



# Small Millets

## A Nutritional Powerhouse for Food Security and Health

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### Abstract

Small millets are a group of coarse cereals that are considered a staple food for tribal people in Asia and Africa, especially in areas where major crops like rice, wheat, and maize fail to produce significant yields. These millets are valued for their nutritional

properties, as well as their high resistance to abiotic stresses and ability to grow with minimal nutrient input. In addition, small millets can be grown almost anywhere without depleting natural resources, making them ideal for sustainable and environment

friendly farming practices. Small millets are a rich source of carbohydrates, dietary fibers, fats, proteins, essential vitamins and minerals, trace elements, essential amino acids, and antioxidants, making them functional foods. Despite their excellent nutritional properties and easy cultivation methods, there has been relatively little scientific research conducted on these "orphan cereals" by scientists. However,

### Introduction

Small millets were widely cultivated as traditional crops in rain-fed areas of semi-arid regions around the globe; however, the introduction of cash crops restricted their cultivation to particular areas. Although small millets belong to the same family (Poaceae) of major cereals [e.g., rice (*Oryza sativa*), wheat (*Triticum aestivum*), maize (*Zea mays*), and sorghum (*Sorghum bicolor*)], these crops are superior to major cereals in terms of agro ecological traits, nutritional quality, and the potential to ensure the immediate demands of food security. In terms of agro ecological traits, millets have better water-use and nitrogen-use efficiencies that enable them to withstand water limiting conditions. For example, foxtail millet requires ~250 g of water to produce 1 g of dry biomass, whereas wheat and maize require ~450 and 500 g, respectively. Similarly, a study in finger millet reported a requirement of nitrogen fertilizer as low as 20–60 kg/ha for better productivity. Small millets are also rich in micro- and macro-nutrients, total protein, fiber, and resistant starch. For instance, finger millet is rich in calcium (~364 mg per 100 g) and potassium (~320 mg per 100 g), and little millet and barnyard millet have high iron contents (~10–18 mg

recent studies have shown that small millets contain phenolic compounds, soluble fibers, and starch-lipid-protein interactions that contribute to their hypoglycemic properties. These neglected crops can potentially address both health and food security issues, thanks to their therapeutic properties and ability to withstand severe weather conditions.

per 100 g). The total protein is high in foxtail millet and barnyard millet (>10%), and crude fiber is rich in barnyard millet, little millet, foxtail millet, and fonio (~7–14%). Further, the majority of small millets are gluten-free, and therefore facilitate the preparation of low glycemic index products.

Millets are the coarse cereals cultivated by smallholders and tribal farmers mainly under rainfed conditions. The distribution of millets is mainly noted in the Asian and African continents and some portions of Europe. These are among the foremost ancient cultivated crops in India. Millets are categorized into two, namely, major and minor or small millets. Sorghum (*Sorghum bicolor* L.) and pearl millet (*Pennisetum typhoides* L.) belong to major millet group, while finger millet or ragi (*Eleusine coracana* L. Gaertn), barnyard millet (*Echinochloa frumentacea* L.), foxtail of Italian millet (*Setaria italica* L.), kodo millet (*Paspalum scrobiculatum* L.), little millet (*Panicum sumatrense* L.), proso millet (*Panicum miliaceum* L.) and brown-top millet (*Brachiaria ramosa* L. Stapf; *Panicum ramosum* L.) teff (*Eragrostis tef*), fonio (*Digitaria exilis*), Job's tears (*Coix lacryma-jobi*), guinea millet (*Brachiaria*

*deflexa*), and browntop millet (*Urochloa ramosa*) are known as small millet. The grains of small millets are nutritionally superior to rice and wheat, as these are rich in dietary fibre, proteins, minerals and vitamins and hence these are re-evaluated as nutri-cereals. Agricultural sustainability is comprised of food and nutritional security and in developing world malnutrition is a major concern where majority of human population is habituated in cereals-based diet. In this context, millets can be a suitable option for nutritional security of undernourished people of developing countries. Apart from nutritional importance, small millets have the qualities to ascertain agricultural sustainability in resource-poor and fragile ecological conditions. Small millets in cropping system provide multifaceted benefits like yielding of grains and forage, enriching of agro-diversity, checking of erosion in arid regions and assuring higher C sequestration. Under the adverse impacts of global warming and climate change ecologically hardy small millets can withstand under hostile climatic conditions. In India and Africa, small millets as whole or flour form are mainly used for food and allied purpose, whereas in Japan they are mainly used as birds' feed. India is one of

#### **Nutritional Importance of Small Millets**

Small millets have myriad of health benefits and due to high levels of insoluble dietary fibre, phytates, phytochemicals catechins, flavonoids etc. They are rich source of minerals like copper and iron. Unlike rice, they release glucose steadily without affecting the metabolism of the body. The incidence of diabetes is rare among the population which consumes

the major producers of these minor crops. Small millets are excellent source of nutrients and contain 60-70% dietary carbohydrates, 6–10% protein, 1.5–5% fat, 12–20% dietary fiber, and 2–4% minerals, many essential phytochemicals (phenolics, flavanoids, tocopherols and carotenoids) compared to rice or wheat and have several health benefits to the consumers. There is a huge scope of developing value added products from minor millets, which may have health benefits to human beings. Millets may be considered as functional foods. Functional foods contain bioactive ingredients which are beneficial for physiological benefit of human beings and can combat with chronic diseases. The flavonoids like tannin, anthocyanin; phenolic compounds; tocopherols and carotenoids- found in small millets, are natural antioxidant that protect the phospholipid membranes around nerves, heart, muscles and red blood from the attack of reactive oxygen species and thus prevents from carcinogenesis, cardiovascular diseases and aging. Carotenoids are reported to prevent atherosclerosis maintain normal functioning of immune system, retina of eyes and serves as precursors of vitamin A.

small millet diet. The millet protein characterization showed that its protein concentrate is a potential functional food ingredient and the essential amino acid pattern suggests possible use as a supplementary protein source to most cereals because it is rich in lysine. Small millets are minor millets and major studies

are done for foxtail millet, barnyard and proso millet.

The foxtail millet is also known as Italian millet. It is one of the world's oldest cultivated crops. In the northern area of China it has been widely used as a nourishing gruel or soup for pregnant and nursing women and has been applied to food therapy. It has been recorded that millet has many nutritious and medical functions. Foxtail yellow seeded cultivars, medicinally used as astringent, digestive, emollient and stomachic. It is also used in the treatment of dyspepsia, poor digestion and food stagnancy in abdomen. White seeds are refrigerant and used in the treatment of cholera and fever while the green seeds are diuretic and strengthening to virility. This millet contains 12.3% crude protein and 3.3% minerals.

Barnyard millet showed comparable amounts of crude protein with foxtail millet which was highest among all the millets studied. It is apparent that millet oil could be a good source of natural oil rich in linoleic acid and tocopherols. Millets are good sources of magnesium and phosphorus. Magnesium has the ability to help reduce the effects of migraine and heart attacks, while, phosphorus is an essential component of adenosine triphosphate (ATP) a precursor to energy in the body.

Proso millet is the best alternative crop for diversifying and intensifying winter wheat-based dryland production systems. Proso Millet is calculated to be 356 Kcal per 100 gm. The protein content is similar to that of wheat, but it contains no gluten and by itself is not suitable for yeast-leavened bread. The protein content was found to be (11.6% of

dry matter) and was significantly rich in essential amino acids (leucine, isoleucine, and methionine) than wheat protein. It is rich in vitamins and minerals such as copper and magnesium. Proso millet also improved glycemic responses and plasma. In addition, proso millet protein concentrate has protective effects against D-galactosamin-induced liver injury in rats concluded that proso millet protein could be a potential therapeutic intervention in type-2 diabetes. The nature of polyphenols and dietary fiber of finger millet and their role with respect to the health benefits associated with millet. The composition of free and bound lipids in proso millet flours and brans were analysed and found that, in the free lipids, hydrocarbons, sterol esters, triacylglycerols, diacylglycerols, and free fattyacids were present. Proso millet is rich source of B vitamins, especially vitamin-B6 and folic acid.

The little millet, also known as kutki or saamai, is a small grain that is widely grown in India and other parts of Asia. Despite its small size, it packs a punch in terms of its nutritional benefits. Here are some of the key nutritional benefits of little millets. Rich in Fiber: Little millet is rich in dietary fiber, which can help regulate digestion, promote satiety, and prevent constipation. High in Protein: Little millet is a good source of protein, making it a great addition to a vegetarian or vegan diet. Low in Fat: Little millet is low in fat, making it a great option for people looking to maintain a healthy weight. Rich in Minerals: Little millet is a good source of essential minerals like iron, calcium, and magnesium, which are important for maintaining healthy bones and overall body function. Gluten-Free:

Little millet is naturally gluten-free, making it a great option for people with celiac disease or gluten intolerance. Low Glycemic Index: Little millet has a low glycemic index, which means it can help regulate blood sugar levels and reduce the risk of developing type 2 diabetes. Versatile: Little millet can be used in a variety of dishes, including porridge, pilafs, salads, and baked goods.

Small millets are highly nutritious and render various health benefits. The nutritional facts of small millet are listed below are;

- Helps control Blood sugar levels when consumed on regular basis. It showed

lowered triglyceride levels, LDL/VLDL Cholesterol and increase in HDL Cholesterol.

- It is known for its Low Glycemic index-gradual increase in blood sugar after food intake when compared to rice.
- Ideal food for people suffering from Diabetes & Gastric problems.
- Reduces risk of Heart Attack.
- Helps in the development of Body Tissue & Energy Metabolism.
- Rich in Anti-oxidants.

### Conclusion

Small millets have the potential to serve as an important source of nutraceuticals, offering a natural way to treat a range of health issues, including diabetes, tumors, obesity, and premature aging. In addition, small millets are an excellent source of calcium, essential amino acids, and vitamins. Given their versatility, a variety of value-added products can be derived from small millets, highlighting the need

for continued research to evaluate their nutritional properties. The fields of nutraceuticals and nutrigenomics are always seeking natural sources that are rich in nutrients, and small millets fit the bill perfectly. These grains are not only cost-effective but also easy to grow, environmentally friendly, and highly nutritious, making them an ideal option for sustainable agriculture.