

Millets: Magical Health Promoting Nutritious Crops

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Introduction:

Indian millets are a group of nutritiously rich, drought tolerant and mostly grown in the arid and semi-arid regions of India. They are small-seeded grasses belonging to the botanical family Poaceae. They constitute an important source of food and fodder for millions of resource-poor farmers and play a vital role in ecological and economic security of India. These millets are also known as "coarse cereals" or "cereals of the poor". Indian Millets are nutritionally superior to wheat and rice as they are rich in protein, vitamins and minerals. They are also gluten-free and have a low glycemic index, making them ideal for people with celiac disease or diabetes. Millet production has remained relatively stable over the past few years, with an estimated production of 28 million metric tons in 2020. The majority of millet is produced in Africa, followed by Asia. India is the largest producer of millet, followed by Niger and China.

Millet is a drought-tolerant crop that can be grown in dry, arid climates where other crops would fail. It is also a nutritious grain that is high in fiber and essential minerals. For these reasons, millet will continue to be an important food crop in the years to come. In many states of India they are using different varieties of millets respectively. All the millets are three to five times higher in their nutrition content when compared to nutritional content of widely used rice and wheat. Wheat and rice provide with security of food while millets give many securities like food, health, nutrition, livelihood, animal feed etc, making millets as yield of agricultural security. Millets are having nutritional and also health benefits and they also help in managing health problems like diabetes mellitus, hyperlipidemia, etc. (Veena, 2003). In India, Karnataka is the leading producer of millets. Over 58% of global production is millets, but very few Indians are acquiring the knowledge of its health benefits and their nutritional value. (Upadhyaya et al., 2007)

Nutritional Quality of Millets

The nutritional content of food is an important factor in the maintenance of a human body's metabolism and wellness. The nutritional content is critical for developing and maximizing the human genetic potential. Millet's nutrition is comparable to major staple cereals (rice, wheat, and maize), since they are an abundant source of carbohydrates, protein, dietary fiber, micronutrients, vitamins and phytochemicals. Millets provide energy ranging from 320–370 kcal per 100 g of consumption (Table 1). Millets have a larger proportion of non-starchy polysaccharides and dietary fiber compared to staple cereals and comprises 65–75% carbohydrates. Millets with high dietary fiber provide multiple health benefits such as improving gastrointestinal health, blood lipid profile, and blood glucose clearance. Millets with minimal gluten and low glycemic index are healthy options for celiac disorder and diabetes (Sharma et al., 2018). Millets are also rich in health-promoting phytochemicals such as phytosterols, polyphenols, phytocyanins, lignins, and phyto-oestrogens. These phytochemicals act as antioxidants, immunological modulators, and detoxifying agents, preventing age-related degenerative illnesses such as cardiovascular diseases, type-2 diabetes, and cancer. A study (Azad M.O.K et al., 2019) reported that millets contain about 50 different phenolic groups and their derivatives with potent antioxidant capacity, such as flavones, flavanols, flavononols, and ferulic acid. A significant amount of phenolic components, which are important antioxidants in millets, are found in bounded form in proso and finger millet and in free form in pearl millet (Azad M.O.K et al., 2019). Another study Chandrashekhar et al., 2010 reported that proso millet comprises various phytochemicals such as syringic acid, chlorogenic acid, ferulic acid, caffeic acid, and p-coumaric. It has also been reported that almost 65% of the phenolics are present in the bound fraction. The presence of these phytochemicals and important antioxidants indicates the potential benefits of millets to human health. A detailed summary of the nutritional profile of selected Indian millets is discussed below and highlighted in Table 1.

Table 1 Nutritional profile of millets in comparison with cereals (per 100 g).

Grains	Energy (kcal)	Protein (g)	Carbohydrate (g)	Starch (g)	Fat(g)	Dietary Fiber (g)	Minerals (g)	Ca (mg)	P (mg)

Sorghum	334	10.4	67.6	59	1.9	10.2	1.6	27	222
Pearl millet	363	11.6	61.7	55	5	11.4	2.3	27	296
Finger millet	320	7.3	66.8	62	1.3	11.1	2.7	364	283
Proso millet	341	12.5	70.0	-	1.1	-	1.9	14	206
Foxtail millet	331	12.3	60.0	-	4.3	-	3.3	31	290
Kodo millet	353	8.3	66.1	64	1.4	6.3	2.6	15	188
Little millet	329	8.7	65.5	56	5.3	6.3	1.7	17	220
Barnyard millet	307	11.6	65.5	-	5.8	-	4.7	14	121
Maize	334	11.5	64.7	59	3.6	12.2	1.5	8.9	348
Wheat	321	11.8	64.7	56	1.5	11.2	1.5	39	306
Rice	353	6.8	74.8	71	0.5	4.4	0.6	10	160

Source: Indian Food Composition Tables and nutritive value of Indian foods

Millet wise Nutritional profile:

- Proso millet has a higher nutritional value when compared with staple cereals as it contains a higher concentration of minerals and dietary fiber (Table 1). Proso millet is a rich source of vitamins and minerals such as iron (Fe), calcium (Ca), potassium (K), phosphorus (P), zinc (Zn), magnesium (Mg), vitamin B-complex, niacin, and folic acid. Proso millet contains essential amino acids in significantly higher quantities, except for lysine, the limiting amino acid. However, proso millet has an almost 51% higher essential amino acid index than wheat (Kalonova et al., 2006). Moreover, the products prepared from proso millet exhibit a lower glycemic response than staple cereal-based products. A review reported that products prepared from proso millet show a significantly lower glycemic index (GI) compared to wheat- and maize-based products (Das et al., 2019).

- Pearl millet shows an energy value comparable to the staple cereals. Pearl millet contains a lesser amount of carbohydrates than the staple cereals, and it mainly contains high amylose starch (20–22%), and the insoluble dietary fiber fraction helps in exhibiting a lower glycemic response. Pearl millet protein is gluten-free and contains a higher prolamin fraction, making it suitable for people with gluten sensitivity. The amino acid score in pearl millet is good; however, it is poor source of lysine, threonine, tryptophan, and other sulphur-containing amino acids (Nambiar et al.,2011). Pearl millet is high in omega-3 fatty acids and also important nutritional fatty acids such as alpha-linolenic acid, eicosapentaenoic acid, and docosahexaenoic acid. It also contains other micronutrients such as Fe, Zn, copper (Cu), K, Mg, P, manganese (Mn), and B-vitamins (Zhang et al.,2014).
- Kodo millet provides an energy value similar to the other millets and staple cereals. However, with the exception of finger millet, the protein content of kodo millet is lower than that of other selected millets and it provides gluten-free protein (Table 1). Kodo millets contains high amounts of vitamins and minerals, especially B-complex vitamins, B6, niacin and folic acid, Fe, Ca, Mg, K, and Zn. Kodo millet is very easy to digest and thus can be beneficial for infant and geriatric product formulation.
- Foxtail millet has a greater nutritional value compared to major cereals such as wheat and rice due to its copious dietary fiber content, resistant starch, vitamins, minerals, and essential amino acids, except for lysine and methionine, but it is richer than most cereals. Among the selected millets, foxtail millet contains the highest protein (Table 1). Foxtail millet also contains a high amount of stearic and linoleic acids, which helps in maintaining a good lipid profile.
- Finger millet has the highest carbohydrate content among the selected millets. However, carbohydrates consist primarily of slowly digestible starch, dietary fiber, and resistant starch and thus offer a low glycemic index compared to most common cereals such as rice and wheat (Gull et al.,2014). Finger millet contains around 7% protein (Table 1), which is less than that of other millets, but it has a good amino acid score and contains more threonine, lysine, and valine than other millets. Subsequently, micronutrients such as Ca, Fe, Mg, K, and Zn, as well as B-vitamins, especially niacin, B6, and folic acid, are abundantly available.

- The nutritional value of little millet is comparable to other cereal and millet crops. It contains around 8.7% protein and balanced amino acids, and it is a rich source of sulphur-containing amino acids (cysteine and methionine) and lysine, which is lacking in most cereals (Neeharika et al.,2020). It is generally considered to induce a lower glycaemic response due to the presence of abundant dietary fiber, resistant starch, and slowly digestible starch (Patil et al.,2020). It is also a good source of micronutrients such as Fe, P, and niacin. Recently, many value-added products have been prepared using little millet to capitalize on the health benefits of little millet.

Health Benefits of Millets

Table 2 Shows health benefits of different types of millets. In present scenario people are very conscious about health. Millets are hidden source for health promoting phytochemicals, and antioxidant as nutraceuticals as well as functional food

Types of millets	Health benefits
Finger millet	Inhibit cataract eye lens, Lower plasma glucose level, Antimicrobial activity against Bacillus cereus and Aspergillus, flavus
Foxtail millet	Anti hyperglycemic activity
Proso millet	Improved HDL, Lower triglycerides, Prevent cardiovascular disease
Kodo millet	Inhibit glycation and cross linking of collagen leads to inhibition of aging
Pearl millet	Inhibiting the growth of the phytopathogenic fungi
Barnyard millet	Improved the levels of HDL
Little millet	Inhibitory effects on lipid peroxidation

Millets- Diabetes

Millets have ability to reducing glucose by enzymatic hydrolysis of complex carbohydrate in hyperglycemia. The aldose reductase enzyme helps in preventing accumulation of sorbitol and decrease the risk of diabetes. Millets also help in controlling sugar level in blood and delay wound healing process (Rajesh Keran N S et al., 2004). The whole grain foods are consumed to be effective for the prevention and management of diabetes mellitus, and showed that millet intake population epidemiologically lower of



diabetes (American Diabetes Association 2005; Shobana and others 2009; Kim and others 2011). Some studies find out on humans (male & female) the effect of millet grains and their effect on diabetes. Results showed that persons who has taken millet in diet, found to decrease the level of blood glucose (Pradhan et al., 2010).

Millets – Cancer

Millets are rich in antinutrients such as phenolic, tannins and phytates which help in reducing the risk of cancer. It contains phenolics which effective for the prevention of the cancer initiation and progression (Chandrasekara, A. et al., 2011). Millets contains linolic acid which helps in preventing tumor . Sorgam has anticarcinogenic properties and antimutagenic property due to presence of tannins and polyphenols (Grimmer et al., 1992). Millet grains are rich in phenolic acids, tannins, and phytate that act as “antinutrients” (Thompson 1993). A recent study has showed that phenolics of millets may be effective in the prevention of cancer initiation and progression in vitro (Chandrasekara and Shahidi 2011).

Millets – Celiac disease

Celiac disease is a genetically problem associated with consumption of gluten one of the component of cereal grain mainly in wheat. Millets are gluten free which help to decrease irritation of other cereal grains (Saleh et al., 2013). Millets are gluten-free foods and beverages that can be suitable for celiac disease person. (Taylor and others 2006; Taylor and Emmambux 2008; Chandrasekara and Shahidi 2011, 2011).

Millets – Heart Disease

Millets are good source of magnesium which helps in reducing heart attack. Millets are rich in phyto-chemicals which help in lowering cholesterol and prevent cardio vascular disease (Lee et al., 2010). Millets have a good source of protein and essential amino acid, micronutrient and phytochemicals. It plays significant role as health promoter and also help in preventing diabetes, hyperlipidaemia, etc. (Veena, 2003).

Conclusion

The millets are considered as nutraceutical due to its amazing nutritive value and health benefits over other cereals. Now it is an established fact that the whole world is facing many health challenges because of fiber-less foods. It is also clear to 1000s of patients that all the lifestyle diseases can be made to disappear just by eating millets for breakfast, lunch and



dinner and removing refined foods like rice, wheat, refined flours, processed meats, refined oils, packed & ready to consume -kind of foods and milk. Millets have multiple health benefits to include these ancient prized grains-like seed in our regular diet. Most of the civilized people have not even heard about millets and much less understand the benefits of millet nutrition. And yet, millet is one of the best-kept secrets of our ancient ancestors. Traced back to its origin in China, millets have been used throughout the ages and across many countries. The aim of this study is to help the people to recognize the importance of food and to introduce the millets as a nutritious food, fulfilling the nutritional need of global population and to find ways to consume the millets nutritionally, effectively and to reduce the problems of malnutrition and other health problems. All the millet foods are having significant health benefits, with their rich content of nutrients like fibre which helps in metabolic disorders like Diabetes, Obesity, Cardiovascular diseases etc, their good protein content which helps in child growth and development, with calcium content which helps in the bone development in both children and geriatric people, with good iron content helps in ailing of anaemia and with gluten free characteristics helps the celiac disease patients and helps in gluten insensitivity.

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