



Millets: The Eco-Friendly Superfood Revolutionizing Sustainable Food Systems

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Introduction:

The small-seeded grains known as millet crops have been grown for many years in India. Millets belong to minor cereals in the grass family Poaceae. Millets are cereal crops grasses with small-seeded structures planted in diverse tropical and desert climates with the capacity to thrive in less rich soil. The millets are enrooted to becoming a worldwide phenomenon. The United Nations (U.N.) has decided to designate 2023 as the international year of millets, a resolution sponsored by India and supported by more than 70. Millets also called small millets are cultivated for their small kernels which are the products of small grassy plants belonging to the Poaceae family. The other name minor millets may indicate them to be minor crops yet are important for their nutritional values, medicinal benefits, feed for animals, and saviors during food crisis (Yenagi *et al.*, 2010). The French word "mille," which means thousand, is where the word "millet" comes from, suggesting that a handful of millets contains thousands of grains. Millets are frequently cultivated on marginal or degraded fields with very low nutrient levels and in semi-

arid environments with little rainfall. In regions where famine is a common occurrence, the crops provide a living for people, and in regions with little rainfall, millets provide a more consistent crop than other crops. Millets are small-seeded with different varieties such as pearl millet (*Pennisetum glaucum*), finger millet (*Eleusine coracana*), kodo millet (*Paspalum setaceum*), proso millet (*Penicum miliaceum*), foxtail millet (*Setaria italica*), little millet (*Panicum sumatrense*), and barnyard millet (*Echinochloa utilis*). They are known as coarse cereals beside maize (*Zea mays*), sorghum (*Sorghum bicolor*), oats (*Avena sativa*), and barley (*Hordeum vulgare*). Millets are C₄ plants with very superior photosynthetic efficiency, short duration, higher dry matter production capacity, and a high degree of tolerance to heat and drought. They also easily adapt to degraded saline, acidic and aluminum toxic soils (Yadav and Rai, 2013). These extraordinary characters of millets make them suitable crops to tackle the hurdles of climate change and formulate millet-based climate resilient technologies. Millets are not currently regarded as a single

significant item in the North American and European food basket, but their value as a component of multigrain and gluten-free goods has been emphasized. However, millet is a staple crop in many African and Asian regions, and it is used to make a variety of traditional dishes and drinks, including porridges, bread (fermented or unfermented), and snack foods, particularly among the less affluent portions of their respective societies. The world's largest producer of millet is India. In 2020, the two millets grown in India, Pearl Millet (Bajra) and Sorghum (Jowar), would account for roughly 19% of global production. In 2020, India produced 40.51% of the world's pearl millet, followed by 8.09% of the millet produced by sorghum. Rajasthan, Karnataka, Maharashtra, Uttar Pradesh, Haryana, Gujarat, Madhya Pradesh, Tamil Nadu, Andhra Pradesh, and Uttarakhand are the leading millets-producing states in India. Currently, these ten states collectively account for almost 98% of India's millet production in 2020–21.

Millet Crop Overview:

A small-grained cereal plant belonging to the Poaceae family is millet. They are notable for their resilience, versatility, and high nutritional content. It is often recognized that millets can withstand harsh environmental conditions, including regions that are prone to drought and have little soil fertility. Their short growth season and suitability as rainfed crops make them ideal for small-scale and subsistence farming. Millet crops are

extremely versatile and can be used for a variety of purposes, including as animal feed, human consumption, and industrial activities (Chaudhary *et al.*, 2020). Due to their lack of gluten and low glycemic index, they are suitable for people with dietary restrictions or health issues. Additionally abundant in dietary fiber, antioxidants, and minerals (iron, calcium, and phosphorus), millet supports a healthy diet (Saxena *et al.*, 2018).

Finger Millet (Ragi): The ear heads of the crop resemble finger of human hand thus giving it the name. The probable origin of Ragi or Finger millet is highlands of Ethiopia and Uganda. one of the most extensively grown millets in India is called finger millet (Ragi), which is also known by its scientific name, *Eleusine coracana*. It is generally grown in hilly and southeastern states. Ragi is used to make a range of foods, including porridge, roti, and malted beverages. Ragi is noted for its high nutritional value, particularly calcium and iron.

Pearl Millet (Bajra): Pearl millet, also known as *Pennisetum glaucum*, is a drought-tolerant millet crop that is mostly cultivated in arid and semi-arid regions of India. It is an essential staple food in areas like Rajasthan, Gujarat, and Haryana. Pearl millet grains are used to make animal feed, porridge, and rotis (flatbread).

Foxtail Millet (Kangni): Foxtail millet, scientifically known as *Setaria italica*, is a widely grown crop in the Andhra Pradesh, Tamil Nadu, and Karnataka states. It is known for having a high protein content

and is used to make a variety of dishes, such as dosa, pulao, and upma.

Little Millet (Kutki): Little millet (Kutki) is a small-grained millet crop grown in the arid parts of Its scientific name is *Panicum sumatrense*. It is often used in the southern states to make traditional cuisines like idli, dosa, and Pongal.

Nutritional Values of Millets:

Because of the overindulgence in processed junk food over the past few decades, there has been an exponential rise in the incidence of obesity and diabetes. There is a surge in the demand for foods that are high in dietary fiber, complex carbs, and advantageous phytochemicals in order to fight them (Shobana *et al.*, 2007). The high gluten content in wholegrain cereals like wheat and rice makes it difficult to generate nutritious diets or nutraceuticals, even if research is being done to biofortify these cereals with phenolic acids that impart antimutagenic, antiglycemic, and antioxidative effects.

Different Food Items Made from Millets Flour:

Flatbreads: These are staple foods in Africa. The millet flours undergo a specialized fermentation treatment with yeast and lactic acid bacteria that yields soft leavened textured bread with acidic flavor.

Rotis or chapatis: These are the most well-known unfermented flatbreads made from millets and are popular staple foods of India. Rotis or chapatis resemble a soft pancake with a flexible puffed texture.

They are usually served with pickles, vegetables, chutney, meat, or sauce.

Dosa and Idli: These products are popular in southern parts of India, the semi-fermented millet flour is used in making dosas and idlis, that are served with sambar or chutney.

Couscous: It is pasta-like culinary prepared from semolina of millets in North Africa. The semolina is steamed and agglomerated stirred with yogurt and consumed. Usually, the couscous products are categorized based on the size of the particle of semolina used.

Health Benefits of Different Millets:

Millets are also documented for their beneficial health effects like antioxidant activity, anti-diabetic, anti-tumorigenic, atherosclerogenic effects, and antimicrobial properties (Yang *et al.* 2012). The products derived from finger millet are useful for the growth of bone mass in growing children, as well as for the prevention of osteoporosis and other bone disorders in adults and aging populations. Finger millet seed coat is rich in phytochemicals like polyphenols and nutritional fiber and is also very excessive in minerals specially calcium. Due to excessive polyphenolic content inside the seed coat of finger millet reduces the threat of most cancers and diabetes and excessive fiber that promotes sluggish digestion and blood sugar balance (Muthamilarasan *et al.*, 2016). Barnyard millet sprouted seed is astringent, acidic, emollient, and stomachic. It is used for the treatment of abdominal dyspepsia, impaired digestion,

and nutritional stagnation. White seeds are refrigerant and are used in cholera and fever care. Proso millet has a higher protein content (11% dry basis) and a higher concentration of important amino acids (methionine, leucine, and isoleucine) than wheat. It can be prepared and cooked in a variety of ways. The grains can be cooked entirely, boiled, or steamed to form salad. This is similar to rice. Proso millet is used to manufacture fermented drinks in Asia and Africa, and it can be utilized as a substratum in distilled liquors and beers. The intake of proso millet and other millets is associated with a decreased risk of type 2 diabetes mellitus because whole grains are a rich source of magnesium. Like most millets, foxtail millet has a laxative effect that promotes a balanced digestive tract. It is also an excellent source of crude fiber, aids in digestion, and encourages bowel movement. Glycemic load (GL), which reflects both the quality and quantity of carbohydrates in food and allows comparison of the potential glycemic impact of practical food portions and low glycemic index foods like kodo, has been shown to increase in both healthy and diabetic subjects (Riccardi *et al.* 2008). Kodo's water-soluble fiber can be used to maintain or minimize blood glucose response in patients with diabetes and cardiovascular disease.

Millets Are Cure for Coronary Diseases:

Millet grains are a nutritional powerhouse that can successfully reduce coronary stenosis and improve heart health. They contain magnesium, potassium, and plant lignins, which work as vasodilators to

lower blood pressure and lower the risk of heart attacks and other cardiovascular diseases. Millets' high fiber content boosts the body's benefits of HDL (High Density Lipoprotein) and lowers cholesterol, removing LDL (Low Density Lipoprotein) from the system.

Millets Can Manage Sugar Level to Tackle Diabetes: Millets are a rich source of magnesium that helps in stimulating the level of insulin in the body and thus increase the glucose receptors' efficiency in the body. This in turn helps in a healthy balance of sugar level in the body thus reducing the chance of type-I and type-II diabetes (Saleh *et al.*, 2013).

Millets Help in Detoxification (Antioxidant Properties): Millets are rich in components like curcumin, ellagic acid, quercetin, and various other beneficial catechins that assist the system to clear any toxins and xenobiotics by promoting appropriate excretion and neutralizing enzymatic activity. More than 50 phenolic compounds belonging to several classes, namely, phenolic acids and their derivatives, dehydrodiferulates and dehydrotriferulates, flavonols, and flavones, flavan-3-ol monomers and dimmers, etc., are greatly crammed in millets and can be utilized as functional food ingredients and as sources of natural antioxidants.

Environmental Benefits of Millet Cultivation:

Drought Tolerance and Water Use Efficiency: Due to millet's exceptional drought resistance and water-saving

qualities, growing it offers significant environmental benefits. Millet crops may be grown in places with limited water supplies because they have evolved to thrive in dry, arid climates. They need a lot less water than other major cereal crops like wheat and rice. Millet crops have developed adaptations for water scarcity and water-saving strategies. They are less dependent on sources of surface water because to their extensive root systems, which enable plants to take in water from the soil's deeper layers. The ability of millets to maintain productivity under rainfed conditions or with little irrigation contributes to water conservation and lessens the burden on water supplies.

Improvement of Soil Health: Millet cultivation is essential for enhancing the fertility and health of the soil. These plants have fibrous roots that improve soil structure and raise the level of organic matter. The large root system of millet plants aids in soil agglomeration, prevents soil erosion, and increases the soil's ability to retain water. Additionally, millets are regarded as crops with modest nutrient requirements. They are appropriate for cultivation on nutrient-deficient soils because of their capacity to effectively utilize the available nutrients in the soil (Joshi, 2018).

Biodiversity Preservation: Millet crop farming helps to preserve biodiversity in agricultural environments. Millets are frequently cultivated using conventional and organic farming methods, which support biodiversity by sustaining

conventional seed variants and the diversity of agroecosystems.

Minimizing Chemical Input: Compared to other traditional cereal crops, millet production frequently requires fewer chemical inputs, such as fertilizers and insecticides. There is less need for artificial pesticides because millets are naturally resistant to illnesses and pests. Additionally, millets are less vulnerable to pest and disease infestations than other important grain crops. This encourages an environmentally benign approach to bug management and reduces the need for chemical pesticides. Millet is a sustainable option for agricultural practices because of its environmental benefits, which include tolerance to drought, effective use of water, improvement of soil health, preservation of biodiversity, and requirement for less chemical inputs.

Conclusion:

High-energy meals known as millets or nutri-cereals were first domesticated and grown as early as 10,000 years ago. The cultivation of millets is typically done on marginal and degraded land with low soil nitrogen levels and little rainfall. Finger millet, pearl millet, foxtail millet, barnyard millet, proso millet, kodo millet, and tiny millet are the seven major millets grown worldwide. The inclusion of nutrient-dense millets in our regular diets is the only method to fight back. Millets are special because of their abundance of proteins, phytochemicals, minerals, dietary fibers, antioxidants, and polyphenols;

these substances work as an elixir to combat illnesses.

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