

Nutritional value of millets

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Milletts include a group of small-grained cereals widely cultivated and consumed throughout arid and semi-arid parts of the world. They are agronomically superior in terms of shorter growing periods, have ability to grow in marginal lands with minimum inputs and are resistant to biotic and abiotic stresses. More importantly, the millet grains are nutritious with a carbohydrate content of about 60–68%, protein content of 6–12%, fat content of 1.7–5.4% and total ash content of about 1.3–2.7%. They are good sources of dietary fibre and micronutrients including minerals and B-vitamins. Apart from this, millets contain phytochemicals including the phenolic compounds with excellent health beneficial attributes. Owing to their excellent nutritional value and the ability to survive under changing climate scenarios, these crops may serve vital role in achieving global nutritional security in a sustainable manner.

Keywords: Climate resilience, Nutraceutical, Nutritional security

MILLETTS are among the oldest crops to be domesticated and cultivated by humans and have been a vital component of dry farming system in several Asian and African countries. Fine cereals including wheat and rice are generally preferred for human consumption, and millet grains have often been neglected since long. However, these ‘orphan crops’ remain staple food and source of nutrition to the resource-constrained farmers inhabiting arid and semi-arid tropics. Of late, with climate change and malnutrition becoming major concerns across the globe, millets have started to regain their significance owing to their nutritional quality and climate smart nature.

Milletts include the major and small millets where sorghum and pearl millet are the major millets and finger millet, foxtail millet, little millet, proso millet, kodo millet, and barnyard millet are the important small millets. These millet grains are nutrient-dense and exhibit nutraceutical properties. Also, these grains are utilized as bird feed in several countries including the United States. Apart from being nutritionally superior, these crops also exhibit several agronomic benefits including the ability to grow under harsh environmental conditions, resistance to biotic and abiotic stress, and shorter growing periods. Owing to these benefits, millets are now regarded as ‘smart foods’ which are good for the farmer, consumer, and the environment.

Nutritive value of millets

The proximate composition of millets in comparison with the commonly consumed cereals, viz. rice, wheat and maize are presented in Table 1. The energy value of millets varies from approximately 307–347 Kcal. Millets contain about 60–68% carbohydrates, 6–12% protein, 1.7–5.4% total fat, and 1.3–2.7% total ash content. The total dietary fibre content of millet grains ranges from 6–12%. Millets are good source of micronutrients including minerals and B-vitamins as well as phytochemicals with health benefits.



Millet grains
Source: ICAR-IIMR

Table 1. Proximate composition of millet grains in comparison with rice, wheat, and maize

Grain	Protein (%)	Fat (%)	Ash (%)	Carbo-hydrate (%)	Total dietary fibre (TDF)	Energy
Sorghum	9.97	1.73	1.39	67.7	10.2	334
Pearl millet	10.96	5.43	1.37	61.8	11.5	347
Finger millet	7.16	1.92	2.04	66.8	11.2	320
Foxtail millet	12.3	4.30	2.6	60.1	10.7	331
Little millet	10.13	3.89	1.34	65.5	7.7	346
Proso millet	11.5	3.5	2.7	64.5	9.6	341
Kodo millet	8.92	2.55	1.72	66.2	6.4	331
Barnyard millet	6.2	2.20	1.3	65.5	12.6*	307
Rice, raw, milled	7.9	0.52	0.56	78.24	2.81	356
Wheat, whole	10.59	1.47	1.42	64.72	11.2	321
Maize, dry	8.8	3.7	1.17	64.7	12.2	334

Source: Indian food composition tables, NIN-2017; Nutritive value of Indian food, NIN-2007; Malleshi *et al.* 2021; *Roopashree U *et al.* 2014

Carbohydrates: Similar to other cereals, carbohydrate forms the major nutritional component of millet grains. Starch constitutes the major carbohydrate in millets and represents about 55–78% of grain weight. Soluble sugars including sucrose, glucose, fructose, raffinose, stachyose form the minor carbohydrate fraction of millets.

Dietary fibre: The dietary fibre components are concentrated on the pericarp and endosperm part of the grain. Millets are good source of dietary fibre. Both major and small millets possess dietary fibre higher than rice while, pearl, finger and barnyard millet possess dietary fibre comparable to or better than wheat.

Proteins: Millet grains are good source of protein. They possess higher protein content as compared to rice and maize, and on par with wheat. Among the millet grains, foxtail and proso millet have the highest protein content (~12.3 and 11.5%, respectively), which is higher than the protein content of wheat (10.6%). Regarding the amino acid composition, like most cereals, millets are deficient in lysine. Pearl millet has a balanced essential amino acid composition, among the millet grains. Being gluten-free, these grains are a source of protein for people who suffer from celiac disease.

Fat: Fat or lipids are mainly concentrated on the germ layer of millet grains. The fat content of these grains varies from 1.7% in sorghum to 5.4% in pearl millet. The relatively higher fat content of the pearl millet partly explains the shorter shelf-life of pearl millet flour. Regarding the fatty acid composition, millets contain unsaturated fatty acids including the essential fatty acids, viz. linoleic acid and linolenic acid.

Micronutrients: Millets are rich sources of micronutrients including minerals and vitamins, especially the B-vitamins. The important minerals found in millet grains are presented in Table 2. Most millets contain good amount of phosphorus (P), magnesium (Mg), potassium (K) etc and finger millet is a rich source of calcium (Ca). In fact, the calcium content of finger

millet (364 mg/100 g) is the highest known for any cereal. One hundred gram of finger millet is sufficient to meet more than a quarter of the RDA of calcium of an adult human being. Also, millets, especially, pearl millet is a good source of iron (Fe) and zinc (Zn).

Table 2. Important minerals present in millets in comparison with rice, wheat, and maize

Grain	Ca (mg)	P (mg)	Mg (mg)	Zn (mg)	Fe (mg)
Sorghum	27.6	274	133	1.9	3.9
Pearl millet	27.4	289	124	2.8	6.4
Finger millet	364.0	210	146	2.5	4.6
Foxtail millet	31.0	290	81	2.4	2.8
Little millet	16.1	130	91	1.8	1.3
Proso millet	30.0	*	153	1.4	2.0
Kodo millet	15.3	101	122	1.6	2.3
Barnyard millet	20.0	280	82	3.3	5.0
Rice, raw, milled	7.5	96	19	1.2	0.6
Wheat, whole	39.4	315	125	2.8	3.9
Maize, dry	8.9	279	145	2.3	2.5

Source: Indian food composition tables, NIN-2017; Nutritive value of Indian food, NIN-2007; Malleshi *et al.* 2021; *Data not available

Like other cereals, millets are good sources of B-vitamins, viz. B1 (thiamine), B2 (riboflavin), B3 (niacin) and folic acid (Table 3). The B-vitamins are mainly present in the bran and germ layers and hence decortication, a commonly employed processing technique to convert the small millets in to edible form, is known to reduce these micronutrients.

Table 3. Important B-vitamins present in millets in comparison with rice, wheat, and maize

Grain	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Folic acid (µg)
Sorghum	0.35	0.14	2.1	39.4
Pearl millet	0.25	0.20	0.9	36.1
Finger millet	0.37	0.17	1.3	34.7
Foxtail millet	0.59	0.11	3.2	15.0
Little millet	0.26	0.05	1.3	36.2
Proso millet	0.41	0.28	4.5	*
Kodo millet	0.29	0.20	1.5	39.5
Barnyard millet	0.33	0.10	4.2	*
Rice, raw, milled	0.05	0.05	1.7	9.32
Wheat, whole	0.46	0.15	2.7	30.1
Maize, dry	0.33	0.09	2.69	25.8

Source: Indian food composition tables, NIN-2017; Nutritive value of Indian food, NIN-2007; Malleshi *et al.* 2021; *Data not available

Anti-nutrients: Millets contain certain anti-nutrients such as phytic acid that interfere with absorption of minerals. Sorghum and finger millet are known to contain tannins, polyphenolic compounds with some anti-nutritional properties. The anti-nutrients are found in the outer layers of the grain and hence, the common household processing methods including decortication, milling, soaking, roasting, germination, fermentation

and cooking are known to reduce the negative impacts of anti-nutrients.

Phytochemicals: Much of the health beneficial effects of millets have been attributed to the presence of abundant phytochemicals including phenolic compounds, phytosterols etc. Phenolic compounds, viz. phenolic acids, flavonoids etc which are present in millets impart bioactivities including anti-oxidant, anti-microbial, anti-diabetic, and anti-hypertensive properties. The 3-deoxy anthocyanins which are found in sorghum are known to exhibit several bioactivities including the ability to protect from certain types of cancers.

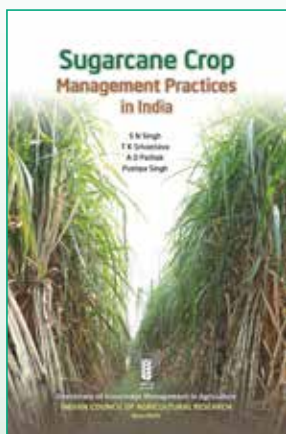
SUMMARY

Though our country has achieved the goal of combating hunger through green revolution, lack of micronutrients including iron, zinc, calcium etc in daily food intake continues. In this context, millets with

their balanced nutritional composition, inherently rich micronutrient profile and nutraceutical properties are highly relevant. Millets have a low carbon footprint and excellent adaptability to survive under climate extremes. Hence, they are regarded as 'smart food' which are good for the consumer and environment. The United Nations has officially declared to celebrate 2023 as the 'International Year of Millets' following India's proposal to Food and Agricultural Organization (FAO) and is aimed at creating awareness about their nutritive value, potential health benefits and their suitability for cultivation under changing climatic conditions. This would serve to enhance awareness among people, thereby improving the cultivation and consumption of these heritage crops paving way for sustainable nutritional security.

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Sugarcane Crop Management Practices in India



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TECHNICAL SPECIFICATIONS

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