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## Small Millets and Human Health

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### Abstract

The term "millets" is derived from the word "mil" or "thousands," alluding to the significant number of grains produced from a single seed. However, the Hindi word "Kadann" is derived from the Sanskrit word "Kadannam," which originally referred to the food of the poor or "Nindit Ann." This classification doesn't accurately represent millets, as they are a nutritional powerhouse for human health. Some millets, like barnyard and pseudo millets (such as Amaranthus and buckwheat), are consumed during fasts and boast high nutritional value. Millets encompass a diverse group of crops and play a crucial role in rainfed farming, providing livelihoods to nearly 50% of India's rural workforce and supporting 60% of the country's cattle population. Millet grains are rich in protein, fiber, calcium, and minerals, offering a means of ensuring nutritional security for those who cannot afford a diverse diet. Despite their nutritional and medical benefits, millet cultivation has been on the decline. Immediate policy and market support, value addition, and promotional activities are necessary to revive millet production. Increasing productivity and stimulating demand should be the twin goals. The development of healthy millet-based foods and their commercialization should receive focused attention, particularly in urban areas, to expand millet consumption beyond traditional rural communities. Millets were nearly forgotten until the last decade, but they are now making a significant comeback due to their nutritional superiority and climate resilience. However, breeding efforts for small millets, including finger millets, have lagged behind those for crops like sorghum and pearl millet. Recombination breeding, which can enhance yield potential and climate resilience, has not been fully explored, primarily due to the autogamous nature of small millets. It is essential to prioritize the development of small millets as future climate-smart crops.

**Keywords:** Small millets, Nutritional powerhouse, yield enhancement, climate resilience.

### Introduction

Small millets are warm-season cereals primarily cultivated in semi-arid tropical regions across Asia and Africa under rainfed farming systems. This group of small millets includes finger millet (*Eleusine coracana*), kodo millet (*Paspalum scrobiculatum*), proso millet (*Panicum miliaceum*), foxtail millet (*Setaria italica*), little millet (*Panicum sumatrense*), and barnyard millet (*Echinochloa frumentacea*). Small millet grains are rich in dietary energy, vitamins, various minerals (particularly iron, calcium, and zinc), insoluble dietary fiber, and phytochemicals with antioxidant properties, making them a category known as "Nutri-cereals." These grains contain compounds that are beneficial in combating various chronic diseases, including ischemic strokes, cardiovascular diseases, cancer, obesity, and type II diabetes.

Small millets have played a significant role in the food staples of human history, particularly in Asia and Africa, with India, Nigeria, and Niger being notable producers. India, in particular, is the world's largest producer of millets, with finger millets being a prominent variety. However, there has been a steady decline in the area of small millets in India, except for finger millets, which have been made possible by the widespread cultivation of high-yielding and blast-tolerant varieties.

Under the challenges of climate change, millets exhibit a greater ability to grow compared to other cereals, thanks to their agroecological traits, nutritional quality, and capacity to meet immediate food security needs. They have better water and nitrogen use efficiency, making them more resilient to water-limiting conditions. For example, foxtail millet requires less water to produce 1 kg of dry matter compared to wheat and maize. They are also rich in micro and macronutrients, total protein, fiber, and resistant starch. For instance, finger millet is high in calcium and potassium, while little millet and barnyard millet have a high iron content.

Small millets are also gluten-free, which simplifies the creation of low glycemic index products. India is a major producer of these minor millets, and there is significant potential for developing value-added products from them that can provide health benefits. Millets can be considered functional foods, as they contain bioactive ingredients with physiological benefits and the potential to combat chronic diseases. They act as natural antioxidants, protecting various bodily components from the harmful effects of reactive oxygen species, which can lead to conditions like carcinogenesis, cardiovascular diseases, and aging. Carotenoids found in millets are known to prevent atherosclerosis and maintain the normal functioning of the immune system and retinas in the eyes.

### Distribution of Small millets in Indian States

Finger millet stands out as the most popular small millet crop and is cultivated across numerous states in India. This versatile crop thrives in all regions of the country, spanning from Central, Southern, Eastern, and Western, to Northern India, growing at altitudes ranging from sea level to as high as 8000 feet. The decline in the cultivation area of finger millet has been relatively modest, primarily due to enhancements in productivity. In contrast, other small millets have witnessed a more significant than 50% reduction in their cultivation areas, leading to a corresponding decline in the overall production in the country.

The productivity of these small millets has remained low and stagnant, hovering at around 450 kg per hectare. While comprehensive and up-to-date statistics for each small millet variety are still lacking, it's evident that over 60% of the cultivation area for small millet is dominated by finger millet. Following distantly are little and kodo millets, each occupying just above 10% of the cultivation area, with barnyard, foxtail, and proso millets following suit.

Despite small millets being cultivated in nearly every state of India, the distribution of individual millet varieties is not uniform. Kodo, little, and foxtail millets find widespread cultivation in Karnataka, Tamil Nadu, and Andhra Pradesh.

### High-yielding varieties of small millets

Table:1 High yielding of small millets(hariprasanmal *et al.*,2016)

S.No.	Crop	Varieties	Yield(kg/ha)	Duration(days)	Recommended area state	Scientific name
1.	Finger millets (Ragi)	CO-15	3233.00	115-125	All states	Eleusine Corocans(L)
		Viale-352	3300.00	95-100	U.K.	
		Indira ragi	2600.00	120-125	C.G	
		PPR-2700	2600.00	105-115	Orisa, MHAP	
		KMR-204	3000.00	100-105	Karnataka	
		JPU-67	4000.00	110-120	All states	
		KMR-301	5000.00	120-125	Karnataka	

2.	Little millets(kutaki)	OLM-217	2800.00	105-110	CS,Orisa,Gujarat	Panicum sumatrense(L)
		OLM-208	1200.00	100-105	CS, MP	
		OLM-36	2800.00	95-100	All states	
		OLM-203	2500.00	105-110	All states	
3.	Kodo (Rice grass)	Indira kodo	2500.00	100-105	MP	Paspalum scrobiculatum(L)
		TANU-86	2700.00	95-110	CS	
		DPS-9-1	2600.00	105-115	All States	
		JabahaKodo-98	2600.00	100-105	MP	
4.	Foxtail millets(kangani)	SIA-3156	2000.00	85-90	All states	Setaria itelica(L)
		SIA-3088	2000.00	70-75	All states	
		HMT-100-1	2500.00	90-95	Karnataka	
		Luxmi	2500.00	80-85	All States	
5.	Barnyard millets (sava)	CO-2	2200.00	95-100	Tamil Nadu	Echinochloacrusgalli(L)
		PRJ-	2500.00	115-120	U.K	
		BL Madira-127	2200.00	75-80	U.P,Gujrat	
6.	Proso millets (chena)	TNU-202	2000.00	70-75	All States	Panicum Miliaceum
		CO-5	2300.00	70-75	Tamil Nadu	
		TNU-145	2000.00	70-75	All states	

### Nutritional Importance of small millet

Millets are traditional staple foods in many dryland regions worldwide. In India, they are cultivated across approximately 17 million hectares, resulting in an annual production of 18 million tonnes, and they contribute significantly, accounting for 10% of the country's food grain production. Millets, often referred to as "Nutri-cereals," are known for their exceptional nutritional content, which includes protein, essential fatty acids, dietary fiber, B vitamins, and various minerals such as calcium, iron, zinc, potassium, and magnesium. These grains are associated with a range of health benefits, including blood sugar level reduction for those with diabetes, blood pressure regulation, thyroid health, and the prevention of cardiovascular and celiac diseases. Despite their impressive nutritional value, the direct consumption of millet as a primary food source has considerably declined over the past three decades.

The significance of nutrition as the cornerstone of healthy development is frequently underestimated. Today, individuals are increasingly conscious of their health and strive to combat metabolic disorders and lifestyle-related diseases. The National Agricultural Innovation Project (NAIP) on millet value chains facilitated the establishment of an institutional mechanism, forming a consortium of stakeholders in a public-private partnership, creating a win-win situation for each party involved. These collaborative efforts led to processing interventions and product development using small millets, which exhibited encouraging nutritional values. Extensive research on nutrition and health benefits was conducted under the supervision of the National Institute of Nutrition, with micronutrient studies and findings reported in terminal reports. These products were shown to have a relatively low glycemic index and glycemic load compared to wheat-based products. Commercialization efforts have expanded to include all millets, even though consumer awareness of their nutritional and therapeutic values remains limited. The health branding of millets has been underexploited, despite these grains being known for their rich composition of nutrients and minerals.

Small millets, including Finger millet, Kodomillets, Proso millet, Foxtail millet, Little millets, and Barnyard millet, are vital staples for millions of people worldwide. Typically grown in rainfed areas with low rainfall, they hold great importance for sustaining agriculture and ensuring food security. While these millets are widely consumed by humans in many developing countries, their use has been primarily limited to animal feed in developed nations. Nutritionally, millets are on par with major cereals and serve as excellent sources of

protein, micronutrients, and phytochemicals. Processing methods like soaking, malting, decortications, and cooking can affect the antioxidant content and activity of millet. Small millets contain about 10% protein and 3.5% lipids, with finger millets having a higher protein content, ranging from 12-16%, and 2.5% lipids. Additionally, millets are rich sources of vitamins and minerals, making them a valuable component of a balanced diet.

### Nutritional value of small millets

Millets are extensively grown and popular grains in arid and semi-arid regions around the world. Their significance goes beyond being a staple food, as millets offer a versatile solution to various global challenges due to their abundant vitamins, minerals, phytochemicals, and antioxidants. These grains are a rich source of not only vitamins but also flavonoids, including apigenin, catechin, daidzein, orientin, isoorientin, luteolin, quercetin, isovitexin, myricetin, sponarin, violanthin, lucenin-1, and triclin. Additionally, the presence of essential amino acids enhances the nutritional potential of millet. The substantial antioxidant content found in small millets plays a crucial role in reducing oxidative stress in both humans and animals by significantly reducing the generation of reactive oxygen species (ROS). Many bioactive components in millet are known to mitigate cardiovascular risks, diabetes, aging, and even cancer. Nevertheless, the nutritive and therapeutic potential of these bioactive compounds in small millets remains largely unexplored, and a comprehensive review incorporating available data from the literature is notably absent. This write-up aims to consolidate recent advancements, covering nutritional properties, processing technologies, their impact on reducing anti-nutritional factors, improving nutrient bioavailability, and the potential health benefits associated with small millets.

**Table:2 Average carotenoid content and total antioxidant activity of millets**

Millets	Average carotenoid content( $\mu$ /100g	Average total antioxidant activity
Finger millet	199 $\pm$ 77	15.3 $\pm$ 0.6
Foxtail millet	173 $\pm$ 25	5.0 $\pm$ 0.4
Little millet	78 $\pm$ 19	4.7 $\pm$ 1.1
Proso millet	366 $\pm$ 104	15.3 $\pm$ 0.6

**Note: the percentage contribution of the free bound fraction to total anti-oxidant activity and values are extracted from Adom and Liu**

During the International Year of Millets in 2023, Indian Prime Minister Mr. Narendra Modi emphasized the historical significance of millets, noting that they have been cultivated by humans since ancient times and have served as a crucial food source in the past. He underscored the current necessity of transforming millets into a prominent food choice for the future.

### Conclusion

In recognition of the vital role millets play, 2023 has been designated as the International Year of Millets by FAO. Millets are classified into two categories: major millets, including pearl millet and sorghum, and minor or small millets, which encompass finger millet, foxtail millet, little millet, proso millet, kodo millet, and barnyard millet. Among these, the small millets, often termed minor millets, hold significant importance due to their exceptional nutritive values.

Small millets are particularly rich in soluble fiber, which can effectively capture and reduce the levels of cholesterol in your bloodstream, thus lowering the risk of atherosclerosis and heart disease. They also serve as an excellent source of magnesium, contributing to heart health and potentially preventing heart failure. Millets are packed with tannins, phytates, and phenols, which can be beneficial in conditions like high blood pressure, diabetes, and high cholesterol.

Finger millet, among the small millets, stands out as an outstanding source of B Vitamins, playing crucial roles in various bodily functions, from brain health to cellular division. Vitamin B9, also known as folate, is necessary for the production of healthy red blood cells. Moreover, millets are abundant in protein and calcium, offering more essential amino acids than most other cereals. They are also rich in Vitamins A and B, phosphorus, potassium, antioxidants like niacin, and iron.

To provide a nutritional overview, a quarter-cup of dry millet contains approximately 189 calories, 5.5 grams of protein, 2 grams of fat, 36.5 grams of carbohydrates, 4.25 grams of fiber, and less than 1 gram of sugar. Its sodium content is minimal at 2.5 mg. Like other grains such as wheat or corn, millets are not low in calories, so it's advisable to consume them in moderation.

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