**Millets: Nutritional composition, some health benefits and processing**

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Millets, which are a good source of energy, are a key source of food in arid and semi-arid regions of the world. Cereal grains contain a good amount, fatty acids, minerals, vitamins, dietary fibre polyphenols, and some of them have a significant amount of important amino acids, particularly those containing sulphur (methionine and cysteine). Flour and seed layers of millets are rich in fiber and phytochemicals, which are lost significantly after processing. They provide antioxidants such as phenolic acids and glycosylated flavonoids. Potentially periodic, they improve the viability or effectiveness of probiotics with considerable health benefits. A nutritional significance analysis for the features and functional capabilities of various millet cultivars is required, as is the development of value-added products made from millet.

In addition to wheat, rice, and corn, millets constitute an important cereal. Millets are a key food source for those living in hot, arid regions of the world. They are predominantly planted in marginal agricultural circumstances when major grains fail to produce large yields (Adekunle, 2012). Panicoideae, a subfamily of grasses, is where Job's tears are categorised together with corn, sorghum, and Coix (Yang et al., 2012). Millets are an essential food source in many developing nations due to their capacity to grow despite severe weather circumstances, such as limited rainfall. For millions of Africans, millet is their primary energy source and protein. Numerous nutritional and medicinal properties of millets have been documented (Obilana and Manyasa, 2002; Yang et al., 2012). It is a significant crop during famine because it is resistant to drought and can be stored for an extended period of time with insect damage (Adekunle, 2012).

 Concern exists regarding the categorization of the millet family, as some references classify it as Gramineae while others classify it under Poaceae. Pearl millet (Pennisetum glaucum), which accounts for 40% of world production, Foxtail millet, Annual herbaceous millet or white millet (Panicum miliaceum), and Foxtail Millet are the four most important forms of millets (Eleusine coracana). Pearl millet has the largest seeds and is the kind most frequently consumed by humans (Mariac et al., 2006; ICRISAT, 2007). Minor millets include: Barnyard millet (Echinochloa spp. ), Kodo millet (Paspalum scrobiculatum), Little millet (Panicum sumatrense), Guinea millet, Browntop millet, Teff (Eragrostis tef), and fonio (Digitariaexilis). Sorghum (Sorghum spp. ), and Job's tears (Co In 2007, global millet production reached approximately 32 million tonnes, with India (10,610,000), Nigeria (7,700,000), Niger (2,781,928), China (2,101,000), Burkina Faso (1,104,010), Mali (1,074,440), Sudan (792,000), Uganda (732,000), Chad (550,000), and Ethiopia (500,000) being the leading producers (FAO, 2009). According to FAO 2005, pearl millet production reached around 54% of global production in 2004. Millets in countries such as Sub-Saharan Africa represent a unique component of biodiversity within the food and agricultural safety systems of millions of poor farmers. India is the important role in the achievement of cereal grains (Bhattacharjee et al., 2007), and pearl millet is a significant source of nutrition in the Sahel. Millets are typically crushed into flour, rolled into big balls, parboiled, and afterwards consumed as oats with milk. Millets are also occasionally prepared as beverages. Pearl millet-based Roti is the staple diet of farmers in Gujarat, India (FAO, 2009). Due to the developing need to feed the world's growing population, it is essential to investigate locally grown plants such as millets that are consumed by low-income households in countries such as India and the Sahel zone. Cereals, namely millet-based dishes and beverages, are well-known globally and continue to make up the majority of African countries' diets (Obilana and Manyasa, 2002; Amadou et al., 2011). This article outlines the nutritional profile of millets, their health benefits, and their application in the food sector.

**Nutritional composition of millet grains**

The abundance of calcium, dietary fibre, polyphenols, and protein in millets (Devi et al., 2011) distinguishes them from other cereals. Millets often contain significant levels of important amino acids, notably sulphur-containing amino acids (methionine and cysteine), and have a higher fat content than corn, rice, and sorghum (Obilana and Manyasa, 2002). In general, the lysine and tryptophan content of cereal proteins, especially millets, varies by cultivar; the majority of them include the required amino acid residues as well as minerals and vitamins (Devi et al., 2011; FAO, 2009). Cereal grains are a key source of nutritional micronutrients internationally (Amadou et al., 2011), and the food industry makes extensive use of plant nutrients. Physical, chemical, and biological processes, such as fermentation or an enzymatic treatment, alter the structure and subsequently the physicochemical and functional properties of proteins (Lestienne et al., 2007; Amadou et al., 2011b). Table 1 displays the composition of many millet cultivars, including foxtail, fonio, proso, pearl, and finger millets.

**Table 1 Nutrient value of millets (per 100 g edible portion, 12% moisture).**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Crop | Protein(g) | Fiber(g) | Minerals(g) | Iron(mg) | Calcium(mg) |
| Sorghum | 11 | 6.7 | 2.7 | 3.4 | 13 |
| Finger millet | 7.3 | 3.6 | 2.7 | 3.9 | 344 |
| Foxtail millet | 12.3 | 8 | 3.3 | 2.8 | 31 |
| Kodo millet | 8.3 | 9 | 2.6 | 0.5 | 27 |
| Little millet | 7.7 | 7.6 | 1.5 | 9.3 | 17 |
| Pearl millet | 10.6 | 1.3 | 2.3 | 16.9 | 38 |
| Proso millet | 12.5 | 2.2 | 1.9 | 0.8 | 14 |
| Barnyard millet | 11.2 | 10.1 | 4.4 | 15.2 | 11 |

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**Anatomy of a Whole Grain Kernel**

Germ

Germ, the embryo created after fertilisation by pollen, contains vitamin B and E, antioxidants, phytonutrients, and unsaturated fats. Germ is the embryo generated after fertilisation by pollen.

Millets-Nutrients

Millets are rich in vitamin B, potassium, antioxidants, manganese, phosphorus, as well as iron. They contain 65% carbs, 9% proteins, 3% fat, 2-7% crude fibre, vitamins, and minerals, and are an excellent source of essential amino acids with the exception of lysine and threonine, but are very high in the sulphur-containing amino - acid methionine and cysteine. Linoleic acid and tocotrienols could be abundant in millet oil. It is a gluten-free grain that produces an alkaline environment. Millets provide vitamins B, such as Niacin, folacin, riboflavin, and thiamine, and phosphorus, which are essential for energy generation in the body. Millets are an excellent supply of important fatty acids such as linoleic, oleic, and palmitic acids in their free form, as well as monogalactosul, diglycerides, diagalactosyl, phosphatdyl serine, and phosphatdyl choline in their bound form.

Types of millets

* Little Millet

It aids in weight loss since it contains necessary lipids and a high fibre content. It has a greater quantity of numerous nutrients than others.

* Proso Millet

Proso millet produce and niacin (Vitamin b3). It is traditionally used as a recuperative food, particularly after pregnancy or illness. Vitamin B3 niacin is good for preventing Pellagra, a disorder caused by this vitamin.

* Pearl Millet

Pearl Millet is rich in magnesium, which aids in alleviating asthmatic patients' respiratory issues and migraine symptoms. Pearl millet's insoluble fibre aids in the decrease of excessive bile in the body; an excess of bile leads to gallstones.

* Foxtail Millet

Foxtail Millet aids in the extended release of sugar without disrupting the bossy's metabolism. Due to its high magnesium content, foxtail millet is renowned as a heart-healthy diet and reduces the incidence of diabetes in those who consume it.

* Kodo millet

Kodo millet is a traditional grain that resembles rice closely and aids in weight loss. Additionally, it aids in lowering hip and knee discomfort and regulating menstruation in women.

Health Benefits of Millets

1. DIABETES

• Millets lower postprandial hyperglycemia by inhibiting the enzymatic breakdown of complex carbs, and enzymes such as aldose reductase aid in the prevention of sorbitol buildup and decrease the risk of diabetes-related cataract disorders.

• Sorghum-based foods have a low Glycemic control Index (GI) and lower blood glucose levels after a meal.

• Consumption of millets aids in regulating blood glucose levels and also promotes cutaneous wound healing via antioxidants.

• Diets including finger millet promote cutaneous wound healing due to their low glycemic response and high fibre content.

• Protein derived from fine millets reduces cataract formation in humans.

• Millets aid in the prevention of Type II diabetes due to their high magnesium content, which enhances the performance of insulin and glucose receptors.

1. CANCER

• The concentration of polyphenols and tannins in sorghum (millet) confers anti-carcinogenic and antimutagenic effects. They are capable of acting with human melanoma cells and possessing melanogenic activity.

• Millets are rich in phenolic acids, phytates, tannins, and linoleic acid, which incorporate anti-tumour activity and are antinutrients that help reduce the risk of colon and breast cancer. • Oesophageal cancer incidence is lesser with sorghum (Millet) consumption, resulting in a lower mortality rate from malignant tumors than wheat and corn.

1. OBESITY

• Obesity, which is the most significant rising concern in India, is related with a number of other disorders, including diabetes, hypertension, and cardiovascular issues.

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22% of millets are composed of dietary fibre. Dietary fiber-rich foods improve intestinal function and reduce digestion and absorption, hence minimising the chances of chronic illnesses and obesity.

• Millets aid in hunger satisfaction and weight management, hence lowering obesity.

• Millets aid in the prevention of gastro-intestinal diseases, such as ulcers and colon cancers, by promoting proper digestion and absorption.

 4. CVD

* Millets lessen the likelihood of a cardiac arrest; reduce blood pressure and the danger of heart attacks and strokes, especially in the event of atherosclerosis, because they are a rich source of magnesium.
* Millets are abundant in phytochemicals containing phytic acid, which aid in heart health and preventing cardiovascular disease by lowering plasma triglyceride (Lee, et al., 2010).
* Millets are also an excellent source of potassium, which acts as a vasodilator to maintain blood pressure low.
* Millets are one of the finest strategies to safeguard your cardiovascular health due to their ability to lower blood pressure and enhance circulation.
1. CELIAC DISEASE

• Celiac illness is initiated by the intake of gluten, and the gluten-free nature of millets facilitates their avoidance.

• Since millets are gluten-free, they have a great deal of promise in foods and beverages, and they can meet the increasing demand for gluten-free foods, therefore they are suited.

1. AGING

• Foxtail millet and kodo millet methanolic extracts prevented collagen glycation and cross-linking (Hegde and others 2002). Millets may therefore be beneficial for anti-aging purposes.

• Millet grains are abundant in antioxidants and phenolics; nevertheless, it has been demonstrated that phytates, phenols, and tannin can contribute to antioxidant activity that is crucial for health, ageing, and metabolic disease (Bravo 1998).

• Nonenzymatic glycosylation, the reaction occurs between the aldehyde or ketone of simple sugars and the amino group of proteins, is a major contributor to the difficulties of diabetes and ageing (Monnier 1990)

1. ANTIMICROBIAL ACTIVITY

• Fractions and extracts of millet grain exhibit antibacterial activity.

• Phenolic acids in millets grain were discovered to positively influence its malt quality by reducing the fungus load on the sprouting grain and malt quality; high-phenol finger millet varieties were superior than low-phenol varieties (Sewel and others 2010).

• Proteins preparations of pearl millet effectively inhibited the growth of all phytopathogenic fungi studied.

• Extracts of polyphenolic compounds and other active compounds may be utilised as natural alternatives for food preservation and therapeutic applications.

1. PHYTOCHEMICALS

• Polyphenols are phenolic acids and tannins; flavonoids are present in modest amounts; they operate as antioxidants and contribute to the immune system of the body (Chandrasekaran A, et al., 2010).

• Quercetin, curcumin, ellagic acid, and various other beneficial catechins can help clear the system of foreign toxins and agents by promoting proper excretion and neutralising enzymatic activity in those organs. • The insoluble and soluble total phenolic extracts from several varieties of millet (kodo, finger, foxtail, proso, pearl, and little millets) exhibit antioxidant, metal chelating, and reducing properties (Chandrasekaran and Shahidi, 2010).

Millets are very nutritive and contribute to numerous health advantages. Millets aid in the fight against Obesity.

**CHALLENGES AND FUTURE PERPECTIVES**

Although the nutritive value and potential health benefits of millet grains are comparable to those of wheat, rice, and maize, their utilisation is still primarily limited to rural populations at the household level due to a lack of innovative millet processing technologies that provide easy-to-handle, ready-to-cook or ready-to-eat, and safe products and meals that can be used to feed large populations in urban areas. Millets are the least allergenic and most readily digestible meals, making them the greatest option for gluten-sensitive people. Millets are rich in vital amino acids, fatty acids, and fibre. Diversification of food production must be promoted at both the national and household levels concurrently with yield growth.

Millets include many healthful nutrients, which are essential for the regular functioning of the body. Iron and copper are necessary for the creation of blood cells and the enhancement of blood oxygenation. Phosphorus aids in regulating blood pressure, lipid metabolism, tissue healing, and energy production (phosphorus is a key component of adenosine triphosphate or ATP, a precursor to energy in the body). Consequently aid the body's immune system in its fight against sickness. Millets' magnesium content helps lower the severity of migraines and heart attacks. Millets' niacin (vitamins B3 and B6) can help decrease cholesterol. Millet can help reduce the risk of type 2 diabetes, dietary fibre from whole grains protects against breast cancer, and whole grains protect against paediatric asthma.

Due to a lack of dietary fibre, the entire world faces numerous health issues. The elimination of refined foods such as rice, wheat, refined flours, processed foods, refined oils, packaged & ready-to-consume -type foods, and milk can eliminate all lifestyle diseases, as thousands of patients have discovered. It can be an essential component of medicinal dietary modification and the promotion of the consumption of minor grains. Modern process or a system for attempt to put, milling, and other millet grain food preparation processes are required in order to manufacture high-quality goods on a mass production for urban consumers. In addition, a regular supply of high-quality nutritional composition for industrial applications is required, as is the creation of grain cultivars with a high concentration of important amino acids. Future research studies should evaluate the nutritional content and potential health advantages of nutritional composition and their fractionation in animal and human models to support efforts to promote their use as food.

**CONCLUSION**

Millets include many health-promoting components comparable to those of major grains, including soluble fiber, minerals, vitamins, and photochemicals including phenolic compounds. Millets also offer various possible health advantages. To improve the quality of millet diets and raise the bioavailability of micronutrients, novel preparation and preparation techniques are required. Most sophisticated people have never even heard of millets, let alone comprehend their nutritional benefits. Nevertheless, millet is one of our ancient ancestors' best-kept secrets. For poor people, it is necessary to produce millets-based foods that provide convenience, flavour, texture, colour, and shelves at an affordable price. In order for farmers to gain access to new markets for millets in urban areas and increase their revenue, it is necessary to develop substantially enhanced products.

This project aims to assist people recognise the value of food, present millets as a nutrient-dense food that meets the nutritional needs of the world population, and identify ways to consume millets healthily and effectively in order to minimise malnutrition and other health issues. With their rich content of nutrients such as fibre, which helps in metabolic disorders such as Diabetes, Obesity, Cardiovascular diseases, etc., their good protein content, which helps in child growth and development, their calcium content, which helps in the bone development of both children and geriatric people, their good iron content, which aids in the treatment of anaemia, and their gluten-free nature, which aids in the treatment of celiac disease, all millet foods have significant health benefits.

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