

Millets and Their Nutraceutical Properties: A review

Sayani Ghosal, Paromita Mukherjee*

Department of Food and Nutrition, Swami Vivekananda
University, Barrackpore, West Bengal

*Corresponding email: paromitam@svu.ac.in

Abstract

Millets, a diverse group of small-seeded cereals, have gained global attention for their exceptional nutritional and nutraceutical potential. Once regarded as coarse grains, millets are now considered “smart foods” due to their rich content of dietary fiber, antioxidants, vitamins, minerals, and phytochemicals. These grains exhibit resilience in harsh climates, making them sustainable and economically viable crops for food security. Millets possess significant nutraceutical properties that help manage and prevent chronic diseases such as diabetes, cardiovascular disorders, obesity, and certain cancers. This review explores the classification of millets, their nutritional profile, bioactive compounds, health benefits, and potential applications in nutraceutical and functional food industries. The increasing evidence supporting the health-promoting roles of millets positions them as critical components in the fight against malnutrition and non-communicable diseases. Future strategies should focus on improving millet-based product development, consumer awareness, and integrating millets into mainstream dietary systems.

Introduction

Millets are ancient grains cultivated for thousands of years, particularly in Asia and Africa. They include a variety of small-seeded cereals such as pearl millet (*Pennisetum glaucum*), finger millet (*Eleusine coracana*), foxtail millet (*Setaria italica*), proso millet (*Panicum miliaceum*), and others. Millets were historically sidelined in favor of more popular cereals like

rice and wheat but are now regaining popularity due to their superior health benefits and adaptability to climate change.

The increasing burden of lifestyle-related diseases such as type 2 diabetes, obesity, and cardiovascular disease has necessitated a re-evaluation of dietary patterns. Nutraceuticals—foods or parts of food that provide medical or health benefits—play a pivotal role in health promotion and disease prevention. Millets, being rich in fiber, polyphenols, flavonoids, and other functional compounds, qualify as potent nutraceuticals. This paper reviews the various nutraceutical attributes of millets and their implications for public health and nutrition.

2. Classification and Types of Millets

Millets are generally categorized into major millets and minor millets based on their grain size and significance in agriculture.

2.1 Major Millets

- Pearl Millet (*Pennisetum glaucum*): Most widely grown; rich in iron and zinc.
- Finger Millet (*Eleusine coracana*): High in calcium and dietary fiber.
- Foxtail Millet (*Setaria italica*): Known for low glycemic index and antioxidant properties.

2.2 Minor Millets

- Proso Millet (*Panicum miliaceum*)
- Barnyard Millet (*Echinochloa frumentacea*)
- Kodo Millet (*Paspalum scrobiculatum*)
- Little Millet (*Panicum sumatrense*)

These varieties are traditionally cultivated in dryland areas and are known for their drought tolerance and low input requirements.

3. Nutritional Composition of Millets

Millets offer a unique and dense nutritional profile compared to mainstream cereals:

Nutrient	Millets (avg.)	Rice	Wheat
Protein (%)	7-12	6.8	11.8
Fat (%)	1.5-5.0	0.5	1.5
Dietary Fiber (%)	8-12	0.2	1.2
Calcium (mg/100g)	20-350	10	30
Iron (mg/100g)	2-10	0.7	3.5

- **Macronutrients:** Millets are a good source of protein, with finger millet particularly high in essential amino acids like methionine.
- **Micronutrients:** Rich in iron, zinc, phosphorus, magnesium, and especially calcium.
- **Fiber:** High in both soluble and insoluble fiber, supporting digestive health and glycemic control.
- **Antioxidants and Phytochemicals:** Contain phenolic acids, flavonoids, tannins, and lignans with therapeutic properties.

4. Bioactive Compounds in Millets

Millets are a natural source of a variety of bioactive compounds, which contribute to their functional and nutraceutical potential:

4.1 Polyphenols

These are powerful antioxidants that reduce oxidative stress and inflammation. Finger millet is notably high in polyphenols, especially in the outer seed layers.

4.2 Flavonoids

Found in various millets, these compounds possess anti-inflammatory, anti-cancer, and anti-diabetic properties.

4.3 Phytosterols

Present in millets like pearl millet, phytosterols help lower cholesterol levels and improve heart health.

4.4 Tannins

Though sometimes considered anti-nutritional, tannins have antioxidant effects and potential anti-carcinogenic properties when consumed in moderation.

5. Health Benefits of Millets

The consumption of millets is associated with numerous health benefits:

5.1 Anti-Diabetic Effects

Millets have a low glycemic index (GI), slowing glucose absorption. This helps in controlling blood sugar levels in diabetic patients. Studies show that regular millet consumption can reduce fasting blood glucose and improve insulin sensitivity.

5.2 Cardiovascular Health

The presence of magnesium, potassium, and antioxidants contributes to blood pressure regulation and lipid profile improvement. Millet fibers and phytosterols lower LDL cholesterol levels and improve heart health.

5.3 Anti-Cancer Properties

Phenolic compounds in millets possess anti-carcinogenic activity by inhibiting free radicals and modulating cell proliferation.

5.4 Anti-Obesity and Weight Management

High dietary fiber promotes satiety and reduces calorie intake. Millets help manage weight through better metabolic control and reduced fat accumulation.

5.5 Gastrointestinal Health

The prebiotic properties of millet fibers support gut microbiota diversity and help prevent constipation and other GI disorders.

5.6 Bone Health

Finger millet is extremely high in calcium (up to 344 mg/100g), supporting bone mineralization and reducing the risk of osteoporosis

6. Processing and Bioavailability

Despite their nutritional richness, millets also contain anti-nutritional factors like phytates, tannins, and enzyme

inhibitors. Traditional processing techniques enhance their bioavailability:

- Soaking and Germination: Increases nutrient absorption and decreases anti-nutrients.
- Fermentation: Improves amino acid profiles and introduces beneficial microbes.
- Malting: Enhances enzymatic activity and digestibility.
- Decortication: Removes outer husks, reducing tannin content.

These processes not only improve nutritional quality but also enhance palatability and functional use in food products.

7. Industrial and Nutraceutical Applications

Millets are increasingly being used in the development of functional foods, health supplements, and ready-to-eat (RTE) products:

- Millet-based Breakfast Cereals and Snacks
- Gluten-Free Bakery Products
- Health Bars and Nutraceutical Powders
- Fermented Beverages and Probiotic Foods

These applications are expanding due to consumer demand for gluten-free, high-fiber, and organic foods.

8. Challenges and Future Perspectives

While millets have many advantages, several challenges hinder their widespread acceptance:

- Limited Consumer Awareness
- Inferior Taste Profile (compared to rice/wheat)
- Lack of Processing Infrastructure
- Anti-Nutritional Factors

To overcome these, strategies should include:

- Promoting millet-based foods through public health campaigns.

- Government incentives for millet farming and processing.
- Advancing food technology to improve taste and shelf life.
- Encouraging millet integration into school meals and public nutrition programs.

Conclusion

Millet, once marginalized as poor man's crops, are now recognized for their immense nutraceutical and ecological value. Their unique composition of dietary fiber, resistant starch, bioactive compounds, and micronutrients makes them potent tools in combating non-communicable diseases and promoting sustainable agriculture. With increasing interest in functional foods, millets are poised to play a pivotal role in future health and nutrition strategies. Embracing millets as a regular part of the diet, alongside modern processing and product development, can pave the way for a healthier global population and more resilient food systems.

References

- Saleh, A. S., et al. (2013). Millet grains: Nutritional quality, processing, and potential health benefits. *Comprehensive Reviews in Food Science and Food Safety*.
- Devi, P. B., et al. (2014). Health benefits of finger millet. *Food Science and Human Wellness*.
- Chandrasekara, A., & Shahidi, F. (2011). Antioxidant phenolics of millets and their impact on aging and metabolic disorders. *Journal of Functional Foods*.
- FAO & ICRISAT Reports on Millets (2021).