

Production Status, Nutritional Aspects and Health Benefits of Millets – A Review

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Abstract:

Millets are known as one of the most important cereal grains. Cereal grains are the most important source of the world's food. Millets are used as food and are widely used in rural areas. Millets having amazing values in their nutrition content and play a significant role in traditional diets in many regions. Millets are cultivated in Asia, Africa and America under the arid and semi-arid areas under low rainfall. India ranks 1st in the production of millet among the world. The millet grains are rich in fat, fibre and minerals in comparison to wheat and rice. Millets are rich source of calcium, dietary fibre, polyphenol, protein and amino acids like methionine and cystine hence millets are unique among the cereals. Millets are used in food fortification to overcome against micro nutrient deficiencies. Now days millets are playing important role in people who are suffering from diseases like diabetes, obesity, and cardiovascular disease Millet food is act as a potential prebiotic and help in to enhance the functionality of probiotics. Millets also bears the nutraceutical properties as it is good source of antioxidants helpful in lowering the blood pressure, prevention of cancer and decreasing the risk of tumor.

Keywords: *Fortification, Millet, Nutraceutical, Polyphenol.*

Introduction

The name "millet" has been derived from the word "mil or thousand" referring to the large number of grains that can be produced from a single seed. Similar to other types of grains like wheat and rice millet is a grass that bears edible, small sized grains. Millet is one of the most important drought-resistant crop and rank 6th in terms of world agriculture production. In many underdeveloped countries millets are important foods because of their ability to grow under contrary weather conditions like limited rainfall. Millet is ideal crop for climate crisis because it can withstand high temperature regimes. India is the largest producer and consumer of millets in the world (D. D. Wadikar et al., 2021). In 2018 the millet production in India was 10200 MT and in 2019 the total production of millet is 10700 MT. Millets contributes 60% of total area in which Madhya Pradesh accounts highest 32.4 % area. Karnataka is the leading state in the production of finger millet (ragi), Gujarat is largest producer of pearl millet and Madhya Pradesh for small millets. Millets are also known as nutri-cereals and are a good source of food, feed and fodder (Sujata et al., 2018). Millet plays a major role in providing energy and protein for millions of people. It has been also reported that millet are good source of nutrition and also having the different medicinal properties.

Millets are small-seeded with different varieties such as pearl millet (*Pennisetum glaucum*), finger millet (*Eleusine coracana*), proso millet (*Penicum miliaceum*), foxtail millet (*Setaria italica*), kodo millet (*Paspalum scrobiculatum*), little millet (*Panicum sumatrense*), and barnyard millet (*Echinochloas frumentacea*) (Ahmed et al., 2013). Millets do not require pesticides; act as anti-pest agents in storage conditions for pulses like green gram. The millets do not need any fumigants. Millets are also good source of phytochemicals and micronutrients (Singh and Raghuvanshi, 2012). The millet flour is used in preparation of blended composite flour, food fortification and supplementation in various food products. Millets are rich in micronutrients such as iron, zinc, calcium and vitamins so millets like finger millet, pearl millet, barnyard millet are used in food fortification (Bhumika and Kalpana, 2010). Millets are ground into flour by processing, rolled into round balls, parboiled, and afterward consumed as porridge with milk. Roti, made from pearl millet has been the primary food of farmers in Gujarat. Millet flour is used in the preparation of various extruded and bakery products. After sprouting the malt is used in the preparation of different types of beverages. Now a day's incorporation of millets in the various weaning food products has the more impact with consideration of nutrition value. Vitamins such as niacin, folic acid, riboflavin, thiamine and minerals like calcium, phosphorus and iron are present in the millets that play a key role in energy synthesis in the body. Polyphenols like phenolic acids and tannins are present in the great amount, flavonoids are act as antioxidants and play a major role in body of immune defence (Chandrsekara and Shahidi, 2010). Intake of millet in daily diet will be helpful against the chronic diseases such as cardiovascular diseases, ischemic strokes, cancers, osteoporosis, obesity and type II diabetes (Jones, 2006).

Table no. 01 Proximate composition of millet (per 100g)

Commodity	Carbohydrate (g)	Protein (g)	Fat (g)	Crude fibre (g)	Calcium (mg)	Phosphorus (mg)
Pearl millet	67.5	11.6	5	1.2	42	296
Finger millet	72	7.3	1.3	3.6	344	283
Proso millet	70.4	12.5	1.1	2.2	14	206
Foxtail millet	60.9	12.3	4.3	8	31	290
Kodo millet	65.9	8.3	1.4	9	27	188
Little millet	75.7	8.7	5.3	8.6	17	220
Barnyard millet	74.3	11.6	5.8	14.7	14	121

(Source NIN Hyderabad)

The main objective of this review article is to study the production status of the millets in India, recent research carried for purposes of evaluation of nutritional aspects and potential health benefits of millet grains for the utilization of millets in the development of millet value added food products.

Pearl millet

Pearl millet (*Pennisetum glaucum*) is the most widely grown staple cereal crop. Pearl millet accounts for about two-thirds of India's millet production. It is grown in the dry areas of the country, mainly in the states of Rajasthan, Maharashtra, Gujarat, Uttar Pradesh and Haryana (Shadang and Jaganathan, 2014). Gujarat accounts first in pearl millet production followed by Rajasthan. Pearl millet is rich in resistant starch, soluble and insoluble dietary fibre, minerals and antioxidants. Pearl millet is good source of nutrition for the poorest people. Oil content in the pearl millet is high so it contains more calories. Pearl millet contains (63.2g) starch, (13.6g) crude protein, (7.8g) crude fat, (2.8g) crude fibre and (2.1g) ash (Ali et al., 2003). It is rich source of B vitamins, minerals like potassium, zinc, magnesium, phosphorus, iron, copper and manganese. Pearl millet has the better amino acid profile than the cereals. Magnesium is present in pearl millet which helps in reducing the respiratory problems in asthma patients.

Finger millet

Finger millet (*Eleusine coracana*) is also known as ragi. India is largest producer of finger millet and contributes 60% of global production (Kamini and Sarita, 2011). In India it is widely grown in the states of Karnataka, Tamil Nadu, Andhra Pradesh and parts of North India (Vijayakumari et al., 2003). Finger millet contains the lowest fat. It is rich source of fibre. Finger millet has thirty times more calcium than rice. Finger millet per 100g contains carbohydrates (65–75g), dietary fibre (18g), protein (6–13g), minerals (2.5–3.5g) and calcium (0.38g) (Devi et al., 2014). As the finger millet is good source of calcium it is helpful in strengthening bone and reduces risk of bone damage. Finger millet also has good antioxidant profile. Good source of sulphur containing amino acids like tryptophan, cystine and methionine. Naturally iron is present in finger millet helps to cure anaemia. With its rich fibre content helps to prevent constipation. Finger millet helps to increase the haemoglobin level in blood.

Proso millet

Proso millet (*Penicum miliaceum*) is also called hog millet and golden millet (Farheentaj et al., 2017). Proso millet is cultivated in China, India, Russia and North America. Proso millet is grown in Madhya Pradesh, Uttar Pradesh, Bihar, Tamil Nadu, Maharashtra, Andhra Pradesh and Karnataka. It contains good amount of vitamins and minerals. Proso millet is good source of niacin. It is known as the low glycemic index and gluten free millet. Proso millet per 100g contains the Energy(354kcal), carbohydrate(70.4g), Protein(12.5g), fat(1.1g), fibre(5.2g), minerals(1.9g), calcium(8mg), phosphorus(206mg) and niacin(4.5mg). Proso millet also exhibits the good antioxidant activity. It is rich in total carotenoids. Dietary protein of proso millet is helpful in the cholesterol metabolism (Nishizawa and 1995). It is helpful in prevention of vitamin B3 deficiency that is pellagra.

Foxtail millet

Foxtail millet (*Setaria italica*) is one of the oldest cultivated millets in the world is cultivated in about 23 countries in Asia, Africa, and America. It is grown in hot drought prone and semiarid zones. Foxtail millet is second most cultivated millet after pearl millet. It is also known as Italian millet. In India it is cultivated in the states like Karnataka, Telangana, Andhra Pradesh, Maharashtra, Tamil Nadu, Rajasthan and Uttar Pradesh. Nutritional composition of foxtail millet per 100g includes, carbohydrate (60.9g), protein (12.3g), fat (4.3g), crude fibre (8.0g), mineral (3.3g) and the energy value (351kcal) (Sharma and Niranjana, 2017). It is rich in magnesium, manganese and phosphorus. Foxtail millet is richest source of fibre among the all millets (Hariprasana, 2016). It also contains carotenes and tocopherols. Foxtail millet is good food for the heart as it contain high amount of magnesium. Foxtail millet seeds increase kidney functionality, helps in development of body tissue and energy metabolism.

Kodo millet

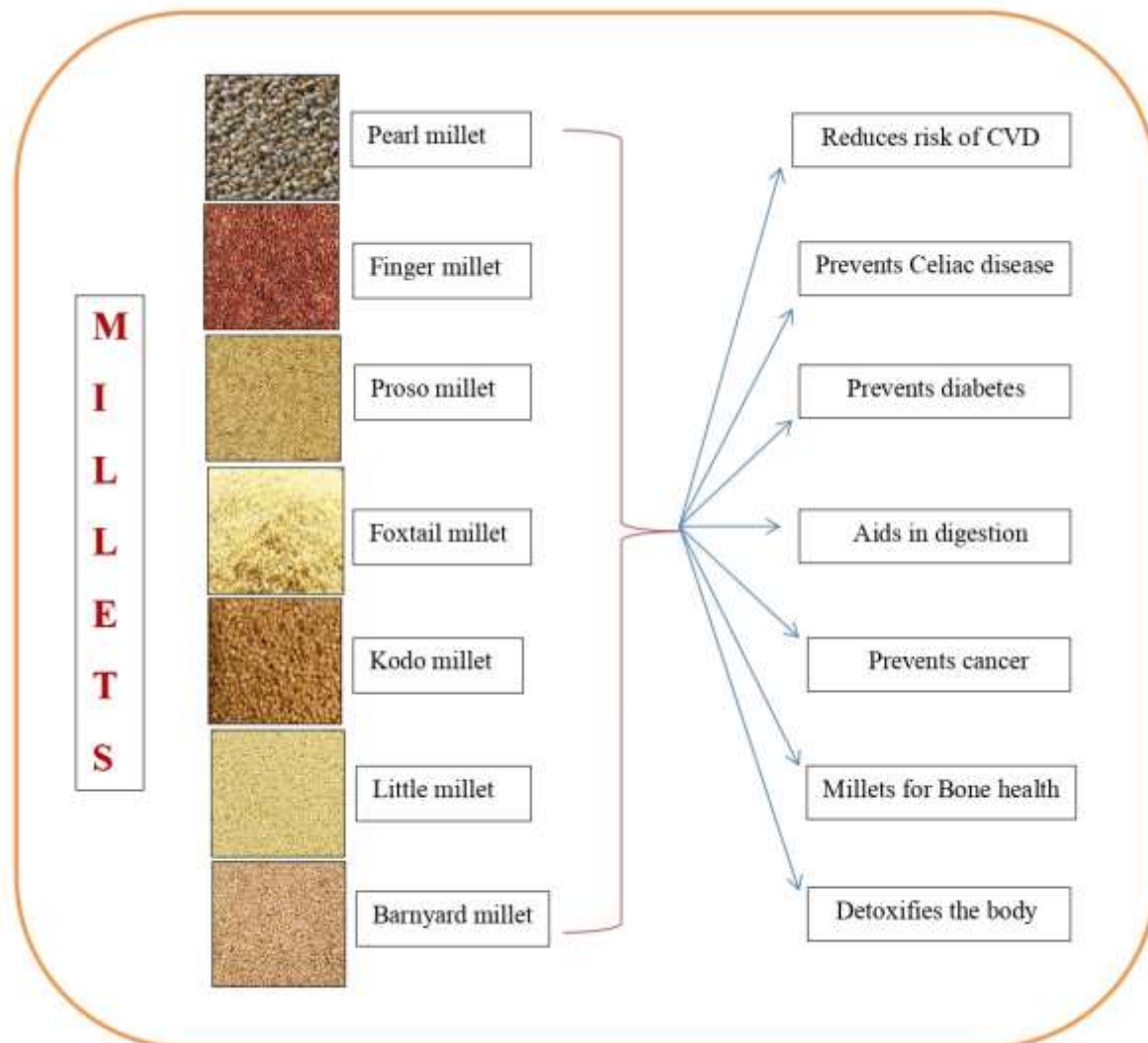
Kodo millet (*Paspalum scrobiculatum*) is grown all over the world in tropic and subtropics region. Kodo millet is traditional food which closely resembles the rice (Kimeera and Sucharitha, 2019). In India it is also known as Indian crown grass. It is majorly cultivated in Kerela, Tamilnadu, Rajasthan, Uttarpradesh and West Bengal. Compare to all millets it is rich in lysine. It is also rich in fibre and mineral content. Kodo millets per 100g contain carbohydrate (66.6g), protein (8g), fat (1.5g), fibre (9g) and mineral (2.6g). Iron content in this millet ranges from 25.86mg to 39.60mg and also good source of vitamin C and E (Chandel et al., 2014). Kodo millet flour is utilised in the production of bakery and extruded food products. Kodo millet also helps in reducing the joint pain and knee pain and helps in regularizing the menstruation in woman (Deshpande et al., 2015). Kodo millet has the good antioxidant potential. It is also helpful in reducing the cholesterol level.

Little millet

Little millet (*Panicum sumatrense*) is one of the important staple cereal crop consumed as rice in India. Andhra Pradesh, Chhattisgarh, Jharkhand, Karnataka, Madhya Pradesh and Maharashtra states are the top grower of the Little millet. Little millet per 100g contains energy (341kcal), carbohydrate (67g), protein (7.7g), fat (4.7g), fibre (7.7g), iron (9.3mg) and phosphorus (220mg) (Mamata et al. 2015). High amount of antioxidants and phytochemicals are present in the little millet (Pradeep and Guha, 2011). Little millet can be utilised in the preparation of idli, dosa, pongal and khichadi. Little millet is a good source of iron. It contains the nutraceuticals like phenols, tannins and phytates. The consumption of little millet will helpful to reduce the blood glucose level. The high fibre content of millet improves the heart health. Vitamin B3 Niacin present in the little millet is good for lowering the cholesterol level.

Barnyard millet

Barnyard millet (*Echinochloa frumentacea*) is an important and fastest growing millet crop (Veena et al., 2005). Chhattisgarh, Madhya Pradesh, Maharashtra, Tamilnadu, Uttar Pradesh and Uttrakhand are top cultivators of the barnyard millet. Barnyard millet is cultivated for the purpose of food and fodder. It is good source of protein, soluble and insoluble fibre. Barnyard millet contains carbohydrate (65g), protein (13g), calcium (23.16mg) and iron (6.91mg). Barnyard millet is helpful in reducing the blood glucose level. Constipation and bloating problems solve with the consumption of barnyard millet as it is rich in fibre. Barnyard millet is correct food in the diet of people who are intolerant to gluten.



Health benefits of Millets

Reduces risk of cardiovascular diseases

Millet is very important grain in our diet which helps to protect our heart. It is a rich source of magnesium, which is an important mineral for reducing blood pressure and the risk of heart attack or stroke particularly in the case of Atherosclerosis. Millets are good source of fibre so it helps to control the cholesterol level. Dietary fibre present in the millet helpful to eliminates dangerous bad cholesterol that is LDL from the body and increases the effect of good cholesterol.

Prevention of Celiac disease

Celiac disease is associated with consumption of gluten. Millets can be added in the daily diet with replacing the food contains gluten. Millets are helpful in prevention of celiac diseases as they are gluten free.

Prevents diabetes

Diabetes is a chronic disease affecting millions of people in the world. Millet is a beneficial staple food in many countries. Millets are rich source of magnesium which helps in increasing the efficiency of insulin and glucose receptors in the body. Millets helps to reduce the risk of type 2 diabetes. Due to low glycaemic index ingestion of millet decreases the risk of diabetes mellitus.

Aids in digestion

Millets help to improve the gastrointestinal system and helpful to eliminate the problems like constipation, excess gas, bloating and cramping. The gastrointestinal conditions such as ulcers and colon cancer reduce by regulating the digestive processes with consumption of millet. Regular digestion and elimination of toxic components also helps optimize kidney, liver and immune system of body.

Prevents cancer

Fibre plays an important role in prevention of cancer. Phenolic acids, tannins and phytates are the ant nutrients present in the millet helpful to reduce the risk of colon and breast cancer. The chemical compounds of millets shows the anti-mutagenic and anti-carcinogenic properties

Millets for Bone health

Millets are rich source of calcium so it is helpful in bone development in the children and geriatric people. Also it contains good amount of phosphorus and amino acids it is helpful in the prevention of osteoporosis. Consumption of finger millet products will helpful to strengthening the bones and tissues.

Detoxifies the body

Many of the ingredients in millet can clean up toxins from the body. The nutraceuticals and antioxidant compounds present in the millet helpful to remove the foreign substances and toxicants from the body. Prebiotic and probiotic beverages prepared from the millet also remove the toxic materials and clean up the body.

Challenges and Future perspectives:

The main challenge is to provide the food for the growing population of country by increasing the more production of millet for future use. Development of millet value added food products will be helpful to overcome malnutrition problems in the rural areas. Utilization of millet grains for export purpose will be achieved through the processing technologies and innovations in the milling operation. Ready to eat, ready to cook and infant's millet value added food products will gain the high market value in the discipline of food

science and technology in upcoming future. Millet utilisations also have the huge scope in the beverage and snacks industry.

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