

Oat (*Avena sativa* L.): A Lesser known Cereal with Well Recognized Nutritional Potential

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Abstract

Oat (*Avena sativa* L.) is an incredible cereal gaining considerable attention now days. Oat grain is abundant in nutrients and health promoting compounds, making it suitable as food and feed. The oat grain has diverse content of nutrients, dietary fibers and phenolic compounds in comparison to other cereals which are beneficial to mankind. Thus, the core aim of this article is to provide insight and comprehension about the nutritional status of oat and their impact on human health.

Keywords: Nutritional composition; Food; Health; Oat; Phenolic compounds.

Introduction

Oat is one of the oldest and major cereal crop in the world since the beginning of civilization. Oat rank around sixth in the world's cereal production statistics following wheat, maize rice, barley and sorghum. In India, this crop is well adapted to a diverse range of soil and primarily grown in *rabi* season. It is widely grown in Uttar Pradesh, Madhya Pradesh, Haryana, Punjab, Himachal Pradesh, Rajasthan, Bihar, Gujarat, Andhra Pradesh and hilly tracts of southern plateau. The multifunctional uses of oat include forage, fodder, straw for bedding, hay, haylage, silage and human food. Oat grain can be for both animal and human consumption [1]. Oat is well suited to cultivation by small holders since they can be grown and harvested with same simple equipment that is used for rice and wheat. Their seed is easily produced, so farmers do not have to buy often and farmer to farmer sales have greatly accelerated the spread of improved cultivars. Now days there are an increasing preference among consumers for foods that contain not only traditional nutrients but also provide other compounds that are beneficial to health and well-being. Oat consumption among humans increases due to its dietary benefits and superior nutritional value [2].

Origin, distribution and morphology

The center of origin of oats is Asia Minor. The cultivated oat

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Avena sativa L. ($2n=6x=42$), a natural allopolyploid, together with wild weedy hexaploid species like *A. sterilis* and *A. fatua*, have evolved through repeated cycles of inter specific hybridization and polyploidization, combining three distinct diploid genomes. All the hexaploid species have a genomic constitution of AACDD [3]. The distribution of different wild and weedy species is confined mainly to the temperate regions of northern hemisphere. The countries bordering Mediterranean, Turkey, Iran, Iraq and parts of the USSR are rich in the diversity of species. The plant is typical graminaceous. The main stem produces a number of tillers. Primary tillers arise in the axils of the older basal leaves of the main stem. Secondary tillers arise in the leaf axils of primary tillers. The leaves differentiate from nodes and are narrow and unstalked, arranged in two rows alternately on opposite sides of the stem. The inflorescence is compound comprising of a series of flowering branches with spikelets. The inflorescence terminates the stem in the form of a panicle. Within the spikelet the flowers develop acropetally. The spikelet consists of 2-3 slender tapering florets borne alternately in two rows on opposite sides of a very short axis, the rachilla. Thus, the floret includes the rachilla, the lemma or flowering glume, the palea, and there productive organs. The organs of reproduction consist primarily of the three stamens, their filaments and anthers, the single ovary with its style and the bifid stigma. The margins of the smaller palea are embraced by the lemma which

has a rounded back and may carry an awn. Anthesis, the anthers dehisce and ripe pollen is shed on to the feathery stigma. Oat is a self pollinated crop [4].

Nutritional composition of oat

Oat whole grain has received great attention nowadays due to their high nutritional value and provides starch, proteins, unsaturated fatty acids, vitamins, minerals, phenolics and significant amount of β -glucan dietary fibre.

Table 1: Composition of oat.

Component	Availability in oat (%)
Starch	60%
Protein	Total: 11-18%
	Globulins: 80 % of total protein
	Prolamins: 15 % of total protein
	Glutelin: 5-66% of total protein
	Albumin: 1-12 % of total protein
Lipid	5-9%
Dietary fibers	β -glucan: 2.3-8.5%
Phytochemicals	α -Tocotrienols and α -tocopherols:
	86–91% of total tococls
	Phenolic compounds: 5.7%
	Avenanthramides:
	AVA1: 2.1-4.3%
	AVA3: 2.8-6.2%
	AVA4: 2.5-4.7%
Trace Minerals	Calcium: 0.54%
	Iron: 0.047%
Vitamins	Thiamine: 0.002%
	Riboflavin: 0.001%
	Niacin: 0.032%

Source: Rasane et al. (2013).

Relevance of oat in context of other cereals

Cereal grains of wheat, maize, and rice are food staples for the majority of human societies. People mainly depends upon wheat and rice for daily diet components. Oat grain is beneficial over wheat and rice as it contains high content of nutritional compounds. According to "USDA database" oat grain contains more protein (16.9 g) than wheat (12.61 g) and rice (7.1 g). Oat grain contain higher lysine content (limiting amino acid), crude fat (containing essential fatty acids i.e. linoleic acid. The micro-nutrients iron (5 mg), calcium (54 mg), zinc (4 mg) is higher than in wheat (Fe 3.19 mg, Ca 29 mg, Zn 2.65 mg) and rice (Fe 0.8 mg, Ca 28 mg, Zn 1.09 mg). It is also a good source of nutraceutical compounds like beta-glucan, dietary fibers, polyphenols, vitamins and antioxidant. The β -glucan content (2-8 gm) in oat is more than in wheat (0.5-1.0 gm) and rice (0.13 gm) [5].

Oat as a potential source of nutraceuticals

India, one of the most populous country, suffers from "hidden hunger" and lots of health problems. The people of India don't get enough nutrients required to lead healthy productive lives from the food that they eat and resulted in stunting growth, diseases and even death. Nutraceuticals are food or part of

food playing a significant role in maintaining normal physiological function and directly provide health benefits. The principal reasons for the growth of the nutraceutical market worldwide are the current population and the health trends. Wheat, buckwheat, oat, barley, flaxseed, brown rice are the most common cereal based functional foods and nutraceuticals. The food products used as nutraceuticals can be categorized as dietary fibre, prebiotics, probiotics, polyunsaturated fatty acids, antioxidants and other different types of herbal/ natural foods. These nutraceuticals help in combating some of the major health problems of the century such as obesity, cardiovascular diseases, cancer, osteoporosis, arthritis, diabetes, cholesterol etc. Oat has been considered as 'supergrain' as it offers potential health benefits due to the presence of excellent amount of β -glucan content and believed to reduce plasma cholesterol, blood glucose and prevent coronary heart disease [6]. Oat β -glucan is a non-starch linear polysaccharides, unbranched and composed of D-glucose unit joined by β (1,3:1,4) linkage. The polymer is composed of short stretches of cellotriosyl (DP3) and cellotetraosyl (DP4) units joined by (1 \rightarrow 3) linkages. The random distribution of cellotriosyl and cellotetraosyl units and presence of (1 \rightarrow 3) linkages leads to twists in polymer chain, allowing water to get in between the chains and makes β -glucan more soluble in water. Due to soluble in nature, its intake promotes water absorption and swelling in the gastrointestinal tract, which might be prevent the absorption of blood glucose and cholesterol. The β -glucan content in oat ranges from 2.3 to 8.5 g /100 g [7]. The Food and Drug Administration (FDA) has accepted a health claim stating that a daily intake of 3 g of soluble oat β -glucan can lower the risk of coronary heart disease [9]. Oat is a good source of phenolic compounds. Traditionally, polyphenols are considered potent antioxidants. The major phenolic acids in oats are ferulic, p-coumaric, caffeic, vanillic, hydroxybenzoic acid and their derivatives. Oats are known for a unique group of antioxidants reported among cereals known as avenanthramide (AVA) and have 10-30 times more antioxidant activity than vanillin and caffeic acid. Studies reported that the AVAs might possess anti-inflammatory and antiatherogenic properties and also involved in controlling the blood pressure, as they produce nitric oxide which dilates the blood vessels [8].

Future perspectives

Oat grain has been referred to as 'supergrain' because they are better adapted to diverse environmental conditions and have high nutritional potential. However, limited research occurs in oat as a nutraceutical crop. Development of oat varieties having high nutritional potential could achieve success in combating hidden hunger and chronic diseases.

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