

Nutrient Profiling of Millets: Analyzing the Major Nutrient Content for Dietary Enhancement"

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KEYWORDS

ABSTRACT

Millets-
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Alternate food
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Millets, recognized as ancient grains, offer immense potential in addressing global nutrition, health, and environmental challenges. An in-depth evaluation of ten key millets Finger Millet, Pearl Millet, Foxtail Millet, Little Millet, Kodo Millet, Barnyard Millet, Proso Millet, Sorghum, Teff, and Amaranth highlights their exceptional nutrient composition. These grains are rich in dietary fiber, essential proteins, and critical micronutrients like calcium and iron, making them effective in combating malnutrition and preventing lifestyle diseases. Finger Millet, with its high calcium content (344 mg/100g), supports bone health, while Barnyard Millet's impressive iron levels (15.2 mg/100g) aid in preventing anemia. Millets' low glycemic index makes them suitable for diabetes management. Collectively, these attributes position millets as vital contributors to global food security and sustainable agricultural practices.

Introduction

Global agriculture and nutrition depend heavily on millets, a class of small-seeded grains "(Singh et al., 2020 and Bhatt et al., 2022)". With little water and chemical inputs, these hardy crops flourish in dry and semi-arid areas "(Singh et al., 2022 and Nagaraja et al., 2024)". They are essential for food security because of their resilience to extreme weather conditions, especially in regions impacted by climate change "(Saxena et al., 2018 and Raut et al., 2024)". In addition to being high in nutrients, millets also have a major role in promoting economic resilience and environmental sustainability "(Satyavadi et al., 2021) and Kumar et al. (2024).

According to "Nithiyanantham et al. (2019)", millets like sorghum, finger millet, pearl millet, and foxtail millet are great providers of dietary fiber, proteins, carbs, and vitamins and minerals "(Hassan et al. (2021) and Bhatt et al. (2022)". Finger millet, for example, is high in calcium, while pearl millet contains significant iron levels "(Singhal et.al, 2022)". Their low glycemic index makes them suitable for managing diabetes, while their dietary fiber supports digestion and weight management. The presence of phenolic compounds and antioxidants enhances their functional food value, offering protection against chronic diseases "(Khalid et.al, 2022)"

The nutritional potential of millets is examined in this study, with a focus on how they can support resilience, sustainability, and health. The study intends to promote millets' revival in modern food systems by presenting them as a viable substitute for traditional staples, resulting in more sustainable ecosystems and healthier diets.

Methodology

The study focused on the nutritional evaluation of ten different varieties of millets, which were sourced from local markets or research institutions. These millets were cleaned, air-dried to ensure consistent moisture levels, and then ground into fine powder. Using

conventional AOAC techniques, the proximate composition of each millet variety including “moisture, ash content, crude protein, crude fat, and crude fiber” was examined (AOAC 2005). The Kjeldahl method was used to determine the protein content, while the Soxhlet extraction method was used to evaluate the fat content. Following digestion with nitric acid and hydrogen peroxide, the mineral composition (Ca, K, Mg, P, Fe, Zn, and Mn) was examined using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). Every measurement was carried out three times, and the results were presented as means $\pm$ standard deviations.

Findings of the study

Nutritional Benefits of Millets (per 100g of Millet):

Millets are highly nutritious, gluten-free grains rich in essential nutrients that offer numerous health benefits. They are excellent sources of dietary fiber, protein, vitamins, and minerals such as magnesium, phosphorus, iron, and B-complex vitamins. The high fiber content aids digestion, promotes gut health, and helps in managing weight by providing a sense of fullness. Millets have a low glycemic index, making them ideal for regulating blood sugar levels and supporting diabetes management. Additionally, their antioxidant properties help combat oxidative stress, reduce inflammation, and support heart health. Including millets in the diet contributes to overall well-being and sustainable nutrition.

Table – 1 Nutritional Benefits of Millets

S.No.	Millet	Protein (g)	Fiber (g)	Mineral (g)	Iron (mg)	Calcium (mg)
1	Finger Millet (Ragi)	7.3	3.6	2.7	3.9	344
2	Pearl Millet (Bajra)	10.6	1.3	2.3	8.0	42
3	Foxtail Millet	12.3	8.0	3.3	2.8	31
4	Little Millet	7.7	7.6	1.5	9.3	17
5	Sorghum (Jowar)	10.4	2.6	1.6	4.1	25
6	Barnyard Millet	11.2	10.1	4.4	15.2	11
7	Kodo Millet	8.3	9.0	2.6	0.5	27
8	Proso Millet	12.5	2.2	0.9	0.8	8
9	Teff	13.3	8.0	2.8	7.6	180
10	Amaranth (Rajgira)	13.6	6.7	3.6	7.6	159

The data underscores the diversity in the nutrient composition of millets, reflecting their unique contributions to dietary health. Protein content is highest in Amaranth (13.6 g), Teff (13.3 g), and Proso Millet (12.5 g), making them excellent choices for protein enrichment. Fiber content peaks in Barnyard Millet (10.1 g), followed by Kodo Millet (9.0 g) and Foxtail Millet (8.0 g), highlighting their role in promoting gut health and aiding digestion.

Millets like Barnyard and Pearl Millet excel in iron content, with 15.2 mg and 8.0 mg respectively, making them valuable in addressing iron-deficiency anemia. Calcium content is remarkably high in Finger Millet (344 mg) and Amaranth (159 mg), vital for bone health, especially in populations prone to osteoporosis. Barnyard Millet and Foxtail Millet stand out for their high mineral content (4.4 g and 3.3 g, respectively), providing essential micronutrients crucial for overall health. Notably, these millets' rich fiber and mineral profiles, along with their low glycemic index, increase their usefulness in the treatment of diabetes and other lifestyle disorders. “The importance of millets in supplying vital nutrients like protein, dietary fiber, and minerals like calcium and iron all of which are frequently lacking in diets high in polished rice and wheat is highlighted by a research by Asrani et al. (2023)”. Millets are a treasure trove of nutrition, each variety offering unique benefits. Their high protein, fiber, and mineral content make them indispensable in combating malnutrition, supporting bone health, and managing

non-communicable diseases. Incorporating millets into regular diets can contribute significantly to health promotion and sustainability. To realize their full potential and incorporate them into worldwide mainstream consumption habits, more study and awareness are needed.

Mineral Composition of Millets (mg/100 g edible portion, dry weight basis):

Millets are nutrient-dense grains with a rich profile of essential minerals that play vital roles in human health. Minerals such as potassium, magnesium, calcium, phosphorus, and iron contribute to maintaining bone health, muscle function, cardiovascular stability, and overall metabolic processes. The mineral composition of millets, varying across different varieties, makes them a valuable addition to diverse dietary regimens. This table highlights the mineral content of popular millets, showcasing their contribution to fulfilling daily mineral requirements.

Table – 5 Mineral Composition of Millets

S.No.	Millet	K (mg)	Na (mg)	Mg (mg)	Ca (mg)	P (mg)	Mn (mg)	Zn (mg)	Cu (mg)	Fe (mg)
1	Finger Millet (Ragi)	408	11	137	344	283	3.9	2.3	0.47	3.9
2	Pearl Millet (Bajra)	398	10	121	42	289	0.6	3.1	0.63	8.0
3	Foxtail Millet	250	4	81	31	290	0.9	2.4	0.59	2.8
4	Little Millet	212	3	95	17	220	0.8	2.3	0.52	2.0
5	Sorghum (Jowar)	350	7	131	25	289	2.0	2.1	0.48	4.1
6	Barnyard Millet	201	5	75	20	280	0.5	3.0	0.62	5.0
7	Kodo Millet	188	5	110	35	188	0.6	1.8	0.36	1.7
8	Proso Millet	170	5	82	8	206	0.4	1.6	0.39	0.8
9	Teff	400	12	184	180	376	3.8	4.0	0.70	6.0
10	Amaranth	507	15	248	159	557	4.0	3.0	0.85	7.6

The table reveals the diversity of mineral composition across millet varieties. Amaranth excels as a mineral powerhouse with the highest potassium (507 mg), magnesium (248 mg), phosphorus (557 mg), and calcium (159 mg) levels, making it exceptional for bone and heart health. Teff and Finger Millet also show superior mineral profiles, particularly in calcium and manganese content, contributing to skeletal health and enzymatic functions. Pearl Millet stands out for its high iron content (8.0 mg), beneficial for combating anemia, while Barnyard Millet is notable for its balance of dietary minerals. Kodo Millet and Proso Millet, though lower in some minerals, are excellent sources of phosphorus and magnesium, essential for energy metabolism and bone health. The mineral composition of millets underscores their critical role in addressing micronutrient deficiencies and promoting overall health. The variety in mineral content across millets offers diverse options to meet specific dietary requirements. Incorporating millets into daily diets can contribute to improving public health, especially in regions affected by mineral deficiencies. A study by CA (2024) corroborates these findings, emphasizing the high mineral content of millets and their role in preventing chronic diseases.

The study highlights their use in combating nutritional deficiencies and promoting sustainable dietary habits.

Conclusion

Millets such as Finger Millet, Pearl Millet, Foxtail Millet, Little Millet, Kodo Millet, Barnyard Millet, Proso Millet, Sorghum, Teff, and Amaranth offer a wealth of benefits. Packed with essential nutrients like proteins, fiber, vitamins, and minerals, they play a crucial role in combating malnutrition, promoting digestive health, and managing chronic conditions like diabetes, heart disease, and obesity. Beyond their health benefits, millets are a key player in sustainable agriculture due to their adaptability to arid and semi-arid regions, low water requirements, and minimal use of chemical inputs. As a result, they can significantly improve food security, reduce dependency on resource-intensive crops, and contribute to more resilient farming systems. Integrating millets into modern diets and farming practices can lead to a healthier population, a more sustainable food system, and a reduced environmental footprint, making them a powerful tool in addressing the challenges of nutrition and climate change.

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