

Review on millets, with a focus on their nutritional benefits, agricultural significance and role in addressing global food security

Nisha Verma¹ Rajeev Kumar Yadav²

¹Department Of Botany, V.R.A.L. Rajkiya Mahila Mahavidyalaya, Bareilly

²Department Of Botany, Bareilly College, Bareilly

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Abstract

Millets, a group of small-seeded grasses belonging to the Poaceae family, have been cultivated for thousands of years. Historically regarded as a staple food in many parts of Asia and Africa, they are now being rediscovered globally due to their resilience, high nutritional value, and potential to address food security challenges. With increasing interest in sustainable agriculture and nutrition, millets are gaining recognition for their contributions to both food systems and health outcomes. Millets represent an important and often underutilized crop that holds great promise for improving global food security, enhancing nutrition, and promoting sustainable agricultural practices. Their resilience to drought, nutritional value, and low input requirements make them an ideal crop for addressing the challenges of climate change, food insecurity, and malnutrition. With increasing awareness and support from both governments and international organizations, millets could play a central role in building a more sustainable and nutritious global food system. Expanding millet cultivation, improving agronomic practices, and enhancing market demand will be key steps in realizing their full potential.

Key words – Millets, small-seeded grasses, Food Security

Introduction

Millets, a group of small-seeded grasses, have been a staple food in many parts of the world for thousands of years particularly in Asia and Africa. Their nutritional value, resilience to climate change, and adaptability to diverse ecosystems make them a topic of increasing academic interest. Here are some important millets along with their botanical names and uses.

Name	Botanical Name	Uses
Pearl Millet	<i>Pennisetum glaucum</i>	<p>Food: Pearl millet is often used to make porridge, flatbreads, and various other food products like flour, couscous, and snacks.</p> <p>Animal Feed: It is a key ingredient in animal feed.</p> <p>Health Benefits: Rich in iron, magnesium, and fiber. It is considered beneficial for heart health, managing diabetes, and improving digestion.</p> <p>Beverages: In some regions, it's used to make fermented beverages like "bajra khichdi" or "bajra roti."</p>

Finger Millet	<i>Eleusine coracana</i>	Food: Commonly used in flour form to make porridge, dosas, pancakes, and flatbreads. Health Benefits: High in calcium, iron, and fiber. It's considered a good food for people with high blood pressure, diabetes, and those needing bone health support. Beverages: Can also be used to make a traditional drink called "ragi malt."
Foxtail Millet	<i>Setaria italica</i>	Food: Used in making porridge, rice substitutes, and in traditional dishes like upma and idlis. Health Benefits: Contains a good amount of protein, fiber, and antioxidants, and is great for managing cholesterol levels, weight management, and improving digestion
Little Millet	<i>Panicum sumatrense</i>	Food: Little millet is used in a variety of dishes like upma, porridge, and khichdi. It is often considered a good alternative to rice and other grains. Health Benefits: It is rich in vitamins and minerals, especially magnesium, phosphorus, and iron. It is good for heart health, digestive health, and is known for being easy to digest.
Kodo Millet	<i>Paspalum scrobiculatum</i>	Food: Used in cooking rice-like dishes, porridges, or made into flour for bread and snacks. Health Benefits: Rich in fiber and antioxidants, Kodo millet helps in regulating blood sugar levels and reducing cholesterol. It also has anti-inflammatory properties and supports digestive health.
Proso Millet	<i>Panicum miliaceum</i>	Food: Proso millet is used in making porridge, breakfast cereals, and snacks. Health Benefits: Rich in protein, vitamins, and minerals, it helps in promoting good digestive health and energy levels. It is also considered helpful in managing blood sugar levels.
Barnyard Millet	<i>Echinochloa frumentacea</i>	Food: Barnyard millet is commonly used in making rice-like dishes, porridge, or in place of rice or wheat in traditional cooking. Health Benefits: High in fiber, antioxidants, and protein. It is good for managing obesity, diabetes, and improving heart health

Benefits of Millets in General

1. **High in Protein:** Millets provide a significant amount of protein, often higher than rice and wheat. Proteins from millets are rich in essential amino acids like lysine, making them a good alternative for vegetarians and vegans.
2. **Rich in Fiber:** Millets are an excellent source of dietary fiber, particularly insoluble fiber. This high fiber content helps in managing digestive health, reducing the risk of constipation, and contributing to lower cholesterol levels.
3. **Minerals and Vitamins:** Millets are abundant in essential micronutrients such as iron, magnesium, phosphorus, and zinc. These minerals play crucial roles in maintaining bone health, immune function, and overall metabolic processes. Additionally, millets contain B vitamins, including niacin, riboflavin, and folate, which support energy metabolism and cellular function.
4. **Gluten-Free:** Millets are naturally gluten-free, making them an important dietary option for people with celiac disease or gluten sensitivity. The rising demand for gluten-free products has increased millet cultivation and consumption in many countries.
5. **Antioxidant Properties:** Millets contain bioactive compounds such as phenolic acids and flavonoids, which have antioxidant properties. These antioxidants help to protect cells from oxidative stress and lower the risk of chronic diseases like cancer, diabetes, and cardiovascular diseases.
6. **Low Glycemic Index:** Millets have a low glycemic index (GI), making them a favorable food for managing blood sugar levels, especially in people with diabetes. This characteristic promotes slower absorption of glucose, preventing rapid spikes in blood sugar.

Millets are versatile, nutritious, and can be used in a variety of dishes, making them an excellent choice for a healthy and sustainable diet. Academic review of millets, with a focus on their nutritional benefits, agricultural significance, and role in addressing global food security.

Nutritional Profile of Millets

Millets are highly nutritious and are considered an excellent source of energy. They are rich in carbohydrates, fiber, vitamins, and minerals, making them a valuable part of human diets, especially in developing countries. Commonly cultivated varieties such as pearl millet, finger millet, and sorghum contain significant amounts of protein (typically 7–12%), essential amino acids (including lysine and methionine), and micronutrients like calcium, iron, and potassium. Additionally, millets are gluten-free, making them suitable for individuals with celiac disease or gluten intolerance.

A review by Reddy et al. (2016) highlighted that millets are a particularly good source of B-vitamins (like niacin and folate) and antioxidants. The high fiber content of millets also promotes digestive health and helps regulate blood sugar, making them beneficial for individuals with diabetes. Moreover, the bioavailability of nutrients in millets is enhanced by the presence of certain fermentation and processing techniques, which increase the absorption of iron and calcium.

Agronomic Significance of Millets

Millets are hardy crops, well-suited to dry and semi-arid regions, where other staple crops like rice or wheat may fail. They have a relatively low water requirement and are resistant to pests and diseases, making them

ideal candidates for sustainable farming in water-scarce areas. The resilience of millets to high temperatures, drought, and poor soil conditions makes them an important crop in the context of climate change, as they can help stabilize food production in regions facing erratic weather patterns.

Research has shown that millets have a shorter growing period compared to other cereal grains, which allows farmers to grow multiple crops within a single year. This characteristic can enhance agricultural productivity and reduce food insecurity in regions with unpredictable weather patterns. Furthermore, millets' ability to grow in marginal soils with minimal inputs aligns with the growing demand for environmentally sustainable farming practices. A study by Yadav et al. (2018) emphasized millets' low environmental footprint, as they require fewer fertilizers and pesticides compared to major cereal crops.

Millets and Food Security

Given the increasing pressure on global food systems due to population growth, urbanization, and climate change, millets are being revisited as a potential solution to address food security challenges. They can contribute to a more diverse and resilient food system by providing an alternative to the heavily relied-upon staples like rice, wheat, and maize. The United Nations has also highlighted millets as a key crop for promoting food security in the context of sustainable development goals (SDGs), particularly in relation to combating hunger, improving nutrition, and fostering sustainable agriculture.

The high nutritional value of millets, combined with their adaptability to harsh environments, positions them as a promising option for improving food security in vulnerable regions. A report by the Food and Agriculture Organization (FAO) noted that millets could help enhance dietary diversity in areas with limited access to other nutrient-dense foods. However, widespread adoption of millet-based diets requires overcoming barriers such as lack of awareness, limited processing facilities, and insufficient market infrastructure.

Millets in Traditional and Modern Diets

In many parts of Asia and Africa, millets have been an integral part of traditional diets for centuries. For example, finger millet (Ragi) is commonly consumed in India in the form of porridge, bread, and beverages. Similarly, pearl millet is used in traditional dishes across sub-Saharan Africa. However, with the advent of modern agriculture and industrialization, the consumption of millets has declined, particularly in urban areas.

To revitalize millet consumption, several efforts are being made to incorporate millets into modern diets. Food scientists and nutritionists are developing innovative millet-based products, such as millet-based snacks, breakfast cereals, and even gluten-free baked goods. Furthermore, as consumer interest in healthy eating and plant-based diets grows, millets are gaining popularity in developed countries as a nutritious alternative to refined grains.

Challenges and Research Directions

Despite their many advantages, the widespread adoption of millets faces several challenges. One of the main issues is the lack of processing infrastructure and the limited availability of millet-based products in markets. Additionally, there is a need for further research into improving the yields of millet crops through genetic improvement and better farming practices.

Moreover, cultural and behavioral factors play a significant role in the acceptance of millets as a mainstream food source. In some regions, millets are perceived as "poor man's food," which can hinder their adoption by

wealthier segments of the population. Educational campaigns and initiatives to raise awareness about the nutritional benefits of millets are essential to changing these perceptions.

Conclusion

Millets hold great potential for improving global food security, enhancing nutrition, and promoting sustainable agriculture. Their resilience to climate change, rich nutritional profile, and suitability for cultivation in marginal environments make them an important crop in the face of modern global challenges. However, greater investment in research, infrastructure, and awareness-building is needed to realize the full potential of millets in modern diets and agriculture. As the world continues to grapple with food security and climate change, millets could play a vital role in building a more sustainable and diverse food system.

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