

## **A Review on Pearl millet: Nutritional significance, composition and its medicinal uses**

Lakshmi Madhuri. M<sup>1</sup>, N V L Suvarchala Reddy. V<sup>2</sup>, Mamatha. M<sup>3</sup>, Anirudh Nambiar. K<sup>4</sup>,  
Swapna. K<sup>5</sup>, Tejaswi A<sup>6</sup>

<sup>1</sup> Assistant Professor, Department of Pharmaceutical Chemistry, Gokaraju College of Pharmacy,  
Hyderabad, Telangana, India.

<sup>2</sup> Professor, Department of Pharmacology, Gokaraju College of Pharmacy, Hyderabad,  
Telangana, India.

<sup>3</sup> Assistant Professor, Department of Pharmacology, Gokaraju College of Pharmacy, Hyderabad,  
Telangana, India.

<sup>4,5,6</sup> Student, Department of Pharmaceutical Chemistry, Gokaraju College of Pharmacy,  
Hyderabad, Telangana, India.

### **Abstract**

Pearl millet (*Pennisetum glaucum*) is a drought-resistant, highly nutritious cereal grain that has been cultivated for centuries, particularly in arid regions of Africa and Asia. It is an important source of carbohydrates, proteins, fiber, and essential micronutrients, making it a staple food in many developing countries. Beyond its nutritional value, pearl millet has been recognized for its potential medicinal benefits. It is rich in bioactive compounds such as phenolic acids, flavonoids, and phytochemicals, which contribute to its anti-inflammatory, antioxidant, and antimicrobial properties. In traditional medicine, pearl millet has been used to manage various health conditions, including digestive disorders, diabetes, and cardiovascular diseases. It is also believed to support the immune system, regulate blood sugar levels, and improve overall gut health. Research into the medicinal properties of pearl millet continues to grow, highlighting its potential as a functional food with therapeutic value for preventing and managing chronic diseases.

**Key words:** millet, medicinal uses, benefits.

### **Introduction**

Pearl millet (*Pennisetum glaucum*) is multipurpose cereal crop belongs to the Poaceae family. It is commonly called as *Bajra*, *Bajri*, *Sajje*, *Kambu*, *Kamban*, *Sajjalu* etc in various Indian local languages. It is commonly used for food, feed, and forages purpose. This millet cultivated mostly in semi-arid part of Africa and Asia. In India, pearl millet is a third most important crop grown after rice and wheat. It is grown on 7.4 million ha area with an average production of 9.13 million tones during 2017-18. The major pearl millet growing states are Rajasthan, Maharashtra, Gujarat, Uttar Pradesh and Haryana which accounts for 90% acreage in the country [1]. Pearl millet is a good source of energy, protein, vitamins, dietary fibers and minerals. It is high in fat and better fat digestibility than other cereals. This is also high in unsaturated fatty acids with higher content of nutritionally important n-3 fatty acid.

Among all the millets, pearl millet has highest content of macronutrients and significantly rich in resistant starch, soluble and insoluble dietary fibers [2]. Pearl millet effectively helps in maintaining the blood sugar level constant in diabetes patient for long period of [3]. Thus, the nutritional composition and health benefits attracted today's market focused present health segment highlighting commercial viability of the crop. Therefore, the main objective of this article is to explore nutritional quality, health benefits, processing techniques, problems and product of pearl millet grain so as to use it for further research in the area of post-harvest processing and value addition of pearl millet crop.

### **Pearl Millet and Its Nutritional Significance**

The higher nutrient content means that pearl millet has been recognized by the Ministry of Agriculture, Government of India as one millet under "Nutri-Cereals" (GOI). Pearl millet has a higher digestibility of fat than most cereals. It is also rich in unsaturated fatty acids with higher nutrient omega-3 fatty acid content. Pearl millet has a maximum content of macronutrients and is considerably rich in resistant starch and soluble and insoluble dietary fiber in contrast to other millets [2]. Basically, pearl millet has a large root structure, which absorbs soil nutrients and has a higher importance for nutrition than other cereal crops, including wheat, rice, maize, and sorghum. A high degree of iron, zinc, magnesium, copper, manganese, potassium, and phosphorus is found in the mineral. This is a strong energy source with a calorific value of 361 Kcal/100 g and a high amount of fibre (1.2 g/100 g) [1]. It is higher [4] and is a healthy source for vitamin B, vitamin A, folic acid, calcium, and magnesium [5]. Pearl millet grain has a higher fat content than other cereals which causes low product quality [6].



**Fig. 1 Pearl millet crop in the field**

### **Chemical composition of millets**

Millets are a rich source of various phytochemicals including tannins, phenolic acids, anthocyanins, phytosterols and pinacosanols. These phytochemicals have potential positive impact on human health. All millet grain and especially sorghum fractions possess high antioxidant

activity in vitro relative to other cereals and fruits. The major phytochemicals include phenolic compounds and others. Millets are a good source of phenolic compounds with a variety of genetically dependent types and levels of phenolic acids, flavonoids and condensed tannins. Gallic Acid, chlorogenic acid, caffeic acid, ferulic acid, vanillic acid, kaempferol, quercetin, catechin etc were reported from various millets. Essential amino acids such as histidine, arginine, threonine, lysine, tyrosine, methionine, valine and leucine and non-essential amino acids such as serine, glycine, aspartic acid, glutamine, alanine, proline, isoleucine and phenylalanine were reported to be present in various millets.[2]

### **Potential Health Benefits in Pearl Millet**

Millets have potential health benefits and epidemiological studies have showed that consumption of millets reduces risk of heart disease, protects from diabetes, improves digestive system, lowers the risk of cancer, detoxifies the body, increases immunity in respiratory health, increases energy levels and improves muscular and neural systems and millets are protective against several degenerative diseases such as metabolic syndrome and Parkinson's disease.

Pearl millet is helpful to patients with diabetes as it has a relatively low glycemic index that helps to digest gradually and produce glucose at a slower rate than other foods [7]. This can sustain long periods of stable blood sugar levels. Pearl millet grain contains phenolic compounds in pericarp and grain testa, in particular flavonoids, which inhibit tumor production [8]. It is high in iron and zinc content which may help in increasing HB and also preventing from anemia disease. Pearl millet grain is gluten-free, and it is one of the alternatives for the patients who have celiac diseases to consume a gluten free diet for a normal and healthy lifestyle [9]. Pearl millet has a large amount of phosphorus. Phosphorus is very essential for bone growth and development as well as for development of ATP which is the energy currency of our body [10]. The pearl millet lignin and phytonutrients serve as good antioxidants and thus prevent heart related diseases. For this reason, pearl millet is considered good for cardiac health [3].

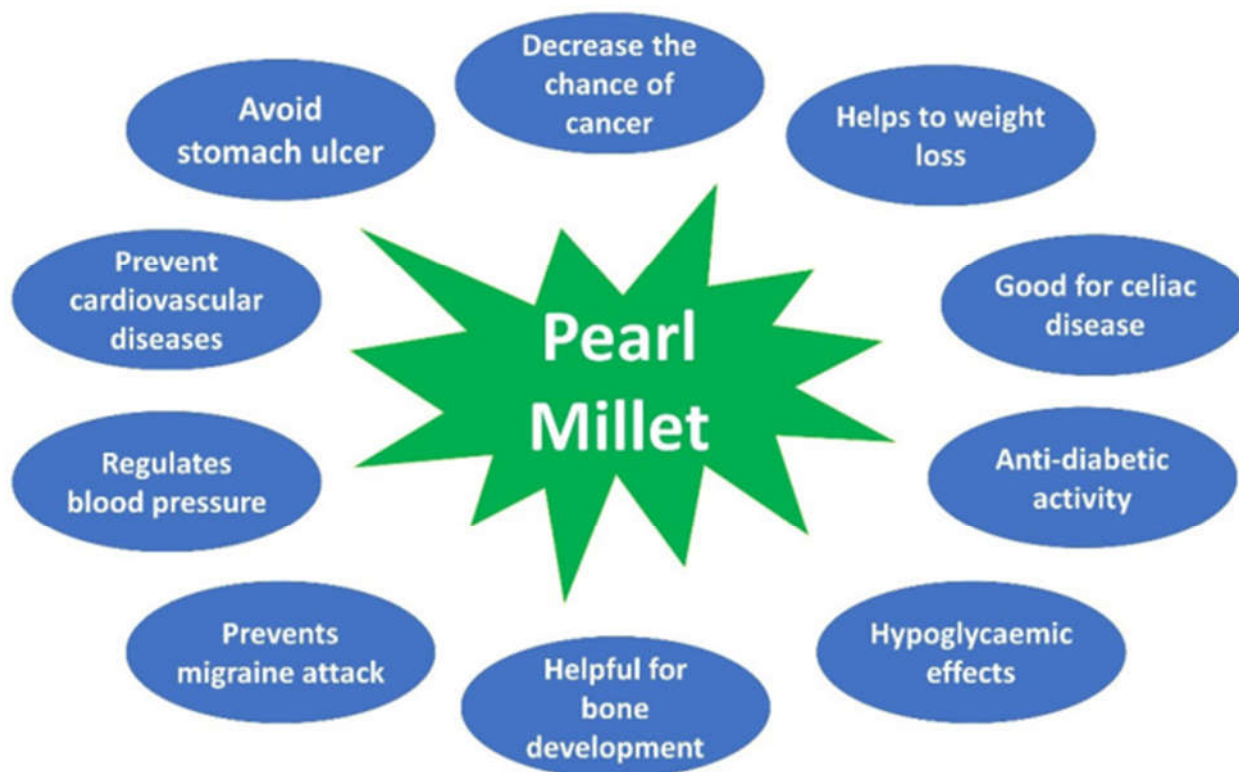
Epidemiological evidence from research studies has shown that diets rich in plant foods are protective against several degenerative diseases such as cancer, cardiovascular ailments, diabetes, metabolic syndrome, and Parkinson's disease [11,12,13,14]

Millets must also be accepted as functional food and nutraceuticals because they provide dietary fibers, proteins, energy, minerals, vitamins, and antioxidants required for human health. Several potential health benefits such as preventing cancer and cardiovascular diseases, reducing tumor incidence, lowering blood pressure, risk of heart disease, cholesterol, and rate of fat absorption, delaying gastric emptying, and supplying gastrointestinal bulk were reported for millets [15]

**Table 1: Medicinal Uses of Pearl Millet**

Disease	Health Benefits in Pearl Millet
Anaemia	High iron content (8mg/100g) High Zinc content (3.1mg/100g) May help in increasing Hb [16]
Constipation	High fiber (1.2g/100g) content, May help in dealing with constipation.
Diabetes	The intake of whole grain foods is suggested to be beneficial for the prevention and management of diabetes mellitus, and epidemiologically lower incidence of diabetes has been reported in millet consuming populations [17]. Has Low glycemic index, Help in dealing with diabetes. Starch fractions such as SDS and/or RS are nutritionally important as they have significant implications on human health, particularly glucose metabolism, diabetes management [18,19].
Cancer	Anti cancer property Inhibit tumour Development. Rich in phenolic acids, tannins, and phytate that act as “anti nutrients” (Thompson, 1993). However, it has been established that these antinutrients reduce the risk for colon and breast cancer in animals [20]
Celiac	Pearl millets are gluten-free, they have considerable potential in foods and beverages that can be suitable for individuals suffering from celiac disease [21,22].
Diarrhea	Due to presence of Lactic acid bacteria act as Probiotic treatment.
NCDs	Peral millet have Flavonoids, phenolics Omega 3 fatty acids, Inhibits DNA scission, LDL cholesterol, liposome oxidation and proliferation of HT-29 adenocarcinoma Cells. So help full in NCD [13]
Helps in bone growth development and repair	Pearl millet has a large amount of phosphorus and also a good source of calcium. Both are very essential for bone growth and development.
Stomach Ulcers	he most common cause for stomach ulcers is excess acidity in the stomach after food intake. Pearl millet is one of the very few foods that remains his alkaline property thus prevents formation of stomach ulcers or reduces the effect of ulcers.
Heart health	The lignin and phytonutrients in millet act as strong antioxidants thus preventing heart related diseases. So that pearl millet is considered good for heart health [23].High amounts of magnesium present in pearl millet have been shown to control blood pressure and relieve heart stress.

Respiratory problems for asthma patients	Pearl millet contains high concentration of magnesium which helps reduce severity of respiratory problems for asthma patients and is also effective in reducing migraine attacks
Weight loss (Obesity)	Pearl millet can be beneficial in the process of weight loss as it is high in fibre content [12].
Preventing Gall stones:	The high fibre content in pearl millet is also known to reduce the risk of gall stone occurrence. The insoluble fibre content in pearl millet reduces the production of excessive bile in our system [24].
High Satiety value	Owing to its fibre content it takes longer for the grain to move from the stomach to the intestines [25]. This way, pearl millet satiates hunger for a long period of time and thus helps in lowering the overall consumption of food.
Well digested source of nutrients	Pearl millet exhibits higher apparent small intestine digestibility of essential amino acids than other grains. With a high level of essential amino acids coupled with superior in vitro pepsin digestibility values, suggests that pearl millet is a nutritious and well-digested source of calories and protein for humans.
Anti allergic Properties	Pearl millet is a treasure trove of beneficial properties. The grain is very digestible as such and has a very low probability of causing allergic reactions. Due to its hypo allergic property, it can be safely included in the diets of infants, lactating mothers, elderly and Convalescents
Anti ageing	The chemical reaction between the aldehyde group of reducing sugars and the amino group of proteins, termed as non enzymatic glycosylation, is a major factor responsible for the complications of diabetes and aging [26]. Millet grains are rich in antioxidants and phenolics; however, it has been established that phytates, phenols, and tannins can contribute to antioxidant activity important in health, aging, and metabolic [27].



**Figure 2: Medicinal Uses of Pearl Millet**

## Conclusion

Increased nutritional knowledge challenges the food industry to create new food items with distinctive qualities that can improve people's health. Recent studies highlighted that the development of health-promoting ingredients and functional foods can prevent and control diabetes and other chronic diseases. This review has shown that pearl millet has a significant impact on diabetic individuals. It is a good source of vitamins and minerals, and is very beneficial for diabetic patients. A variety of bioactive compounds present in pearl millet possess numerous health benefits such as antimicrobial, antioxidant, antidiabetic, anticancer and hypocholesterolemic effects, as well as hypoglycaemic activity and guarding against diet-related diseases. It is still mostly restricted to household-level communities in rural areas. One important feature of medicinal dietary change and the encouragement of the use of pearl millet may be to include more nutritious and conventional whole-grain and multigrain alternatives for processed carbohydrates. In order to increase the consumption of pearl millet and to take advantage of its

immense nutritious potential, diversification of food production and consumption, in tandem with increasing yields, must be promoted at both national and household levels.

## REFERENCES

1. Singh N, Singh S P , Kumar M , Kanhiya K and Kumar A (2018). Nutri Cereal Pearlmillet: Way Forward. *Int.J.Curr.Microbiol.App.Sci* 7(6): 578-581.
2. Ragaee S, Abdel-Aal EM, Noaman M. (2006). Antioxidant activity and nutrient composition of selected cereals for food use. *Food Chem* 98(1):32–8.
3. Dayakar Rao B., Bhaskarachary K., Arlene Christina G.D., Sudha Devi G., Vilas, A. Tonapi, (2017). Nutritional and Health benefits of Millets. ICAR\_ Indian Institute of Millets Research (IIMR) Rajendranagar, Hyderabad, PP 112.
4. Taylor J.R.N., Emmambux M.N. *Technology of Functional Cereal Products*. Elsevier; Amsterdam, The Netherlands: 2008. *Products Containing Other Speciality Grains: Sorghum, the Millets and Pseudocereals*; pp. 281–335.
5. Pattanashetti S.K., Upadhyaya H.D., Dwivedi S.L., Vetriventhan M., Reddy K.N. *Genetic and Genomic Resources for Grain Cereals Improvement*. Elsevier; Amsterdam, The Netherlands: 2016. *Pearl Millet*; pp. 253–289.
6. Chapke R.R., Prabhakar R., Prasad G.S., Das I.K., Tonapi V.A. *Improved Millets Production Technologies and Their Impact*. IIMR Publication; Hyderabad, India: 2018. pp. 1–88.
7. Asp, N.G.(1996). *Dietary Carbohydrate: Classification by Chemistry and Physiology*, *Journal of Food Chemistry*, 7:9-14.
8. Huang, M. T., and Ferraro, T., Phenolics compounds in food and cancer prevention (1992). In: *PhenolicCompounds in Food and Their Effects on Health II*, ACS Symposium Series, 507:8–34.
9. Jukanti A K , Laxmipathi Gowda C L, Rai K N, Manga V K and Bhatt R K (2016). Crops that feed the world 11. Pearl Millet (*Pennisetum glaucum* L.): an important source of food security, nutrition and health in the arid and semi-arid tropics. *Food Sec.* 8:307–329.
10. Malik S. Pearl Millet-Nutritional Value And Medicinal Uses (2015). *International Journal of Advance Research and Innovative Ideas in Education*, 1(3): 414-418.
11. Manach C, Mazur A and Scalbert A (2005). Polyphenols and prevention of cardiovascular diseases. *Current Opinion in Lipido* 16 77–84.
12. Scalbert A, Manach C, Morand C, Remesy C and Jimenez L (2005). Dietary polyphenols and the prevention of diseases. *Critical Reviews in Food Science and Nutrition* 45 287–306.
13. Chandrasekara A and Shahidi F (2012b). Bio accessibility and antioxidant potential of millet grain phenolics as affected by simulated in vitro digestion and microbial fermentation. *Journal of Functional Foods* 4 226–37.
14. Chandrasekara A, Naczka M and Shahidi F (2012b). Effect of processing on the antioxidant activity of millet grains. *Food Chemistry* 133 1–9.

15. Truswell AS (2002). Cereal grain and coronary heart disease. *European Journal of Clinical Nutrition* 56(1) 1–4.
16. Sehgal S, Kawatra A and Sing G (2003). Recent technologies in Pearl Millet and Sorghum processing and food product development. CC Technical Paper no.34 Proceedings of the Expert Meeting ICRISAT Patancheru, Andhra Pradesh, India.
17. American Diabetes Association (2005). Diagnosis and classification of diabetes mellitus. *Diabetes Care* 28 37–42.
18. Shobana S, Sreerama YN and Malleshi NG (2009). Composition and enzyme inhibitory properties of finger millet (*Eleusine coracana* L.) seed coat phenolics: mode of inhibition of  $\alpha$ -glucosidase and pancreatic amylase. *Food Chemistry* 115(4) 1268–73.
19. Thompson LU and Yoon H(1993). Starch digestibility as affected by polyphenols and phytic acid. *Journal of food science*. 49:1228-1229.
20. Graf E and Eaton JW (1990). Antioxidant functions of phytic acid. *Free Radical Biology and Medicine* 8(1) 61–9.
21. Taylor JRN and Emmambux MN (2008). Gluten-free foods and beverages from millets. In: Gallagher E, editor. *Gluten-Free Cereal Products and Beverages*, (Burlington, MA: Elsevier) 1–27.
22. Taylor JRN, Schober TJ and Bean SR (2006). Novel food and non-food uses for sorghum and millets. *Journal of Cereal Science* 44(30) 252–71
23. Ahmed AI, Abdalla AA and El Tinay AH (2009). Effect of traditional processing on chemical composition and mineral content of two cultivars of pearl millet (*Pennisetum glaucum*). *Journal of Applied Science Research* 5(12) 2271–6.
24. Liu RH (2007). Whole grain phytochemicals and health. *Journal of Cereal Science* 46 207–19.
25. Miller G (2001). Whole grain, fiber and antioxidants. In: Spiller GA, editor. *Handbook of Dietary Fiber in Human Nutrition*, (USA, Boca Raton, FL: CRC Press) 453–60.
26. Monnier VM (1990). Nonenzymatic glycosylation, the Maillard reaction and the aging process. *Journal of Gerontology* 45 105–11.
27. Bravo L (1998). Polyphenols chemistry, dietary sources, metabolism and nutritional significance. *Nutrition Revised* 56 317–33.