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1. Millets and its Importance in Nutritional Security

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Abstract:

This book chapter explores the intrinsic significance of millets in addressing the global challenge of nutritional security. Millets, a diverse group of small-seeded grasses, have long been grown and have emerged as critical contributors to sustainable and resilient food systems. Millets are significant due to their great nutritional value and health advantages. They include a lot of vitamins, minerals, phytochemicals, and antioxidants, which can help prevent heart disease, diabetes, ageing, and even cancer. Millets are also high in dietary fiber, which can help lower the glycemic index of a food and encourage the formation of healthy gut bacteria. Millets are also gluten-free and high in protein, making them a good source of protein. They also include a lot of unsaturated fats, minerals including calcium, iron, and zinc, and B vitamins. Millets include phytochemicals that have been found to have antioxidant, anti-inflammatory, antibacterial, and anticancer activities, including as phenolic acids, flavonoids, and tannins. Overall, millets are a nutritious and useful diet that may be beneficial to one's health.

Keywords:

Millets, dietary fiber, functional food, health, nutritional security

1.1 Introduction:

The word “millet” has originated from the French word “Mile” meaning thousand which implies a handful of millets contain thousands of grains.

Millets are often grown in semi-arid conditions with very less rainfall and marginal or degraded lands with very low nutrient contents **(kumar *et al.*, 2021)**.

The crops help people in areas where famine is a common occurrence, and millets produce a more consistent harvest than other crops in low rainfall areas **(Tadele, 2016)**.

Millets are a group of extremely variable small, seeded grasses that are widely grown all over the world as cereal crops or grains for fodder and human sustenance.

They are classified as functional or agronomic rather than taxonomic (Rao et al., 2017). Millets are drought and other extreme weather resilient crops that require minimal chemical inputs such as fertilizers and pesticides to grow **(Vikaspedia, 2022)**.

Millets have long been a staple meal and an important source of revenue for Indian farmers, particularly in semi-arid areas. They grow in both the Kharif and Rabi seasons and are a major food and fodder crop in the world's semi-arid tropics (SAT).

These grains are the principal source of nutritional energy and protein for over a billion people in the semi-arid tropics **(Rao *et al.*, 2019)**.

In acknowledgment of the importance of millets as a nutritious and sustainable food supply, the United Nations General Assembly has named 2023 the International Year of Millets.

The goal of this campaign is to create knowledge about the nutritional and environmental benefits of millets, as well as to promote their use worldwide **(Sharma B, 2015)**.

Millets are a category of extremely varied tiny, seeded grasses that are commonly grown as cereal crops or grains for fodder and human nourishment all over the world. They are not classified as a taxonomic category, but rather as functional or agronomic groups.

Millets are major crops throughout Asia and Africa's semi-arid tropics (particularly in India and Nigeria), accounting for 97% of millet production. The crop is preferred due to its great yield and short growing season in dry, hot circumstances **(Rao *et al.*, 2017)**.

It outperforms other cereals because it contains vital amino acids (such as leucine, isoleucine, valine, and phenylalanine), minerals (calcium, iron, and zinc), vitamins, phytochemicals, and antioxidants.

Furthermore, millets can be used to treat chronic disorders such as diabetes, cardiovascular disease, and cancer **(Mishra *et al.*, 2022)**.

Millets are thought to provide nutraceutical health benefits as well. These include, but are not limited to, increased digestive system well-being, cholesterol reduction, heart disease prevention, diabetes prevention, cancer risk reduction, increased energy levels, and muscular system enhancement **(Hossan *et al.*, 2021).**

1.2 Classification of Millets:

Millets are classified into two categories (Figure 1), Major Millets and Minor Millets based on their grain size. Major Millets i.e. Sorghum (Jowar), Pearl Millet (Bajra), Finger Millet (Ragi/Mandua); Minor Millets i.e., Foxtail Millet (Kanngani/kakun), Proso Millet (Cheena), Kodo Millet (Kodo), Barnyard Millet (Sawa/Sanwa/Jhangora), Little Millet (Kutki) **(Vikaspedia, 2022)**.

1.2.1 Major Millets:

A. Sorghum:

Sorghum is a warm-season crop that is sensitive to cold temperatures but relatively resistant to significant pests and illnesses. The grain is made up of naked caryopsis, which includes a pericarp, endosperm, and germ. Despite their vast physical variation, sorghum is divided into four groups: (1) grain sorghum, (2) glum fodder sorghum, (3) grass sorghum, or (4) Sudan sorghums and broomcorn **(Singh *et al.*, 2023)**.

B. Pearl Millet:

Pearl millet originated in Central Tropical Africa and is now found across the tropics and India. Pearl millet is highly suited to growth conditions that include drought, low soil fertility, and high temperatures.

It is effective in soils with high salinity or low pH. It can be produced in locations where other cereal crops, such as maize or wheat, would not survive because to its resistance to tough growing circumstances **(Satyvathi *et al.*, 2021)**.

C. Finger Millet:

Finger millet (Eleusine coracana (L.) Gaertn) is primarily grown for its grain. Finger millet is a tall, tufted annual grass that grows up to 170 cm tall.

Finger millet grain is not frequently utilised for livestock: it is primarily a food grain, but its quality for livestock is inferior to maize, sorghum, and pearl millet.

It is sometimes used in India to feed young calves, growing animals, and sick and convalescing animals **(Maharajan *et al.*, 2022)**.

1.2.2 Minor Millets:

A. Foxtail Millet:

Foxtail millet is a Chinese native and one of the world's oldest cultivated crops.

Foxtail millet is drought resilient, and due to its early maturity; it can avoid some droughts. It can be planted as a short-term catch crop due to its rapid growth.

It may grow in a variety of heights, soils, and temperatures. Its grain is utilised for human consumption as well as poultry and cage bird feed **(Yang *et al.*, 2022)**.

B. Proso Millet:

Proso millet is a perennial grass that grows from seed each year. Proso millet is an excellent intercrop between two crops that require a lot of water and pesticides due to its shallow root system and tolerance to atrazine residue. The last crop's stubbles let more heat into the soil, resulting in faster and earlier millet growth **(Bangar *et al.*, 2021)**.

Kodo Millet:

Kodo millet is found in moist settings throughout the world's tropics and subtropics. Kodo millets are high in B vitamins, including niacin and B6, as well as minerals like calcium, iron, potassium, magnesium, and zinc.

Kodo millets contain no gluten and are suitable for gluten sensitive people. Regular consumption of kodo millet is extremely good for postmenopausal women suffering from cardiovascular disease symptoms such as high blood pressure and cholesterol levels **(Bunkar *et al.*, 2021)**.

C. Barnyard Millet:

Barnyard millet is a multipurpose crop grown for both food and fodder. Barnyard millet has a low carbohydrate content that is slowly digested. Linoleic acid is the most abundant fatty acid in barnyard millet, followed by palmitic and oleic acid. It also exhibits a high degree of amylase retrogradation, which aids in the creation of more resistant starches.

As a result, it may be prescribed for patients with cardiovascular disease and diabetes mellitus. Barnyard millet is particularly good at lowering blood glucose and cholesterol levels **(Renganathan *et al.*, 2020)**.

D. Little millet:

Little millet seeds are smaller than normal millet seeds. Because of its early maturity and tolerance to severe agro-climatic conditions, little millet is another reliable catch crop. Stover is an excellent cattle feed **(Vetriventhan *et al.*, 2021)**.

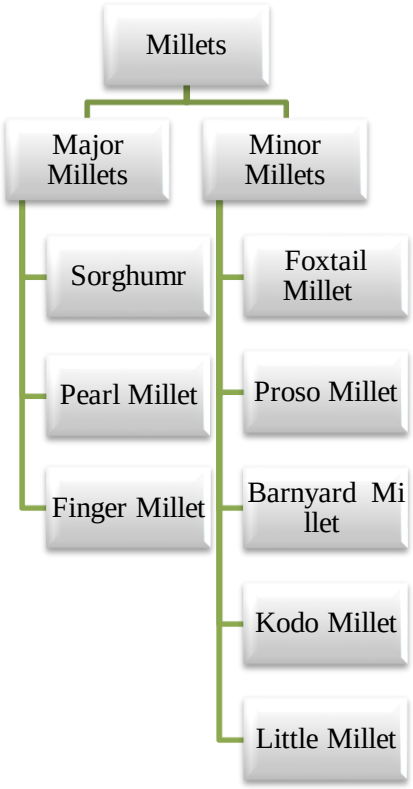

Figure 1.1: Classification of Millets

1.3 Nutritional Composition:

The millet grain contains roughly 65% carbohydrate, a major percentage of which is in the form of non-starchy polysaccharides and dietary fibre, which help to avoid constipation, lower blood cholesterol, and limit the release of glucose into the bloodstream after digestion. Regular millet consumption is associated with a lower risk of cardiovascular disease, duodenal ulcer, and diabetes **(Kimeera ambati & Sucharitha K V, 2020; Rotela *et al.*, 2021)**.

Millet grains are high in vitamins like thiamine, riboflavin, folic acid, and niacin. In terms of mineral and fatty acid content, millets are comparable to rice and wheat **(Kumar *et al.*, 2022; Rizwan *et al.*, 2022)**. Millet's carbohydrate composition varies greatly, with amylose and amylopectin content ranging from 16-28% and 72-84%, respectively **(Rao *et al.*, 2017)**.

In India, millet is frequently ingested with legumes, resulting in reciprocal protein supplementation, increased amino acid content, and improved overall protein digestibility **(APEDA, 2022).**

Table 1.1: Nutritional Composition of Millets (mg/ 100 g)

Millets	Carbohydrates	Protein	Fat	Minerals	Fibre	References
Pearl millet	67.0	11.8	4.8	2.2	2.3	(Muthamilarasan *et al*., 2016) [29]
Finger millet	72.05	7.3	1.3	2.7	11.5	(Shobana *et al*., 2013) [45]
Foxtail millet	63.2	11.2	4.0	3.3	6.7	(Jaybhaye *et al*., 2014) [22]
Kodo millet	66.6	9.8	3.6	3.3	5.2	(Saleh *et al*., 2013) [38]
Proso millet	70.4	12.5	3.1	1.9	14.2	(Habiyaremye *et al*., 2017) [17]
Little millet	65.55	8.92	2.55	1.72	6.39	(Dayakar Rao *et al*., 2017) [10]
Barnyard millet	68.8	10.5	3.6	2.0	12.6	(Ugare *et al*., 2011) [49]

Table 1.2: Mineral Nutritional Composition of Millets (mg/ 100 g)

Millets	Ca	P	Fe	Mg	K	Na	Mn	Cu	Zn	References
Pearl millet	46	379	8.0	137	442	12.0	1.8	1.06	3.1	(Himanshu *et al*., 2018) [20]
Finger millet	137.33	158.43	1.46	6.38	35.19	3.70	2.85	0.06	0.48	(Sanusi *et al*., 2019) [39]
Foxtail millet	23	310	3.2	130	270	10	2.2	0.9	2.1	(Serna-Saldivar *et al*., 2019) [41]
Kodo millet	32.33	300	3.17	110	141	4.8	1.10	1.60	32.7	(Kumar *et al*., 2018; Chandra *et al*., 2016) [24, 8]
Proso millet	10	200	2.2	120	210	10	1.8	0.8	1.7	(Kumar *et al*., 2018; (Serna-Saldivar *et al*., 2019) [24, 41]
Little millet	30	260	20	133	370	8.1	20	4	11	(Himanshu *et al*., 2018) [20]
Barnyard millet	22	280	18.6	82			0.96	0.60	3	(Chandra *et al*., 2016) [8]

Source: Bhatt et al., 2022

1.4 Health Benefits of Millets:

Millets have several health benefits (see Figure 2). According to epidemiological studies, eating millets lowers the risk of heart disease, protects against diabetes, improves the digestive system, lowers the risk of cancer, detoxifies the body, boosts immunity in respiratory health, boosts energy levels, and protects against several degenerative diseases such as metabolic syndrome and Parkinson's disease. Millets include beneficial elements such as resistant starch, oligosaccharides, lipids, and antioxidants such as phenolic acids, avenanthramides, flavonoids, lignans, and phytosterols **(Rao *et al*., 2018)**.

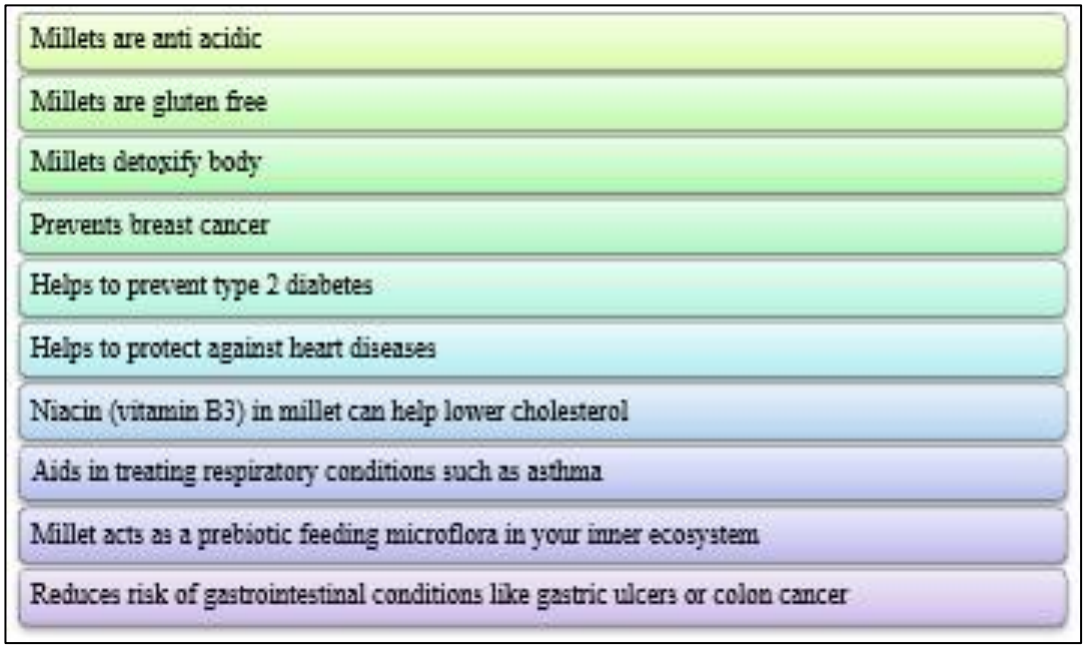

Figure 1.2: Health Benefits of Millets

1.5 Conclusion:

Millets provide several health benefits, including a high concentration of vitamins, minerals, phytochemicals, and antioxidants.

Millets have also been found to lower the chance of acquiring cardiovascular disease, diabetes, and cancer.

They are also anti-inflammatory, antibacterial, and have wound healing effects. Millets have been found to improve blood pressure, lessen hyperlipidemia, and enhance HDL-C (commonly known as "good" cholesterol).

Millets are also high in dietary fibre, which improves digestion and encourages the establishment of good gut flora. Millets are functional foods that have been used to cure and prevent dietary disorders.

They are also good to persons who have Celiac Disease or are malnourished. Finally, millets provide a number of health benefits and can be an important part of a well-balanced diet.

The chapter most likely emphasises the importance of boosting millet planting, consumption, and awareness in order to diversify diets, improve food security, and contribute to community well-being.

As policymakers, researchers, and the general public gain a better understanding of millets' nutritional value, it becomes clear that incorporating these grains into mainstream agricultural practises is not only a viable option, but also a necessary step towards achieving comprehensive nutritional security.

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