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Review Article

Traditional wisdom, modern solutions: millets as medicine for India's tribal communities

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ABSTRACT

Millets, which are small-grained crops, are deeply rooted in Indian agriculture and food systems since ancient times. Despite their numerous health benefits, these nutritious grains have faced a significant downfall in agricultural land coverage in recent years and have been overshadowed by the popularity of crops like wheat and rice, especially after India's Green Revolution. Interestingly, for many tribal communities across the country, millets remain not only a regular dietary item but also a symbol of their cultural identity and traditions. Tribes constitute approximately 8.6% of India's population and contribute significantly to the nation's ethnic/cultural diversity. As per UNICEF data, over 40% of under-five year tribal children are experiencing stunted growth and 16% of them are profoundly stunted owing to undernutrition. Millets, often termed 'Nutri-cereals' due to their superior nutritional profile, can be an important staple food for addressing nutritional deficiencies prevailing among tribal communities. In this review, we have compiled a comprehensive literature on the dietary benefits of millets, their pharmacological properties and their integration in tribal culture, and livelihood. Additionally, we have covered the significance of millets in the sustainable development of agriculture and the circular economy of farmers.

Keywords: Millet, Nutrition, Medicine, Tribe, Non-communicable diseases

INTRODUCTION

Millets are among the earliest cultivated grains and have supported human diets for generations, valued for their diversified nutrient content, comprising complex carbohydrates, high-quality proteins, dietary fibre, and vital micronutrients. In the context of escalating climatic and resource-related challenges including climate variability, diminishing water resources, and sustained issues of food insufficiency, these adaptable drought-tolerant crops have drawn renewed national and scientific focus due to their capacity to enhance sustainable and climate-adaptive food systems. The classification of millets into major and minor millets, based on their grain size and cultivation extent.[1] Major millet includes sorghum, pearl, and finger millet, while foxtail, Kodo, little, proso, and barnyard millet are classified as minor millets.[2] In India, millets are crucial to agriculture, nutrition, and traditional diets. Globally, India ranks first in millet production, contributing 38.4% of the total production.[3] In 2023, the Government of India recognised their importance by declaring them as 'Sri Anna.'[4] Millets, comprising sorghum (Jowar), pearl millet (Bajra), finger millet (Ragi), foxtail millet (Kangni), Kodo millet, and little millet, are grown in different regions of the nation.

MILLETS IN INDIA

Pearl millet is predominantly cultivated in the arid and semi-arid zones of Gujarat, Rajasthan, Haryana, Uttar Pradesh, and Maharashtra, and serves as a key source of protein, fiber, and several important minerals and vitamins.[5] It is recognized for the management of several diseases, such as stomach ulcers, cardiovascular disorders, asthma, migraines, cancer, weight control, diabetes, celiac disease, cholesterol, and the prevention of gallstones.[6] Sorghum, adaptable to diverse climatic conditions, is widely cultivated in Andhra Pradesh, Karnataka, Maharashtra, and Tamil Nadu.[7] It is a valuable source of carbohydrates, slowly digestible starch, dietary fiber, lipids, essential minerals, and vitamins. Sorghum provides significant health benefits, especially in celiac disease, obesity, diabetes, cardiovascular diseases, cancer, and oxidative stress.[6]

Finger millet is known for its exceptional nutritional profile, rich in calcium and iron, and flourishes in the hilly terrains of Karnataka, Tamil Nadu, and Andhra Pradesh. Finger millet contains the highest minerals, with potassium (408 mg%) and calcium (344 mg%). It also contains sulphur-containing amino acids and dietary fiber in comparison to white rice. Currently, it is the primary staple food in India.[8] It has been recognized for multiple health benefits, including weight loss, promoting bone health, diabetes control, combating anaemia, alleviating asthma, and supporting liver health.[6] Foxtail millet, valued for its resilience and nutritional benefits, is predominantly cultivated in states like Andhra Pradesh, Maharashtra, Rajasthan, Karnataka, Telangana, and Tamil Nadu.[9] Studies suggest that consuming foxtail millet can contribute to lowering blood glucose levels, improve digestion, and decrease the risk of chronic diseases such as obesity, diabetes, and cardiovascular disease.[10]

Little millet is a small-seeded cereal, valued for being a significant source of dietary fiber, vitamin B, energy, protein, and minerals, such as phosphorus, calcium, and iron, as well as low carbohydrate and fat content.[11] In India, little millet is cultivated in Madhya Pradesh, Tamil Nadu, Chhattisgarh, Karnataka, Jharkhand, Odisha, Gujarat, Maharashtra, Uttar Pradesh, and Andhra Pradesh.[12] Little millet serves an essential role in the management and prevention of disease, including cancer, inflammation, cataracts, diabetes, cardiovascular conditions, and gastrointestinal ailments.[11] Kodo millet is an ancient millet that flourishes in suboptimal soil conditions and consists of about fat (1.45%), ash (2.95%), carbohydrates (65.65%) and protein (8.35%), along with vital vitamins, minerals and sulphur, valued for the management of diabetes, ageing, cancer, celiac disease, and cardiovascular disorders like hypertension and elevated cholesterol levels.[13] In India, its cultivation is concentrated in Madhya Pradesh, Karnataka, Chhattisgarh, Gujarat, and Tamil Nadu.[14] These millets contribute significantly to food security, especially in areas prone to climatic uncertainties, and are integral to the traditional food heritage of India. Figure 1 represents the distribution of millets in India and their primary cultivation regions with their significant nutritional properties.

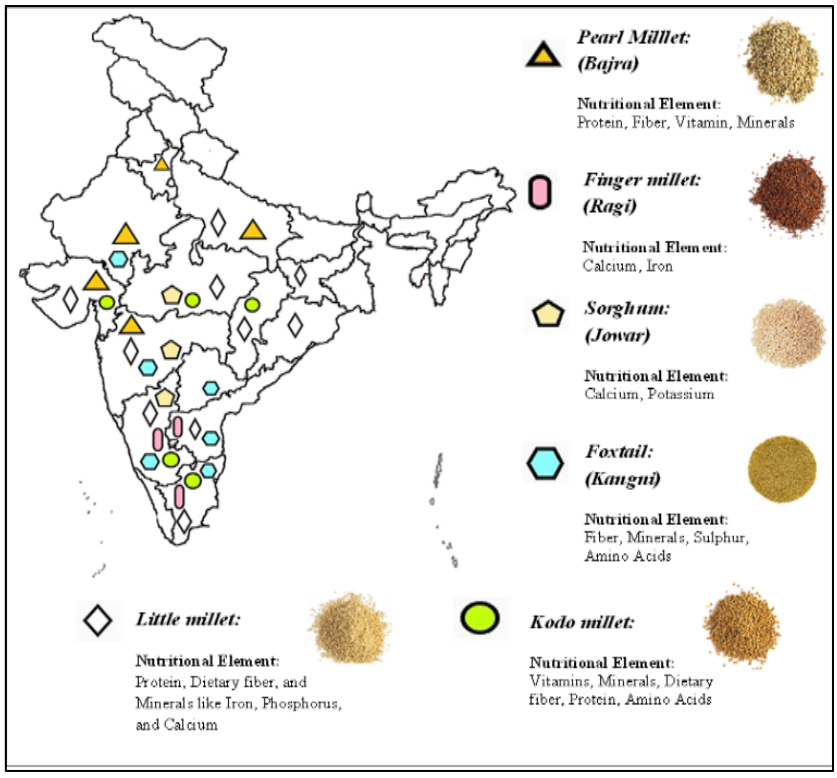

Figure 1: Millets in India.

MILLETS AS A MEDICINE

Millets are known as "superfoods" because of their high nutritional value when compared to other grains.[15] Finger millet is free from gluten with rich nutrients, including polyphenols (0.3-3%), calcium (0.38%), and dietary fiber (18%). It supports bone health, regulates blood sugar, aid digestion, reduces cholesterol, and boosts immunity. Its antioxidants help to combat metabolic diseases, oxidative stress and ageing, while antimicrobial properties facilitate wound healing. Regular consumption helps in the management and prevention of anaemia, cardiovascular diseases, diabetes, and digestive problems, making it an essential food for overall health and suitable for those with celiac disease.[16] In addition to, pearl millet is known as the "Powerhouse of Nutrition" due to its high energy, protein (8-19%), vitamins, healthy fats, and high fiber content. In addition, it also has essential micronutrients like iron, magnesium, zinc, calcium, copper, phosphorous, manganese, riboflavin, and folic acid. It is beneficial for people as it is gluten-free. Additionally, it has antioxidant properties and plays a crucial role in ageing, and its unsaturated fatty acids (75%) and phytic acid are effective in lowering cholesterol and phytate, which reduces cancer risk.[5] Pearl millet plays a crucial role in combating hidden hunger, chronic diseases and micronutrient deficiencies, rendering it essential for health improvement and national security, especially in areas struggling with malnutrition.[5]

Sorghum is a rich nutritional source containing bioactive phenolic compounds and it is free from gluten, makes it a safe and beneficial alternative for individuals with celiac diseases. The antioxidant properties of sorghum, due to its phenolic composition, aids in managing chronic diseases, promoting health, and disease prevention. Its condensed tannins and phenolic compounds, including 3-deoxyanthocyanidins, and 3-deoxyanthocyanidin-rich compositions, exhibit anticancer properties. Additionally, it contains diverse bioactive phenolic compounds that protect against cardiovascular diseases and dyslipidemia. Its lipids, including polycosanols and phytosterols, support cardiovascular health by managing cholesterol absorption, synthesis, and excretion.[17] Similarly, little millet is also gluten-free, makes it suitable for those with gluten intolerance or celiac diseases. It is a valuable source of potent antioxidants, including flavonoids, phenolic compositions, polyphenols, and tannins, which are essential for promoting health by contributing to the prevention and management of diseases like cardiovascular diseases, inflammation, cataracts, cancer, gastrointestinal disorders, and diabetes. The bioactive properties of polyphenols include anti-inflammatory, neuroprotective effects, anticarcinogenic, and antiviral, which further emphasise their substantial potential health benefits.[11]

Kodo millet helps to reduce oxidative stress and maintains glucose levels in type-2 diabetes, attributable to its high antioxidant content. As a gluten-free food, it is beneficial for those with gluten intolerance, and it is easily digestible due to the presence of lecithin. Furthermore, Kodo millet is beneficial for postmenopausal women exhibiting cardiovascular risk, including hypertension and high cholesterol, and it reduces the risk of cardiovascular disease due to a higher amount of radical scavenging activity. Additionally, it contains phenolic acids, phytes and tannins that contribute to preventing breast and colon cancer in animals, highlighting its potential in cancer prevention.[14] Furthermore, foxtail millet offers numerous medicinal properties that support human health. It has both hypolipidemic and antioxidant properties. Due to its low glycemic index, it is beneficial for those suffering with diabetes. It is rich in resistant starch and high in antioxidant level, which helps to reduce inflammation and potentially promote anti-cancer and anti-ageing benefits. It supports digestive health as it is naturally gluten-free and contributes to overall nutrition owing to its rich content of amino acids, vitamins, minerals, and fatty acids. Additionally, its astringent properties are due to high tannin content, assisting in the improvement of appetite. The grain also shows diuretic effects by supporting gallbladder function and serves as an emollient, promoting softer skin.[18]

Table 1 delivers a clear summary of the millets that are cultivated in India. It outlines their key regions of cultivation, vital nutritional components, and corresponding medicinal benefits.

Table 1: summary of the millets that are cultivated in India.

Millets	State	Nutritional elements	Prevention and management of the diseases
Pearl millet (Bajra)	Gujarat, Haryana, Uttar Pradesh, Rajasthan, and Maharashtra	Protein, fiber, vitamins, minerals	Stomach ulcers, cardiovascular disorders, asthma, migraines, cancer, diabetes, celiac disease, cholesterol control, gallstones
Finger millet (Ragi)	Karnataka, Tamil Nadu, Andhra Pradesh	Dietary fiber, minerals, sulphur, amino acids	Obesity, bone health, diabetes, anaemia, asthma, liver disorders
Sorghum (Jowar)	Maharashtra, Karnataka, Madhya Pradesh	Carbohydrates, slowly digestible starch, dietary fiber, lipids, minerals, vitamins	Celiac disease, obesity, diabetes, cardiovascular diseases, cancer, and oxidative stress

Continued.

Millets	State	Nutritional elements	Prevention and management of the diseases
Foxtail (Kangni)	Tamil Nadu, Karnataka, Andhra Pradesh, Rajasthan, Telangana, Maharashtra	Fiber, Minerals, Sulphur-containing amino acids	Blood glucose levels, digestion, diabetes, cardiovascular disease, obesity
Little millet	Tamil Nadu, Andhra Pradesh Jharkhand, Chhattisgarh, Karnataka, Maharashtra, Madhya Pradesh, Gujarat, Uttar Pradesh, and Odisha	Energy, protein, dietary fiber, minerals, Carbohydrates, fats	Cancer, reduces inflammation, cataracts, diabetes, cardiovascular conditions, gastrointestinal ailments
Kodo millet	Gujarat, Karnataka, Chhattisgarh, Madhya Pradesh, Tamil Nadu	Protein, fat, carbohydrate, ash, vitamins, minerals, sulphur	Diabetes, ageing, cancer, celiac disease, cardio-vascular diseases like high blood pressure and high levels of cholesterol

SITUATING THE IMPORTANCE OF MILLETS FOR TRIBAL HEALTH

Tribes have a deep connection with nature, where plants play an important role in their culture and daily life.[19] The majority of tribal people are consuming millets in their diet from the traditional knowledge passed down from their ancestors, which also keeps them disease-free.[20] Among the plants, millets stand out and impact broader societal well-being and environmental sustainability, its relevance is more than just tribal communities.[21] Unlike conventional crops like wheat and rice, which often rely heavily on fertilisers and pesticides, millets require fewer inputs, making them more conducive to sustainable agricultural practices.[22,23] This aligns with the traditional wisdom of indigenous tribes in India, who have historically practised sustainable agriculture, including the cultivation of millets. However, the advent of the green revolution disrupted these age-old practices, adversely affecting tribal communities who had long relied on millets for sustenance.[24]

Acknowledging the significance of millets, the Indian government has recently begun promoting their cultivation and consumption.[25] This initiative not only addresses the pressing issue of food security but also contributes to achieving broader sustainable development goals. Millets, once considered the tribal food, have now gained recognition for their medicinal properties and nutritional value, offering a modern solution to environmental and health challenges.[26] As, by the pretreatment and processing of most millets, vitamins, minerals, and dietary fibre content got improved, which made it a more nutritious and balanced diet.[27] With their low cultivation costs and inherent medicinal properties, millets offer a pathway to economic empowerment and enhanced well-being among tribal populations.[26]

Tribal communities in India confront a multitude of health challenges, ranging from malnutrition to communicable and non-communicable diseases.[28] These health issues are intricately linked to various factors, including limited access to healthcare, insufficient nutrition, and evolving dietary habits.[29,30] Notably, the declining consumption of traditional foods like millets stands out as a prominent factor contributing to the declining health status of these communities.[31] However, recent years have witnessed a stark reduction in millet availability, while interventional studies have demonstrated that millets can significantly contribute to alleviating malnutrition and enhancing mineral intake in tribal communities.[32,33] Consequently, the continued reduction in millet production may contribute to a higher burden of malnutrition, particularly among tribal populations. UNICEF highlights that undernutrition remains a serious concern among tribal children, with stunting affecting over 40% of those under five years of age, and severe stunting observed in around 16%.[34] Millets were once the primary sustenance for tribal communities.[35] Yet, the arrival of high-yielding rice and wheat varieties has precipitated a sharp decline in millet consumption, consequently depriving individuals of essential nutrients crucial for holistic growth and development.[36] The United Nations' commitment to ending hunger by 2030 resonates with the imperative to promote millet consumption, particularly among tribal communities.[37] The year 2023, known as the International Year of Millets, highlights the crucial role of these grains in fostering nutrition security and sustainable food systems while safeguarding traditional crops and biodiversity.[38]

CONCLUSION

Reintroducing millets into the diets and agricultural systems of tribal communities in India offers a holistic solution to address the nutritional deficiencies and livelihood challenges. Millets are rich in essential nutrients and bioactive compounds; they help in strengthening immunity and reducing the burden of malnutrition and other diet-related diseases among vulnerable tribal populations. Their low-input, climate-resilient nature makes them highly suitable for cultivation in tribal regions, aligning with traditional knowledge systems while enhancing food security and economic self-reliance. The Government of India has acknowledged

millets as "Sri Anna," and their promotion during the International Year of Millets (2023) reflects a strategic commitment to leveraging millets as traditional crops in advancing key Sustainable Development Goals (SDG), particularly Zero Hunger, Good Health and Well-being, and Responsible Consumption and Production. Promoting millet-based food systems not only restores indigenous food cultures but also contributes to livelihood opportunities, environmental sustainability and tribal empowerment. It is the urgent need to revive and mainstream this forgotten grain in the context of sustainable and inclusive growth.

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