

Review Article

Nutritional and Nutraceutical Importance of Minor Millets: A Review

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ABSTRACT

World is facing agrarian as well as nutritional challenges. Agricultural lands with irrigation facilities have been exploited to maximum, and hence we need to focus on dry lands to further increase grain production. Millets as climate change compliant crops score highly over other grains like wheat and rice in terms of marginal growing conditions and high nutritional value. Millet is an alkaline forming grain that is gluten-free. Millets are also rich sources of phytochemicals and micronutrients; they play many important roles in the body immune system. Millets have medicinal and nutraceutical properties in the form of antioxidants which prevent deterioration of human health such as lowering blood pressure, risk of heart disease, obesity, prevention of cancer and cardiovascular diseases, diabetes and decreasing tumor cases etc. Millets cultivation can keep dry lands productive and ensure future food and nutritional security. Minor millets are an important traditional food with tremendous nutritional and medicinal application but, less concern about the importance of minor millets among the people. This review focused on to evaluate the medicinal efficacy of minor millets for document a good reference for further research on minor millets to develop the novel drugs for healthy society.

Keywords

Millets, Dry lands,
Nutrition,
Nutraceutical,
phytochemicals,
Micronutrient
deficiency

Introduction

Minor millets are small coarse of grains belonging to the group of forage grass called millet (Weber 1998), belongs to the family poaceae; most of the genera belongs to the sub-family panicoideae, that can grow in extreme ecological conditions (Seetharam *et al.*, 1989). Millets are small-seeded grasses that are hardy and grow well in dry zones as rain-fed crops, under marginal conditions of

soil fertility and moisture. They account for <1% of global cereal production and 3% of coarse cereal production. India, Niger and China are the largest producer of millet in the world, accounting for more than 55% of global production.

As per the FAOSTAT, global millet production for the year 2019 was 27.8 million tonnes. India is the largest global producer with a 41.0 % global market share. Millets

are considered as crop of food security because of their sustainability in adverse agro-climatic conditions. These crops have substantive potential in broadening the genetic diversity in the food basket and ensuring improved food and nutrition security. Millets are consumed primarily as food in most of the developing countries. It is highly nutritious, high energy food, and in recent years, an important component of processed foods. Along with nutrition millets offer health benefits in daily diet and help in the management of disorders like diabetes mellitus, obesity, hyperlipidemia, cancer etc. Millets are having unique advantage for health, being rich in micronutrients, particularly minerals and B vitamins as well as nutraceuticals.

Major millets are sorghum and pearl millet. Among the millets, small millet comprises finger millet (*Eleusine coracana*), kodo millet (*Paspalum scrobiculatum*), foxtail millet (*Setaria italica*), barnyard millet (*Echinochloa* spp.), proso millet or white millet (*Panicum miliaceum*) and little millet (*Panicum sumatrense*).

Though millets are not the important part of daily diet of American and European people, now these countries have recognized the importance of millets as ingredient in multigrain and gluten-free cereal products. However, in many Asian and African countries millet is the staple food of the people in millet producing areas and used to prepare various traditional foods and beverages like *idli*, *dosa*, *papad*, *chakli*, *porridges*, breads, infant's food and snack foods.

Whilst a number of traditional foods are made in the domestic household, the lack of large-scale industrial utilization discourages the farmers raising millet crops. Therefore, many countries Including India, China, USA etc. have now started research projects to

study and develop process technology for nutritional improvement, health benefits and to promote their utilization as food on large scale.

Medicinal importance of minor millets

India occupies the first position in major production of minor millets, but we have less aware of their importance and its nutritional property (Ahmed *et al.*, 2013). Millets are highly nutritious and has antioxidant properties which provide balanced nutrition (Vandana Misra *et al.*, 2014). Pearl millet consists of secondary metabolites like tannins, flavonoids, terpenoidse, glycosides, phenol and steroids. Based on its pharmacological properties, it can cure several health problems like cancer, diarrhea and cardiovascular diseases (Hellen Mueni Ndiku and Hellen Mueni Ndiku and Mutuku Chrispus Ngule,2015). Also finger millet is considered as one of most important minor millet, due to its high nutritional content which includes calcium, iron, magnesium, potassium, zinc (Sonia Plaza-Wutrich *et al.*, 2012).Magnesium in millets can help reduce the effects of migraines and heart attacks. Fiber from whole grains has been shown to protect against breast cancer and whole grains have been shown to protect against childhood asthma. Calcium present in the finger millet is higher than the other nutrients and when compared to rice, finger millet is rich in protein, iron content and other medicinal properties (Singh and Raghuvanshi, 2012) which have been presented in the Table 1.

Finger millet

Finger Millet is one among the most nutritious cereals and is a good source of natural calcium which helps for bone strengthening and helps in reducing the risk of bone fractures. On daily consumption of whole grain of finger millet and its products

can protect against the risk of cardiovascular diseases, Type II diabetes and gastrointestinal cancers and other health issues (Mckeown *et al.*, 2002). It is milled with the testa which is generally rich in dietary fiber and micronutrients to prepare flour (Devi *et al.*, 2014). The dietary fiber, minerals, phenolics and vitamins concentrated in the outer layer of the seed coat form the part of the food and offer their nutritional and health benefits (Antony *et al.*, 1998). Finger millet helps to increase the hemoglobin level and helps to fight malnutrition and degenerative diseases (Reddy, 2017). Fibers of finger millet gives fullness feeling thus controlling the excessive food consumption (ICAR - Indian Institute of Millets Research, 2017 (IIMR).

Barnyard millet

Barnyard millet is a multipurpose crop which is cultivated for food and fodder. It is a good source of protein, which is highly digestible and is an excellent source of dietary fiber with good amount of soluble and insoluble fractions (Hadimani and Malleshi 1993). The carbohydrate content of barnyard millet is low and slowly digestible, which makes the barnyard millet a nature's gift for the modern mankind who is engaged in sedentary activities (Veena *et al.*, 2005). Barnyard millet is most effective in reducing blood glucose and lipid levels.

Little millet

Little millet is rich in cholesterol, when consumed increases good cholesterol in the body, suitable for growing kids and strengthens the body. Its complex carbohydrate digests slowly which is very helpful for diabetic patients (Gayatri 2015). Its high fiber content is yet another positive making it an ideal part of pongal or even kheer instead of rice (Reddy, 2017). It contains high phosphorous (220 mg/100g)

and iron (9.3 mg/100g). It is especially good for people have low body mass. Few recipes which can be prepared using little millet are dosa, idli, pongal, kichadi (Nutritive value of Indian foods NIN 2007).

Proso millet

Proso millet is produced in China, Russia, India and countries of Eastern Europe and North America. In Western nations proso millet is of minor economic importance because of the great abundance of wheat, maize and other cereal crops (Delost-Levis *et al.*, 1992). Therefore there the grain of proso millet is mainly used as bird feed. However in recent years, it started to become a more popular crop due to its high quality proteins. Grains are rich in minerals and vitamins and their nutritive parameters are minimally the same over better than common cereals (Seetharam, 1999). Quality of protein decreases after drying but amount of protein increases (Kalinova and Moudry 2006). Pellagra is a skin disease which causes the skin to become dry, scaly and rough. Proso millet consists of protein and niacin (Vitamin B3). Traditionally it is used as recuperative food, especially post pregnancy or illness (Jana Kalinova, 2007)

Kodo millet

Kodo millet is nutritious grain and a good substitute to rice and wheat. The protein fiber and mineral content are much higher than the major cereals like rice. The major protein fraction in kodo millet is gluten (Sudharshana, *et al.*, 1988). Kodo millet is traditional food which helps to use in weight loss. It is easily digestible and is rich in phytochemicals and antioxidants which help in preventing different lifestyle related diseases. Kodo mill *et al.*, so helps in reducing the joints and knee pain and helps in regularizing the menstruation in woman (Deshpande *et al.*, 2015).

Table.1 Nutritional Benefit of Millets (For 100g of Millet)

S.no.	Millet	Protein (g)	Fiber (g)	Mineral (g)	Iron (mg)	Calcium(mg)
1	Sorghum	10	4	1.6	2.6	54
2	Pearl millet	10.6	1.3	2.3	16.9	38
3	Kodomilet	8.3	9	2.6	0.5	27
4	Foxtail millet	12.3	8	3.3	2.8	31
5	Proso millet	12.5	2.2	1.9	0.8	14
6	Little millet	7.7	7.6	1.5	9.3	17
7	Finger millet	7.3	3.6	2.7	3.9	344
8	Barnyard millet	11.2	10.1	4.4	15.2	11
9	Teff	13	8	0.85	7.6	180
10	Fonio	11	11.3	5.31	84.8	18
11	Browntop millet	11.5	12.5	4.2	0.65	0.01

Table.2 Nutraceutical importance of millets

S.No.	Minor Millet	Importance	Reference
1	Foxtail millet (<i>Setaria italica</i>)	Type-2 diabetes	Anju Thathola <i>et al.</i> , 2010
2	Finger millet (<i>Eleusine coracanda</i>)	Diabetes	Ryan <i>et al.</i> , 2011
3	Finger millet (<i>Eleusine coracanda</i>)	Cardiovascular disease, Colon cancer, constipation, Diverticulosis, wound Healing	Mathanghi <i>et al.</i> , 2012.
4	Finger millet (<i>Eleusine coracanda</i>)	Maintain body temperature during rainy season.	Pragya Singh and Rita Singh, 2011.
5	Kodo millet (<i>Paspalums crobiculatum</i>)	Severity of asthuma, migraine attacks, reduce high blood pressure, diabetic, Heart disease, atherosclerosis and heart attack	VeenuVerma and Patel, 2012
6	Little millet (<i>Wheat semoline</i>)	Diabetes	SunandaItagi <i>et al.</i> , 2013
7	Barnyard millet (<i>Echinochola frumentacea</i>)	Diabetes mellitus,obesity, hyperlipidemia	Surekha <i>et al.</i> , 2013
8	Finger millet (<i>Eleusine coracanda</i>)	Ascaris, folk remedy for leprosy, and liver disease	Khouloud <i>et al.</i> , 2013

9	Kodo millet (<i>Paspalums crobiculatum</i>)	Diabetes	Manju and Paul Khurana, 2014
10	Kodo millet (<i>Paspalums crobiculatum</i>)	Coronary heart disease, Diabetes	Vandana Mishra <i>et al.</i> , 2014
11	Finger millet (<i>Eleusine coracanda</i>)	Diabetes mellitus	Gull <i>et al.</i> , 2014
12	Pearl millet (<i>Pennisetum glaucum</i>)	Gastrointestinal disease and Ulcer	Hellen Mueni Ndiku and Mutuku Chrispus3Ngule., (2015)
13	Finger millet (<i>Eleusine coracanda</i>)	Cancer	Travis and Manish 2015

As with other food grains, the nutritive value of kodo millet protein could be improved gelatinization (Shinoj *et al.*, 2006) and incorporated in baking of bread and cakes, extrusion of cereal by supplementation with legume protein. Apart from being a rich source of nutrients, Kodomill *et al.*, so contains high amounts of polyphenols, tannins, phosphorus and phytic acids. The antioxidant activity of kodo millet decreases when the whole grain is dehulled and cooked (Chandrasekara *et al.*, 2012). These anti nutrients form complexes with micronutrients such as iron, calcium and zinc and reduce their solubility and bio availability (Balasubramanian, 2013) (Table 2).

Foxtail millet

Foxtail millet is good source of beta – carotene, which is the precursor of Vitamin A (Murugan and Nirmalakumari, 2006). Foxtail millet helps in steady release of glucose without affecting the metabolism of the body. When people consume foxtail millet, the prevalence of diabetes is reduced and it is also known as healthy heart food due to its good source of magnesium (Reddy, 2017). Foxtail millet is mixed with legumes to make porridge and also mixed with soybean to make mixed flour.

Millets are highly nutritious and are very helpful in fighting with many health problems like obesity, diabetes, cardiovascular diseases, cancer, celiac disease *etc* in developing countries are most prominent because of inadequate supply of nutrition.. They are rich in minerals (calcium, iron, copper, magnesium, etc.), gluten-free protein, low glycemic index B-vitamins and antioxidants. They have numerous nutrients which are helpful in different health related problems i.e. 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. Presence of antioxidants in millets is also helpful in protecting our cells against the effects of free radicals. Phytosterols and policosanols are cardio-protective compounds present in the waxy layers of the millet They are beneficial in dealing with inadequate supply of nutrition. So by grounding millets into flour without de-hulling, we can access multiple health related benefits.

They can easily thrive in extreme conditions like drought, and some wild varieties can even prevail in flooded areas and swampy grounds. These important traits make them nutritious and climate change compliant crops. Millets are easily available and cheap in cost. This is mainly due to the lack of awareness and knowledge among the people in choosing the kind of food, especially the small millets.

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