lining in the stomach that eases digestion of gastrointestinal tracts (Ratnasari et al., 2017). Daily intake of oat also helps to prevent cases of colon and rectal cancer. The fibers reduce the time taken in the colon by the waste hence reducing the contact of the lining of the intestine with the carcinogens. Therefore, oat's function is very important in the healthy and disease-free good digestive system (Chen et al., 2020).

Blood Sugar Regulation

Oats are great for consumption for anyone that wants to manage their blood sugar level. One of the reasons is the explanation of their low GI, especially when rich in fiber and beta-glucan, which slow the digestion-absorption process. This kind of release saves the rush of blood sugar levels and low levels of energy, and acts as a reservoir of strength. Oats possess extra therapeutic qualities for type 2 diabetes because they increase the body's sensitivity to insulin. Oats are high in beta-glucan which forms a thickened pool of chyme at the small intestinal site delaying the uptake of glucose. Apart from effectively regulating postprandial glucose levels, this mechanism contributes also to the daily nutritional glycemic burden reduction. Incorporating oat into meal preparation and consumption can assist in lowing fasting blood sugar level in diabetic patients, modifying the glycated hemoglobin A1c level thereby improving the patient's appearance of this disease and decreasing the chances of giving rise to dangerous complications like diabetic neuropathy, nephropathy or cardiovascular diseases (Angelov et al., 2018).

Weight Management

Because of their high fiber and protein content, oats are worth being on weight loss' side. Collectively these nutrients contribute to the product's ability to support increased satiety and decreased total calories consumed. Beta-glucan soluble fiber found in oats swells and becomes a gel mass when consumed and in the stomach delays digestion and improves satiety. Due to their ability to control appetite and prevent hunger, oats means that people can easily stick to their calorie intake plans. Looking at investigations that have been conducted to assess the effects of oats in weight loss it was found that people who took oats had effective and long-term weight loss and improved body composition (Chu et al., 2013). The carbohydrates in oat are NS, Slow releasing carbohydrates, these keep a person energized throughout the day thereby eliminating cravings due to tiredness. Further, maintaining the need for nutrition density of oats to avoid compromising on nutrition when undertaking a weight loss regime. They are a source of macro-elements including magnesium, phosphorus and B group vitamin which are important in metabolism and other processes taking place during weight loss period (Rao et al., 2019).

Anti-Inflammatory Effects

Oats possess avenanthramides, evidence suggests that these polyphenolic compounds offer a rich anti-inflammatory profile. Some of these compounds have been evidenced to lower inflammatory biomarkers, including the C–reactive protein (CRP) that is linked to chronic illnesses. Owing to its anti-inflammatory property, oat intake may help to prevent arthritis, control cardiovascular diseases, and combat metabolic syndrome (Leonova et al., 2020).

Avenanthramides have a way of preventing the formation of different pro-inflammatory factors such as cytokines and interleukins. This mechanism plays an important role in avoiding the aggravation of chronic inflammation. Specifically, a decrease of CRP has been linked with the decreased risk of cardiovascular events, which ultimately creates other opportunities for oats in cholesterol control. It also posse antioxidant activity by defending cells from harm by what is known as ''free radicals." This is especially useful in arresting the complications in chronic ailments and improving the average life span. It prevents the oxidation, which is a source of free radicals, which can form peroxides and impair

cell functions, hence aging is improved upon by avenanthramides in oats, making oats functional foods for improved later life health. Furthermore, inflammatory response is reduced by oats when taken internally, while ground oatmeal paste can be used to treat skin inflammation such as eczema and psoriasis (Rao et al., 2019). Colloidal oatmeal, a preparation of finely ground oatmeal, has been investigated closely for its effectiveness in alleviating itching and inflammation of the skin in different skin conditions. That it forms a protective coating on the skin makes it even more ideal for medicinal use. Oats are also being researched in relation to neuroinflammation. This early research indicates that avenanthramides might beneficially decrease inflammation in the brain, which may help prevent neurodegenerative diseases like Alzheimer's or Parkinson's (Leonova et al., 2020).

Oats in Traditional and Modern Medicine

From the historical past, oats have been used comprehensively in different societies because of their therapeutic value. Many historical sources used oats in treatments for problems associated with the skin, for calming the nerves, and to generally invigorate a person (Hitayezu et al., 2015).

Soothing Skin Conditions

Use of oats to address skin conditions can be traced back to the folk medicine where oats' fine powder was added to baths to soothe itching and inflammation that comes with some skin conditions like eczema, psoriasis or insect bites. Mucilage content in the oat helps in the formation of skin protective layer, hence promotes skin repairing and moisturizing. Oat-based poultices were used for dressing minor wounds, ulcers, burns, and rashes because of their anti-inflammatory properties (Li et al., 2016).

Promoting Relaxation and Reducing Stress

Many people are acquainted with oat primarily due to its relaxation properties as an antidote to stress and anxiety. Fresh oat straw is the green tops of the oat plant and people made beers and teas from it for the nervous system. Both Ayurvedic and European herbal uses of oats for insomnia and enhancing mental alertness can be attributed to oats' mildly sedative activity (Leonova et al., 2020).

Modern Scientific and Technological Studies

New scientific studies have substantiated some of the folk beliefs as to the health-giving properties of oats, thereby increasing its uses in medicine. Currently, oats are used in preparations for the treatment of the skin, in vitamins and other nutrition supplements, hence leveraging on the medicinal value of oats is championed (Hitayezu et al., 2015).

Oat-Based Dermatological Products

Finely milled oatmeal or colloidal oatmeal is an important substrate in many cosmetic preparations. Research reviews show that it effectively alleviates atopic dermatitis, dry skin and sunburns. It contains antioxidant and anti-inflammatory effects that enhance skin barrier repair and cut out inflammation. Thus, oat lipids as well as extracts are used in creams and soap products to improve skin moisturizing and give them a calming property (Li et al., 2016).

Nutraceuticals and Functional Foods

Oats are famous in functional food particularly for their heart healthy claim. Beta-glucan is a soluble fiber and there is much evidence on its ability to reduce cholesterol levels. It also interacts with macronutrients in the human body and forms a gel like substance in the gut thereby decreasing intake of dietary cholesterol and has blood glucose regulating effects. Oat-based supplements and powders are positioned to have prebiotic impact making the gut healthier by stimulating the growth of specified bacteria (Raguindin et al., 2020).

Consumption Forms and Culinary Applications

Oats can therefore be said to fit into several diets, since it comes in many forms. It also makes sure that they can be incorporated in a vegan, gluten-free, and other diets. Further, its preparation methods can augment these values as well to its maximum capacity (Li et al., 2016).

Common Forms of Oats

- Whole oat groats which are the least processed form of oats contain bran, germ and endosperm providing the highest nutrients. It is consumed as a hot cereal for breakfast or used in salads and boiling dishes for hunters' meals (Mao et al., 2021).
- Rolled oats and steel cut oats are the common types of oatmeal, valued for their fast cooking and softness. Perfect for breakfast bowl, served with fruits, nuts, and seeds to make the day breakfast surprisingly healthy (Kumar et al., 2021).
- Oat milk, in which oats are ground with water and filtered out, has become the most popular plant-based milk. Filled with beta glucans it helps reduce cholesterol and is a renewable source of lattes, smoothies and cereal (Hitayezu et al., 2015).

Incorporation into Diverse diets

- **Vegan and Plant-Based Diets**

Oats are popular in vegan diets since they contain minerals, including iron, magnesium, and protein. Due to their ability to blend in with other ingredients, they can be employed in sports energy bars, vegetable protein burgers, and sweet treats (Michels et al., 2019).

- **Gluten-Free Options**

Oats do not contain gluten in its raw form, however during processing there is always a risk of cross contamination. For those people

suffering from celiac diseases or gluten intolerance, there are certified gluten-free oats meaning that they can benefit from oats in their diet (Li et al., 2016).

Cultural and Regional Cuisines

Not only in the Western world the oats are becoming part of the diet, but in many global cuisines the oats are being adapted. For instance, oat derived flat breads, soups and porridge are being commonly used in South Asian and Middle Eastern dishes (Xie et al., 2016).

Maximizing Nutritional Benefits

- Besides helping to soften the oats so it is easier on the stomach, soaking also decreases the levels of phytic acid which un-favorably impacts mineral absorption. Next up, overnight oats, which don't require cooking and thus hold their nutrients in their entirety (Singh et al., 2012).
- Enumerated cooking techniques include boiling or steaming which retain the nutrients in oats. Do not overcook in order to preserve their fiber and antioxidant nutrients inside them (Xie et al., 2016).
- When incorporating the milk or plant based during cooking it is for nutritional reasons especially because of the extra calcium and protein.
- Combining with Other Nutrient-Rich Ingredients enhance its nutritional benefits. One should take vitamin C-rich fruits such as berries along with oats to get better iron absorption. When nuts or seeds are added to the oat products, essential fats enhance the body's absorption of fat-soluble vitamins.
- Oat products may also come with added nutrients such as calcium, vitamin D, B12 and so forth, hence suitable for other elaborate diets (Michels et al., 2019).

Challenges and Future Directions

Oats are gluten free grains, however, contamination with wheat during processing may be tricky for persons with gluten intolerances or who suffer from coeliac disease. The reliability of production procedures and tough methods of certification are obligatory for preventing contamination and for providing consumers with pure oat products. Efforts are still being made to ensure that specific allergens present only in aisle three are eliminated from product offerings that could cause impacts to clients with allergy. The modern techniques of genetic engineering and selection provide a possibility to create oat varieties with more useful characteristics, for example, greater beta-glucan concentration or better antioxidant properties (Alemayehu et al., 2023).

Conclusion

Due to the diverse formats of consumption and the ability to be used in all contexts, oats form part of a diet in all societies and ways of life. Thus, incorporating oats into daily life, not only improves personal health, but also allows caring for the future and providing the body with really healthy and environmentally friendly foods. From a bowl of oatmeal to a health beneficial ingredient in many creative dishes, oats remain an addition to diets and a source of improved health in the world. The issues related to oats include allergy to the grain, cross contamination of gluten and lack of thorough research on the grain the expected challenges of androgenic development can help oats strengthen its role in nutrition and medicine further.

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