

International Millet Year: The Future Food: Nutri - Cereal (“Shree Aan”)

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Abstract: *In India, Millets were traditionally consumed, but due to the push given to food security through Green Revolution in the 1960s, millets were rendered as ‘orphan crops’ - less consumed and almost forgotten. Before the Green Revolution, millets made up around 40% of all cultivated grains, which has dropped to around 20% over the years. Not only has the consumption of millets declined, but the area under production has been replaced with commercial crops, oilseeds, pulses and maize. These commercial crops are profitable, and their production is supported by several policies through subsidized inputs, incentivized procurement and inclusion in the Public Distribution System. This has resulted in changes in dietary patterns with preferential consumption towards fine calorie - rich cereals. Against this backdrop, the Government of India realized the importance of millets in building nutritional security in the country and made several efforts such as gazetting millets as Nutri - Cereals, the celebration of the National Year of Millets in 2018, several small - scale policies on millets and proposing the International Year of Millets to UNGA. Millets (Bajra, Jowar, Ragi etc) are one of the oldest foods known to humans. Millets were among the first crops to be domesticated in India with several pieces of evidence pointing to their consumption during the Indus valley civilization. Recognizing the importance of millets, and creating a domestic and global demand along with providing nutritious food to the people, the Government of India, guided by the vision of Prime Minister Narendra Modi, and spearheaded the United Nations General Assembly (UNGA) resolution for declaring the year 2023 as International Year of Millets. The Proposal of India was supported by 72 countries, and UNGA declared 2023 as the International Year of Millets in March 2021.*

Keywords: Millets, Nutri - cereal, Shree Aan, Value Addition, Food Security

1. Introduction

International Year of Millets (IYOM) - 2023:

Government of India had proposed to United Nations for declaring 2023 as International Year of Millets (IYOM). The proposal of India was supported by 72 countries and United Nations General Assembly (UNGA) declared 2023 as International Year of Millets on the March, 2021.

Now government of India has decided to celebrate IYOM, 2023 to make it people’s movement so that the Indian millets, recipes, value added products are accepted globally.

Objectives:

- Awareness of the contribution of millet to **Food Security** and Nutrition.
- Inspire stakeholders to improve sustainable production and quality of millets.

Millets – The Tradition of India

‘Millets’ were among the first crops to be domesticated in India with several evidence of its consumption during the Indus valley civilization. Being grown in more than 130 centuries at present, Millets are considered traditional food for more than half a billion people Asia and Africa. Millet is common term to categorize small - seeded grasses that are often termed Nutri - cereals or Dryland - cereals and includes sorghum (Jowar), Pearl Millet (Bajra), Finger Millet (Ragi), Little Millet (Kutki), Foxtail Millet (Kakun), Proso Millet (Cheena), Barnyard Millet (Sawa), Kodo Millet (Kodon) and other millets. Millets are good source of carbohydrates, protein, and various micronutrients, including iron, zinc, and vitamin B6. It is also gluten free making it a good option for people with celiac disease or gluten intolerance.

We’ve heard of old saying “You are what you eat”, and it’s still true. A balanced nutritive diet is the mantra to good health. In recent times people are becoming conscious of the consumption of balanced and nutritional diet leading to a healthy lifestyle. Millet grains have been the traditional component of food basket in India.

In India, millets are primarily a kharif crop, requiring less water and agricultural inputs than other similar staples. Millets are important by the virtue of its mammoth potential to generate livelihood, increase farmers’ income and ensure food & nutritional security all over the world. However, despite its many benefits, millet is often overlooked by farmers, policymakers, and the general public in favor of other staple crops such as wheat, rice and maize.

Millets are the native of India and very popular grain also known as ‘Nutri - cereals’. In the field of agriculture, modern technologies and progressive scientific knowledge have promoted better life style of mankind. In agriculture selection and development of good quality seeds, technology innovation, organic fertilizers processing, and improvement of irrigation facilities and use of pesticides have proven the availability of food has been increased. (FAO - World Food Situation, 2017) Due to change the climatic condition production of crops are declining by farmers. Like India, in many developing countries; just because of dry land, subtracting rainfall and low fertile soil, lowering the crop production rate day by day. According to World Bank hunger is a big challenge worldwide. (ICRISAT - Small Millets, 2017) Millet based food products also help in improving the health status of human being. It contains major and minor nutrients in a noticeable amount. It also prevents many diseases and keeps our body healthy. (Jaybhav et al., 2014)

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Perspective of Millets and its sustainable Development in Agriculture and Health

- **Food Safety:** Supportable food source for fight against Hunger.
- **Nutritional Security:** Rich source of micronutrients, macronutrients and phytochemicals.
- **Disease Protector:** Gluten free, Antioxidant rich and Low GI.
- **Profitable:** Low investment required and increase income source of farmers.

Source: Saleh ASM et al, 2013, 'Millet grain: Nutritional quality, processing and potential health benefits'. (Journal of food science and food safety)

Millets For Health and Wealth: Millets are among the oldest foods known to humanity, estimated to have been under cultivation since 8000 BCE. Millets have traditionally been the main source of income, dietary energy (as the staple), and protein for people in arid and semi - arid tropics in the world. Major millets include sorghum (jowar), pearl millet (bajra), and finger millet (ragi/mandua) while minor millets include foxtail millet (kangani/kakun), proso millet (cheena), kodo millet (kodo), barnyard millet (sawa/sanwa/jhangora), little millet (kutki), and two pseudo millets - buckwheat (kuttu) and amaranthus (chaulai).

Though millets have been grown in India for centuries for their nutritional richness, low water and input requirement, and climatic resilience, area under millet cultivation has decreased significant since the 1980s, making space for wheat and rice as the cultivator responded to market demand.

Recognizing the hardiness, health benefits, nutritional density, and suitability of millets to the Indian palate and plate, the Government of India has been promoting millet cultivation in recent years. In April 2018, India rebranded nutrient - rich millets as 'nutricereals' and declared the year 2018 as the National year of Millets. India also sponsored the proposal for declaring 2023 as International year of Millets (IYM), which the United Nations General Assembly accepted. Since then, India has been at the forefront of building a people's movement' around IYM 2023, while positioning itself as the global hub for millets. The Union Budget for FY2024 referred to millets as 'Shree Anna' or Super food (literally the 'finest foodgrain').

“The rice eater is weightless like a bird; the one who eats Jowar is strong like a wolf: one who eats Ragi remains ‘nirogi’ [illness free] throughout his life.

Millets, also known as dryland cereals or nutria - cereals, are small - seeded grasses generally grown in arid and semi - arid conditions. Millets are a rich source of nutrients and minerals and resistant to drought and stress in rainfed farming. Millets are adapted to wide range of ecological conditions and are often grown on skeletal soils that are less than 15 cm deep. These nutrition rich cereals are broadly classified into major groups – major and minor:

- Major Millets: Sorghum, Pearl Millet, Finger Millet.
- Minor Millets: Little Millet Proso, Kodo, Foxtail Millet, Barnyard Millet.

Health Benefits of Major and Minor Millets:

Major Millets

Pearl Millet (*Pennisetum glaucum*; Bajra): High in fiber content, Pearl millet is beneficial in weight loss as it takes a longer time to pass through the stomach to the intestine providing satiety. Pearl millet has evolved over thousands of years to tolerate drought, nutrient deprived soil and extremes of temperature far more effectively than other cereals like wheat and rice.

Origin and Domestication of Pearl Millet

Pearl millet originated in tropical western Africa some 4000 years ago. The race, globosum differentiated from the origin wild race moved to the western side. Whereas the typhoides race reached Eastern Africa and spread to India and southern Africa some 2000 - 3000 years ago.

Sorghum (*Sorghum bicolor*; Jowar): Known as the king of Millets, Sorghum is a crop from the Graminaeae family that is high in carbohydrates. Sorghum's main ingredient is starch which is digested slower than in other cereals. Archeological evidence has identified regions in Sudan, Ethiopia, and West Africa as centers of origin of sorghum, with evidence for more than one domestication event. Sorghum has played role in agriculture in India and India is now considered to be its second center of diversity.

Origin and Domestication of Sorghum

The earliest evidence of use of wild sorghum as a food is from the Sahara, around 7500 BC, where hunter - gathers lived. Introduction to India (2000 - 1700 B. C.) Domestication and cultivation of sorghum dates back to 2000 - 1700 BC with evidences found in the Indus Valley, Over the years, domesticated sorghum was distributed from Africa across the globe via trade routes.

Finger Millet (*Eleusine coracana*; Ragi): Finger millet grains are rich in calcium, minerals, dietary fibre, polyphenols, and proteins. They contain high amount of potassium, which aids in the proper functioning of the kidneys and brains. Potassium enhances smooth functioning of muscles as well. Finger millets are widely cultivated in Africa and India. In India, it is increasingly used in snacks and bakery products.

Origin and Domestication of finger Millet

In the beginning of Iron Age about 5000 years ago in the highlands of Eastern Africa, from Eastern Africa, it spread to other parts of the world including India about 3000 years ago. Later it spread to Southern Africa, around 800 years ago followed by South - East Asia

Minor Millets

Foxtail Millet (*Setaria italic*; Varagu): It grows in temperate areas and is used for both feed and fodder. Foxtail millets are an excellent source of iron and calcium which play a pivotal role in maintaining the health of bones and muscles. Being gluten - free, rich in protein and low on carbohydrates, foxtail is highly recommended for cardiac health, diabetes, cholesterol and strengthening the nervous

system. Foxtail millet was first produced in China and is now grown in the Korean peninsula, several regions of southern Europe, India and Indonesia.

Origin and Domestication of Foxtail Millets

Foxtail Millet came from green millet domestication in northern China about for 8000 years ago. The Cishan culture of China has been recognized as the most basic to domesticate foxtail millet. Outside of its native distribution its farming can be cited at Chengobushan.

Kodo Millet (*Paspalum scrobiculatum*): Kodo millet is rich in fiber and helps to reduce problems like constipation, flatulence, bloating and stomach cramping. It is good source of magnesium which is known to promote heart health and to reduce blood pressure.

Origin and Domestication of Kodo Millets

Kodo millet originated in tropical Africa, Kodo Millet is estimated to have been domesticated in India since 3000 years ago.

Proso millet (*Panicum miliaceum*): Proso millet is rich in minerals, dietary fiber, polyphenols, vitamins, and proteins. It is gluten free and therefore, ideal for the gluten intolerant people. Proso millet contains high lecithin which supports the neural health system. It is rich in vitamins (niacin, B - complex vitamins, folic acid), minerals (P, Ca, Zn, Fe) and essential amino acids (methionine and cysteine).

Origin and Domestication of Proso Millets

Domesticated Proso millet comes from the Cishan site in semi - arid North - East China around 8000 BCE. Whereas evidence of domesticated proso millet cultivation in East Asia and Europe dates to 5000 BCE in Georgia and Germany.

Little millet (*Panicum miliare*): It is relative of proso millet, but the seeds of little millet are much smaller than proso millet. With their low carbohydrate content, slow digestibility and low water soluble gum content, these millets have been attributed to improve glucose metabolism. The grains release sugar slowly in the blood and slow down glucose absorption.

Origin and Domestication of Little Millet

The origin of the little millet crop is now well documented except for its probable Indian origin. Little millet was domesticated in the Eastern Ghats of India and spread to Sri Lanka, Nepal, and Myanmar.

Barnyard millet (*Echinochloa frumentacea*): In India's tropics and subtropics, barnyard millet production is significant. Barnyards are generally utilized as food for both humans as well as animal feed. *Echinochloa frumentacea*, An Indian - based barnyard millet, and *Echinochloa esculenta*, a Japanese - based barnyard millet, are two of the most widely cultivated species. There is limited information on the origin of barnyard millets. General consensus is that these originated in central Asia; *Echinochloa esculenta* was domesticated in Japan, China and Korea whereas *Echinochloa frumentacea* was domesticated in India.

Significance:

Nutritionally Superior:

- Millets are less expensive and nutritionally superior to wheat & rice owing to their high protein, fibre, vitamins and minerals like iron content.
- Millets are also rich in calcium content among all the food grains.
- Millets can provide nutritional security and act as a shield against nutritional deficiency, especially among children and women. Its high iron content can fight high prevalence of anemia in India women of reproductive age and infants.

Gluten - free a low glycemic index:

- Millets can help tackle lifestyle problems and health challenges such as obesity and diabetes as they are gluten free and have a low glycemic index (a relative ranking of carbohydrate in foods according to how they affect blood glucose levels).

Health Benefits

Millets are gluten free, highly nutritious and rich in dietary fibre. They are rich in micronutrients, including calcium, iron, phosphorous, etc. They low in Glycemic Index (GI) as such don't cause huge spike in blood sugar.

In addition, millets have higher nutritional value with more balanced nutrients compared to cereals such as wheat and rice. This nutritional value with more balanced nutrients compared to cereals such as wheat and rice. This nutritional superiority (including balanced micronutrient profile and bioactive flavonoids) make them highly valuable not just as source of food but also for diverse pharmaceutical use.

Surge in occurrence of diseases such as diabetes, obesity, and cardiovascular problems such as heart attack, coronary artery disease and arrhythmias, has become a rising concern across the globe. The presence of high content of proteins, vitamins (A&B), and minerals such as calcium and iron in millets can help in avoiding such diseases. Consequently, millets are the best fit for consumers who prefer to have nutrition rich healthy food with good palatability.

Nutritional Features of Millets

Millets are high in nutrition and dietary fibre. They serve as good source of protein, micronutrients and phytochemicals. The millets contain 7 - 12% protein, 2 - 5% fat, 65 - 75% carbohydrates and 15 - 20% dietary fibre. The essential amino acids profile of the millet protein is better than various cereals such as maize. Millets contain fewer cross - linked prolamins, which may be an additional factor contributing to higher digestibility of the millet proteins.

Similar to cereal proteins, the millet proteins are poor sources of lysine, but they complement well with lysine - rich vegetables (leguminous) and animal proteins which form nutritionally balanced composites to fine cereals. Small millets are good source of phosphorous and iron.

Millets contribute to antioxidant activity with phytates, polyphenols, tannins, anthocyanins, phytosterols and pinacosanol present in it having important role in aging and

metabolic diseases. All millets possess high antioxidant activities.

Nutritional feature of any food is the chief framework for managing human health. In this order millets are full of nutritious basket with low price. These are abundant source of macronutrients and micronutrients like amino acids, carbohydrates, vitamins, minerals and fibers, which are beneficial for cure heart and boost immune system in humans, whereas anti-nutritional factors like phytic acids and polyphenols compounds prevent from unlimited cell growth. One of the best parts of these small grains is that, these are 'Gluten-free'. Due to this property this prevents from celiac disease. Pearl millets and finger are the comparatively more nutritious than other grains. (Grebmer et al., 2018)

Nutritional superiority of millets over other staples such as rice and wheat has led to increased acceptance of millet in food processing industries. The usage of millet in food processing industries. The usage of millets in infant food and

nutrition product is increasing. The presence of millets can also be witnessed in the beverages industry which is marketing millet based gluten free beers to tap the increasingly health-conscious consumer base. Millet malt based on non-alcoholic beverages is also popular.

A comparative study on nutritional value of millets has been depicted in Table 1. In all aspects of nutrition, millets are considered far superior to rice, wheat and maize products. The millets contain 7 - 12% protein, 2 - 5% fat and 15 - 20% dietary fibre. The carbohydrate content millets contain 7 - 12% protein, 2 - 5% and ranges from 60 - 70 grams compared content in millets ranges from 64 - 68 in rice, wheat flour and maize. Proso millet, for example, has the highest protein and vitamin B content amongst other millets, rice and wheat.

Pearl millet offers the highest dietary fibre and iron amongst other grains, while finger millet and barnyard millet offer the highest mineral content.

Table 1: Comparative Study of Nutritional Value in Millets, Wheat, Rice & Maize

Grain (Millet/cereal)	CHO (g)	Protein (g)	Fat (g)	Energy (Kcal)	Dietary Fibre (g)	Ca (mg)	Mg (mg)	Zn (mg)	Fe (mg)	Thiamine (mg)
Sorghum	67.7	10.0	1.7	334.1	10.2	27.6	133.0	2.0	4.0	0.4
Pearl Millet	61.8	11.0	5.4	348.0	11.5	27.4	124.0	2.8	6.4	0.3
Finger Millet	66.8	7.2	1.9	320.7	11.2	364.0	146.0	2.5	4.6	0.4
Kodo Millet	66.2	8.9	2.6	331.7	6.4	15.3	122.0	1.7	2.3	0.3
Proso Millet	70.4	12.5	1.1	341.1	-	14.0	153.0	1.4	0.8	0.4
Foxtail Millet	60.1	12.3	4.3	331.0	-	31.0	81.0	2.4	2.8	0.6
Little Millet	65.6	10.1	3.9	346.3	7.7	16.1	91.4	1.8	1.3	0.3
Barnyard Millet	65.6	6.2	2.2	307.1	-	20.0	82.0	3.0	5.0	0.3
Wheat	64.7	10.6	1.5	321.9	11.2	39.4	125.0	2.9	4.0	0.5
Rice	78.2	7.9	0.5	356.4	2.8	7.5	19.3	1.2	0.7	0.1

Source: IIMR & Indian food composition tables, NIN – 2017

Product Development

The advanced apprehension and relationship between health and nutrition resulted the development of functional food, which means a new concrete approach to acquirement of better nutrition and health index and subtract the possibilities of communicable and non-communicable diseases.

“Product development basically refers to all stages involved in leading a product from special concept through market liberate and beyond, it absorbs a product's entire journey.” (Halagarda, 2018) There are some importance of product development like - Utility of buyer, society improvement and growth of a company. (Earle and Anderson, 2017)

Value Addition

Value addition is the addition of nutrients, enhance quality and for advantage to a material in order to meet the taste, texture and fondness of end users'.

It is the process to upgrade the nutritional quality in food product, in which amount good nutritious food added in the main stuff or recipe to increase its nutritional index. Value addition is a type of reinvention of a food product about nutrition, health and economic consideration as well. It is an extra feature to boost food value. It provides something more in spite of normal food product. (Pant and Chinwan, 2014)

Value added products of millets are possible to solve negative effect of agriculture and food security.

The scope for value addition in millets starts from primary processing wherein the glumes and various foreign materials are separated to desirable, fine edible grains with optimum quality and consumer acceptability. These grains are further subjected to secondary processing via milling the grain to obtain millet flour. The shelf-life of this flour is around 1 - 2 months, which is lower than the shelf-life of other grains, while R&D efforts are ongoing to boost shelf-life of flour to tertiary processing such as RTE (Ready to Eat) and (Ready to cook) segment in order to avoid wastage and boost consumption of millets.

Value added products of millet crops (baked, extruded ready to eat meal, etc) can be marketed and accepted as a good substitute for so called health drinks available in market branded as fortified supplements for children, authenticity of which is regularly questioned by health experts as these contains high amount of sugar and artificial flavoring agents.

Importance of Value Addition -

- Nutritional Security'
- Food Enrichment
- Improvement of taste and texture

- Improvement of Acceptability and palatability
- Economically fair for consumers
- Helpful in food fortification

Grains of millet crops like kodo (*Paspalum scrobiculatum*) are in high demand for preparing composite flours which is the most important input for designing and producing value-added and functional foods (Kaushik *et al.*, 21). These composite flours of millets (sorghum, kodo, pearl millet) and non-millet staple cereals (rice, maize and wheat) are a key ingredient for soft biscuits and cookies, while breads made from millet flours either composite or non-composite are being enquired by scientists for its nutritional value, yielding outstanding results (Akeredolu *et al.*, 2005; Laminu *et al.*, 2011; Vidya *et al.*, 2012). The common millet products in market include flour, meals and grits.

Processing/Value Addition of Nutri - Cereals

The harvesting of millet is mostly carried in manual methods, wherein a lot of admixtures in grains such as dust, debris, immature before dehusking and milling into flour/atta or semolina etc. Pre-cleaning units equipped with designers, graders and aspirator systems are essential for cleaning millets. The following processing technologies are used to convert millets into various value-added products.

2. Conclusion

“This International Year is a timely reminder of this important crop. And it provides a unique opportunity to raise awareness of, and to direct policy attention to the nutritional and health benefits of millet consumption, the suitability of millets for cultivation under adverse and changing climatic conditions and creating sustainable and innovative market opportunities for many countries around the world for millets to benefit farmers and consumers globally.” Food and Agriculture Organization (FAO), Director - General.

Millets has tremendous potential to emerge as staple food crops in world especially in developing countries owing to their easy availability and diverse distribution coupled with presence of large varietal base. Millets perform relatively better than staple food crops like wheat and rice in adverse climatic conditions in arid and semi-arid regions where water resources are limited as well as soils are problematic (saline, sodic alkaline). Millet crops are a cheap source of quality proteins, macro and micronutrients, minerals, organic compounds which are vital for proper physical and mental growth of body. Equipped with a number of health benefits which include prevention from many common and deadly diseases, millets are boon to fight against malnutrition, food insecurity and climate change.

However, in order to fully exploit the uncapped potential, people must be made aware about the usefulness of millets regarding health and farmers should be encouraged by providing incentives to grow more millet. Health nutritional benefits of millets should be properly advertised and marketed. Governments should make collective efforts to increase millet consumption per capita which can save its expenditure to fight diseases which primarily arise due to malnutrition. Millets can be considered as super food.

The millets are considered as nutraceutical due to its amazing nutritive value and health benefits over other cereals. Millets based pasta, biscuits, cakes, weaning food, fermented food and traditional products are available in market with reasonable price. The aim this study is to aware the people to recognize the importance of millets as nutritious food and full-fill the nutritional need of population and also increase demand and consumption of millets in daily meal. Millets are nutritionally effective and can reduce the problem of malnutrition and other health related problems.

3. Future Prospects

Food security: The current scenario have raised relevant concerns to meet the food demand of ever increasing global population which is expected to cross 9 billion mark by 2050 of which 2-3 billion are predicted to suffer from hunger and nutritional insecurities (Godfray *et al.*, 2013; Wheeler and Von Braun, 2013). Elevation in global average temperature globally warming due to emission of greenhouse gases directly reduces crop yield and productivity and endangers agriculture sustainability and food security (Kang *et al.*, 2009). However, the carbon footprints of other minor cereal crops such as millets and sorghum are comparatively low. This is one of the primary reasons millets can be one of the crops that could reduce carbon footprint in the world (Prasad and Staggborg, 2009).

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