

**Indian Farmer**Volume 10, Issue 12, 2023, Pp. 494-498
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ISSN: 2394-1227 (Online)**Popular Article****Millets are powerhouses of nutrition****Neeta Kalasariya^{1*} and Nidhi B. Thakur²**^{1*} Senior Research Fellow, Extension Education Institute, Anand Agricultural University, Anand²Research Associate, Extension Education Institute, Anand Agricultural University, Anand*Corresponding author: kalsariyaneeta9@gmail.com

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With the advances in modern science, the nutritional characteristics of millets have gradually been discovered. Though it was incidental that millets were the first crops to be cultivated, they were also more nutritious. However, their goodness was not known till biochemical and food and health science studies were carried out in modern times.

Nutritional insecurity is a major threat to the world's population that is highly dependent on cereals-based diet, and deficient in micronutrients. Millets are nutritionally superior as their grains contain high amounts of proteins, essential amino acids, minerals, and vitamins. Almost all the millets are used for human consumption in most of the developing countries, but their use has been primarily restricted to animal feed in developed countries. Millets are nutritionally comparable to major cereals for carbohydrates/ energy and serve as good sources of protein, micronutrients, and phytochemicals. The millets contain 7-12% protein, 2-5% fat, 65- 75% carbohydrates, and 15-20% dietary fibre.

Millets possess unique nutritional characteristics specifically have complex carbohydrates, rich in dietary fibre as well as unique in phenolic compounds and phytochemicals having medicinal properties. Millets are a natural source of iron, zinc, calcium, and other nutrients that are essential for curbing the problem of malnutrition in India. They have a higher content of niacin, B6, folic acid, calcium, iron, potassium, magnesium, and zinc. Finger millet is the richest source of calcium (300-350 mg/100 g) and other small millets are good sources of phosphorous and iron. Millets are easy to digest, contain a high amount of lecithin, and are excellent for strengthening the nervous system.

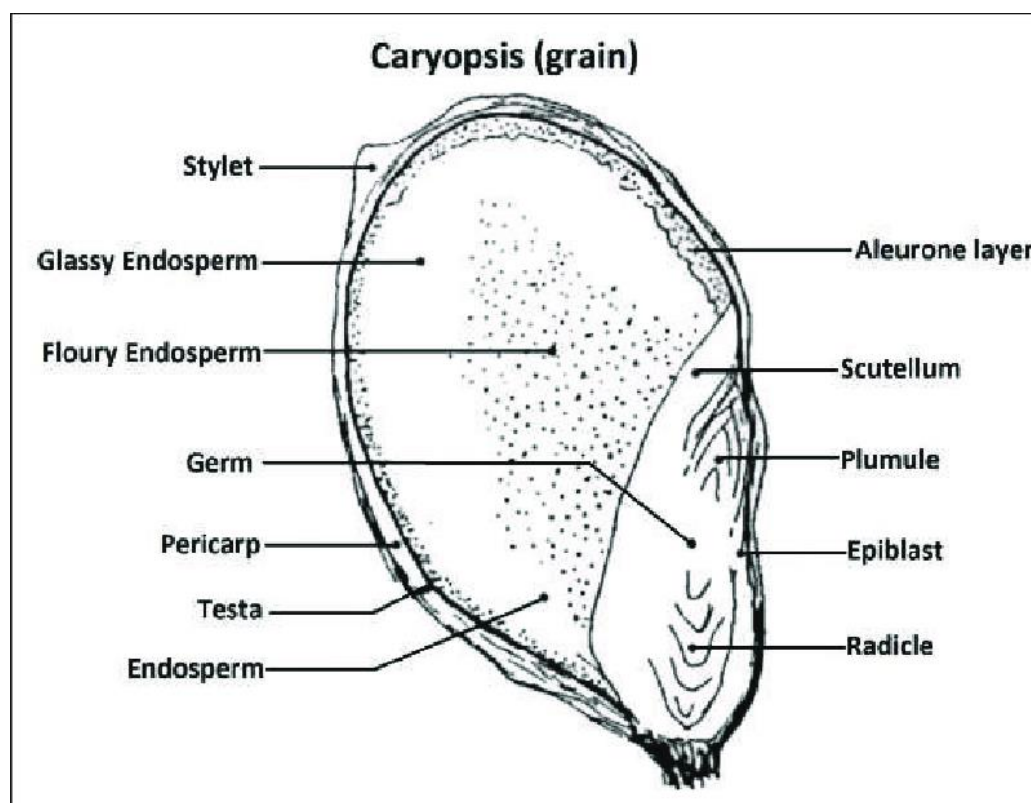
Fig. 1 General structure of millet grain

Table 1. Nutritional composition of millets

Grain	Carbo-hydrates (g)	Protein (g)	Fat (g)	Energy (Kcal)	Dietary fibre (g)	Ca (mg)	P (mg)	Mg (mg)	Zn (mg)	Fe (mg)	Thiamin (mg)	Ribo-flavin (mg)	Niacin (mg)	Folic acid (µg)
Sorghum	67.7	09.9	1.73	334	10.2	27.6	274	133	1.9	3.9	0.35	0.14	2.1	39.4
Pearl Millet	61.8	10.9	5.43	347	11.5	27.4	289	124	2.7	6.4	0.25	0.20	0.9	36.1
Finger millet	66.8	07.2	1.92	320	11.2	364.0	210	146	2.5	4.6	0.37	0.17	1.3	34.7
Kodo millet	66.2	08.9	2.55	331	06.4	15.3	101	122	1.6	2.3	0.29	0.20	1.5	39.5
Proso millet*	70.4	12.5	1.10	341	-	14.0	206	153	1.4	0.8	0.41	0.28	4.5	
Foxtail millet*	60.1	12.3	4.30	331	-	31.0	188	81	2.4	2.8	0.59	0.11	3.2	15.0
Little millet	65.5	10.1	3.89	346	7.7	16.1	130	91	1.8	1.2	0.26	0.05	1.3	36.2
Barnyard millet*	65.5	06.2	2.20	307	-	20.0	280	82	3.0	5.0	0.33	0.10	4.2	-
Wheat flour	64.7	10.6	1.47	321	11.2	39.4	315	125	2.8	3.9	0.46	0.15	2.7	30.1
Rice	78.2	07.9	0.52	356	02.8	07.5	96	19	1.2	0.6	0.05	0.05	1.7	9.32
Amaranth seed	61	13.3	5.6	356	7.5	162.0	412	270	2.8	8.0	0.04	0.04	0.52	24.7
Quinoa	54	13.1	5.5	328	14.7	198.0	212	119	3.3	7.5	0.83	0.22	1.7	173

Source: Indian Food Composition Tables, NIN – 2017; *Nutritive value of Indian Foods, NIN – 2007

Small millets are more nutritious compared to fine cereals. They contain higher protein fat and fibre content. The dietary fibre, due to higher viscosity and water holding capacity, plays a key role in reduction of blood glucose level as well as insulin response. It also lowers the level of cholesterol and decreases the risk of bowel disorders. Dietary fibre components exert their beneficial effects mostly by way of their swelling properties, and by increasing transit time in the small intestine.

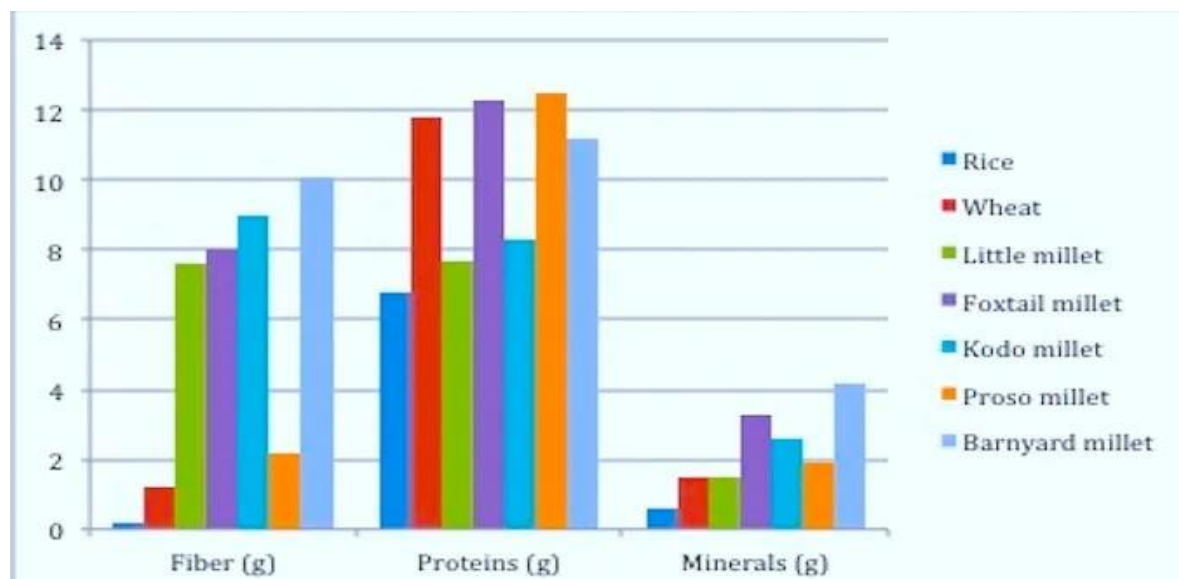
Millets contribute to antioxidant activity with phytates, polyphenols, tannins, anthocyanins, phytosterols, and pinacosanols present in it having important role in aging and metabolic diseases. All millet grains and especially sorghum fractions possess high antioxidant activity in vitro relative to other cereals and fruits. Finger millet tops in antioxidant activity among common Indian foods.

Millets confer good health and protection against non-communicative diseases

Data on scientific evidence for the nutritional and health benefits of millets are now available even as consumers are finding that millets are superior nutritious cereals beneficial for human health. Millets are recommended for the well-being of infants, lactating mothers, the elderly, and convalescents as suitable.

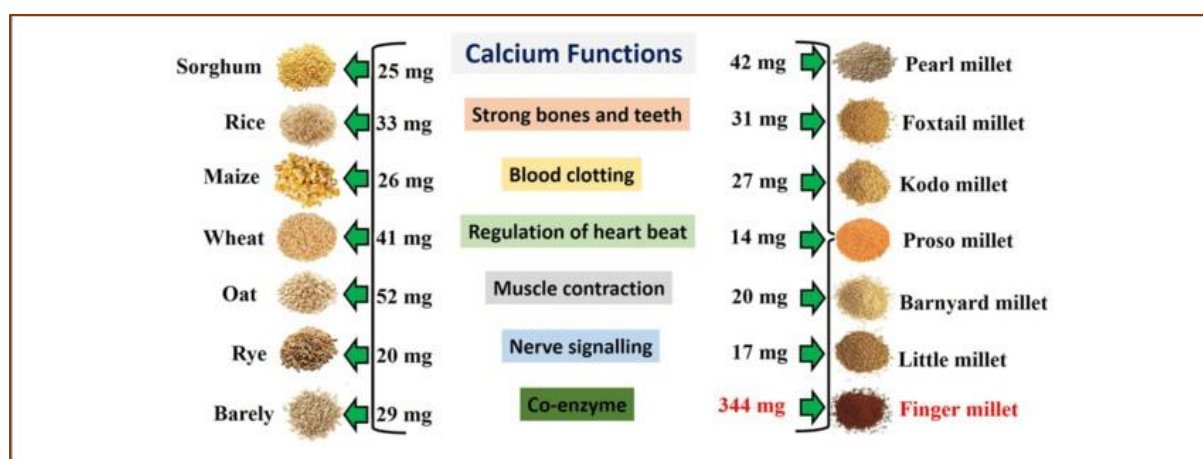
Millets contain slow-releasing glucose, i.e., low in glycemic index. This is very important in fighting the global problem of diabetes. It is well recognized that the incidence of diabetes mellitus and gastrointestinal tract-related disorders are minimal among the population using these grains as staple food. Its fibre content also helps to prevent constipation and may reduce the risk of developing bowel disorders including bowel, and colon.

Fig 2. Nutrient contents of millets and cereals



Properties of dietary fibre in millets and their health consequences

Function	Health consequences	Millet
Water absorbing and bulking property	Energy diluents to formulate low-calorie diets	All Millets
Increased transit time of food in the gut	Reduced risk of inflammatory bowel disease.	Sorghum and Finger Millet
Bile acid and steroid binding	Hypocholesterolaemic activity and reducing the risk of cardiovascular diseases	Pearl Millet, Sorghum and Finger Millet
Retardation of carbohydrate absorption and impaired glucose tolerance	Management of certain types of diabetes	Sorghum, Pearl Millet and Finger Millet
Binding of toxins	As a detoxifying agent	Sorghum



Epidemiological studies have shown that diets rich in millet, including whole grains are protective against non-communicable diseases like diabetes, cancer, and cardiovascular diseases, due to the protective effects of health-promoting phytonutrients. Millets are good for gluten-intolerant people. Magnesium is a micronutrient used for bone mineralization, teeth maintenance, the building up of proteins, enzyme activities, normal muscular contractions, and transmission of nerve impulses. Sorghum is considered a good source of potassium and is practically devoid of sodium. Whole grains are good sources of magnesium, iron, zinc, and copper. Finger and tef millet are good sources of dietary calcium. The percentage of available magnesium is higher in millet than in sorghum, and iron content is significant.

The major portion of sorghum protein is prolamin (kafirin) which has the unique feature of lowering digestibility upon cooking whereas, the millets have a better amino acid profile.

Sorghum proteins upon cooking are significantly less digestible than other cereal proteins, which might be a health benefit for certain dietary groups. On the other hand, millets contain fewer cross-linked prolamins, which may be an additional factor contributing to the higher digestibility of the millet proteins. Sorghum starch is gluten-free, making sorghum a good alternative to wheat flour for individuals suffering from celiac disease.

The Naked caryopsis of finger millet with brick red colored seed coat is generally used in the form of a whole meal in traditional food preparations such as roti, muddle, and Ambala (thin porridge). Regular consumption of whole grain cereals and their products has shown in epidemiological studies that they can protect against the risk of diabetes mellitus, gastrointestinal diseases, and cardiovascular risks. The use of millet as whole grain makes the essential nutrients such as dietary fiber, minerals, phenolics, and vitamins concentrated in the outer layer of the grain or the seed coat form part of the food and offer their nutritional and health benefits.

Pearl millet has a free lipids content range of 5.6-7.1% and a bound lipids range of 0.57-0.90%. The presence of good amounts of phospholipids consisting of both lecithins and cephalins, also offer many health advantage. These compounds have had a great role in general metabolism, being concentrated in the brain are useful in brain function, behavioural disorders and stress. They help in regeneration of membranes and protect liver, lungs, kidneys, and gastrointestinal tract. These compounds are known to enhance the bioavailability of other nutrients and medicines.

The niacin content in pearl millet is higher than all other cereals whereas, finger millet proteins are unique because of the sulphur-rich amino acid contents. Similar to cereal proteins, the millet proteins are poor sources of lysine, but they complement well with lysine-rich vegetable

(leguminous) and animal proteins to form nutritionally balanced composites of high biological value. Millets are therefore consumed as multi-grains to reap the collective health benefits of nutrients. Fonio is in the same class of superfoods as quinoa, tef, and chia seeds. The grain is gluten-free and rich in a number of amino acids, which are often absent in other major cereals. It's easily digestible, and some varieties are rich in protein. Fonio also has a low glycemic index, making it ideal for diabetics. Fonio is prized everywhere for its easy digestibility and low glycemic index. Fonio is rich in methionine and cystine, two amino acids that are essential for growth. In Africa, fonio is often served to honored guests and convalescents, diabetics, and of course people suffering from celiac disease and gluten intolerance.

Kodo millet is rich in B vitamins especially niacin, pyridoxine, and folic acid as well as minerals such as calcium, iron, potassium, magnesium, and zinc. It is also rich in fiber and low in fat content. It contains a high amount of lecithin and is excellent for strengthening the nervous system.

Pearl millet is also proven to effectively help in maintaining the blood sugar level constant in diabetes patients for a long period Pearl millet also contains significant amounts of potential antioxidants like phenols, phenolic acids, and carotenoids. Finger millet-based diets have shown lower glycemic response due to high fiber content and alpha-amylase inhibition properties which are known to reduce starch digestibility and absorption. All small millets have been proven excellent anti-hyperglycemic activity. Millet-based foods also help to obtain better nutrition and as well as considered preventive medicine for diabetes as they are also rich sources of protein and other nutrients. Thus, millet consumption helps in the prevention and control of diabetes.

Proso millet contains the highest number of proteins (12.5%). Barnyard millet is the richest source of crude fiber and iron. Barnyard millet grains possess other functional constituents' et al. γ -amino butyric acid (GABA) and β -glucan, used as antioxidants and in reducing blood lipid levels.

Millets benefit diabetics

There are many dietary advice and options readily available for diabetics. Some have even provided advice on food groups down to grain type. Recently, millets have received an increasing spotlight in combating diabetes as a dietary option. The added benefit of millets is their potential positive contribution toward controlling the symptoms of diabetes. They are known to have higher SDS, mineral as well as leucine content that is positively attributed to a healthy diet for diabetics.

Millets and degenerative diseases

Diets high in fibre and antioxidants have been shown to have beneficial effects on serum lipid profile besides blood sugar. Some forms of cancer are also prevented by high-fibre diets. Millets being high in fibre, antioxidants, and complex carbohydrates are potential candidates for having beneficial effects against diseases like CVD, cancer, and aging in general. Millet consumption decreases triglycerides and C-reactive protein.

Sprouting millets makes more minerals bioavailable

Sprouted (malted) grains are commonly used as weaning foods for infants and as easily-digested foods for the elderly and infirm. Malting of finger millet increases the bio-accessibility of iron and manganese.

Finally, millets are healthy and nutritious foods, but not be understood as miracle foods or possess medicine-like values. Being staple foods, they can beneficially replace at least one to two portions of cereal intake of an average adult. Various traditional dishes can be made out of millet. Food markets especially in urban areas sell several modern-day foods, ready-to-cook and ready-to-eat items, making available an array of options for consumers to embrace millets. The higher protein content of millet provides the bulk of the daily recommended dose when consumed as a staple food. A higher quantity of minerals in millets is helpful for body building and maintenance functions. Fibre-rich diet ensures easy and normal bowel movement. Comparable (to other cereals) portion of carbohydrates and their slower release ensures good control of blood sugar levels and facilitates delaying the next meal. The alkaline nature of millet-based foods leads to a healthy digestive system. Studies have revealed that populations with millet-based diets recorded a lesser incidence of colon cancer. The millets are rich in antioxidants and thus support managing stresses better and are good for our immunity system. Above all, a millet-based diet, characterized by a lower glycemic index, is excellent for preventing the incidence of lifestyle diseases, managing diabetes, and reducing obesity.

Anti-nutrients in millets – challenges and solutions

Despite the well-documented health benefits of millets as an excellent source of nutrients and minerals, they also contain some anti-nutrients (commonly called phytochemicals) that negatively affect its nutrient values by reducing the digestibility of nutrients and mineral absorptions, some of which also confer 'slow glucose release' and 'anti-oxidant' properties. These anti-nutrients mainly include phytates, polyphenols, oxalic acids, tannins digestive enzyme inhibitors, etc. For example,

phytic acid (which is also present in other food grains in varying levels, including rice) binds with dietary minerals such as calcium, iron, magnesium, and zinc and inhibits their absorption in our body. However, the negative impact of these anti-nutrients can be taken care of by using common household food processing techniques like decortications, milling, soaking, malting, germination, fermentation, popping cooking, etc. These methods reduce the content of phytates, phenol, tannins, and trypsin inhibitor activity, improve the digestibility of millets, and also enhance the bioavailability of minerals

Pearl millet has a characteristic in that the hulls and seeds contain small amounts of goitrogenic substances that limit the uptake of iodine to the thyroid. In large amounts, these "thyroid function inhibitors" can cause goiter and some researchers feel this may explain, at least in part, the perplexing correlation between millet consumption and goiter incidence in some of the developing countries where millet constitutes a significant part of the diet. In many of these countries, another contributing factor may be a lack of sufficient dietary iodine. However, it is recommended that those who have a history of goiter and thyroid-related issues should not adopt a pearl millet-based diet.

Conclusion

In summary, millets stand as nutritional powerhouses, offering a diverse range of health benefits. Rich in essential nutrients, and antioxidants, and low in glycemic index, they hold promise in combating diseases like diabetes and cardiovascular issues. Incorporating millet into diets provides a holistic approach to improved health and well-being.