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Unlocking the Power of Minor Millets for Optimal Nutrition

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KEYWORDS		ABSTRACT
Millets, Nutrition, Sustainable Agriculture, Food Security, Ecological Resilience, Socio-economic Development.		Millets are a group of small-seeded grains that have been cultivated by humans for thousands of years. These ancient grains have gained popularity in recent years due to essential nutritional value and versatility in cooking. Millets are gluten-free and rich in fibers, protein, vitamins, and minerals, making them a healthy alternative to traditional grains. They are also low in calories and have a low Glycemic index, making them suitable for people with diabetes or those looking to manage their weight. Millets can be used in a variety of dishes, such as porridge, bread, pancakes, and even as a rice substitute. They have a unique nutty flavor and can be easily incorporated into both savory and sweet recipes. In addition to being a nutritious food source, millets also have a low environmental impact as they require less water and pesticides to grow compared to other grains. This makes them a sustainable option for agriculture and can help reduce the carbon footprint of food production. With their many health benefits and sustainable qualities, it is no wonder that millets are gaining popularity as a staple food in many countries around the world.

Introduction

Millets hold a special place in the cultural and agricultural heritage of India, where they have been cultivated for thousands of years. These ancient grains have served as staple foods for various communities across the country, contributing to the diverse culinary traditions and dietary patterns of different regions.

In India, millets encompass a wide range of species, including pearl millet (bajra), finger millet (ragi), foxtail millet (kangni), little millet (kutki), and sorghum (jowar), among others. Each variety has its unique nutritional profile, taste, and culinary uses, reflecting the rich biodiversity of India's agroecosystems.

Historically, millets have played a vital role in ensuring food security, especially in regions with erratic rainfall and marginal agricultural conditions. Their ability to thrive in low-input environments, along with their drought tolerance and short growing seasons, has made them indispensable for smallholder farmers and marginalized communities.

Millets have been integral to the traditional diets of many Indian states, particularly in South India, where ragi is a staple crop. Ragi, in particular, is highly nutritious, rich in calcium, iron, and dietary fiber, making it a valuable component of diets, especially for infants, children, and pregnant women.

However, there has been a resurgence of interest in millets in India in recent years, driven by growing awareness of their nutritional value, climate resilience, and sustainability. Government initiatives, such as the National Mission on Sustainable Agriculture (NMSA) and the National Food Security Mission (NFSM), have aimed to promote millet cultivation and integrate them into mainstream agriculture.

Moreover, various non-governmental organizations (NGOs), research institutions, and farmer groups have been actively involved in promoting millets through awareness campaigns, capacity building, and market linkages. Efforts to revive traditional millet-based recipes, promote millet-based processed foods, and enhance value chains have also gained momentum, contributing to the resurgence of millets in Indian diets.

Revealing Nutritional status

Macronutrients: Millets are rich in carbohydrates, which provide energy for the body. However, they also have lower glycemic indices compared to refined grains like rice and wheat, which means they cause a slower rise in blood sugar levels. This makes millets particularly suitable for individuals with diabetes or those aiming to manage their blood sugar levels.

Proteins: Millets are good sources of plant-based proteins, making them suitable for vegetarians and vegans. They contain essential amino acids, albeit in varying proportions depending on the type of millet. Finger millet (ragi) is especially notable for its high protein content.

Dietary Fiber: Millets are high in dietary fibre, which aids in digestion, prevents constipation, and promotes gut health. The fibre content also contributes to a feeling of fullness, which can help with weight management.

Micronutrients: Millets are rich sources of various vitamins and minerals. They contain significant amounts of iron, calcium, magnesium, phosphorus, potassium, and zinc, among others. These micronutrients are essential for various bodily functions, including bone health, immune function, and energy metabolism.

Antioxidants: Some millets, such as finger millet (ragi), are rich in antioxidants like polyphenols. Antioxidants help neutralize harmful free radicals in the body, reducing the risk of chronic diseases such as heart disease, cancer, and diabetes.

Gluten-Free: Millets are naturally gluten-free, making them suitable for individuals with celiac disease or gluten sensitivities. They can be used as alternatives to gluten-containing grains like wheat, barley, and rye in gluten-free diets.

Low Fat Content: Millets generally have low-fat content compared to other grains, which can be beneficial for individuals looking to reduce their fat intake.

Overall, incorporating millets into the diet can contribute to better overall health and well-being. They offer a diverse array of nutrients and can be prepared in various ways, including as porridges, flatbreads, salads, and side dishes, making them a versatile and nutritious addition to any meal plan.

Table 1: Nutritional composition of Common Millets

Nutrient	Pearl Millet	Finger Millet	Foxtail Millet	Proso Millet	Barnyard Millet	Little Millet	Kodo Millet
Protein (g/100)	10.6	7.3	12.3	12.5	11.2	7.7	8.3
Dietary Fibre(g/100)	1.3	3.6	8.0	2.2	10.1	7.6	9.0
Iron(mg/100)	8.0	3.9	2.8	0.8	15.2	9.3	0.5
Calcium(mg/100)	42	344	31	14	11	17	27
Magnesium(mg/100)	137	137	81	106	83	119	188
Glycemic Index	Low	Low	Low	Medium	Low	Low	Low
Gluten-Free	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Analysis of millet cultivation patterns across different countries

Analysing millet cultivation patterns across different countries reveals diverse practices influenced by factors such as agro-climatic conditions, cultural traditions, dietary preferences, and economic considerations. Here's an overview of millet cultivation patterns in various regions around the world:

Africa: It is the largest producer of millets globally, with countries like Nigeria, Mali, Niger, Sudan, and Ethiopia being significant producers.

Millets are staple crops in many African countries, particularly in regions with semi-arid and arid climates, where they serve as important food and fodder crops for millions of people.

India: Its one of the largest producers and consumers of millets globally, with a long history of millet cultivation.

Major millet-producing states in India include Karnataka, Maharashtra, Telangana, Andhra Pradesh, and Rajasthan.

Millet cultivation patterns vary across states, with fingermillet (ragi), pearl millet (bajra), and sorghum (jowar) being the predominant varieties grown in different regions.

China: It is a significant producer of millets, with foxtail millet (Setaria italica) and Proso millet (Panicum miliaceum) being the main species cultivated.

Millet cultivation in China is concentrated in the northern regions, where it serves as an important food and feed crop, particularly in areas with limited water resources.

United states: In the United States, millets are primarily grown as forage crops for livestock feed, with limited human consumption compared to other regions.

Proso millet is the most cultivated millet variety in the U.S., particularly in the Great Plains region, where it is grown as a rotation crop with wheat and other cereals.

Russia: Is one of the largest producers of millets in Europe, with Proso millet being the dominant species cultivated.

Millet cultivation in Russia is concentrated in regions with favourable climatic conditions, such as the Southern

Federal District and the Volga Federal District.

Nepal: Millets, particularly finger millet (ragi) and foxtail millet, are important food crops in Nepal, especially in hilly and mountainous regions.

Millet cultivation in Nepal is often integrated into traditional farming systems, with farmers practicing rainfed cultivation and intercropping with other crops.

Overall, millet cultivation patterns vary widely across countries and regions, reflecting the diverse agro-ecological conditions and socio-economic contexts in which they are grown. Understanding these patterns is essential for promoting sustainable millet production and enhancing food security and nutrition worldwide.

Table 2: A Global look of Production of Millets in Recent Years

Country	Millet Production 2021(tons)	Millet Production 2020(tons)	Millet Production 2019(tons)
India	13,210,000	12,488,470	10,235,830
China	2,700,000	2,807,000	2,300,000
Niger	2,146,706	3,508,903	3,270,453
Nigeria	1,922,000	1,905,000	1,925,075
Sudan	1,500,000	422,107	1,133,000
Mali	1,487,683	1,921,171	1,878,527
Senegal	1,039,860	1,144,855	8807,044
Ethiopia	1,000,000	1,218,582	1,125,958
Russia	368,137	396,458	439,771
Nepal	326,443	320,953	314,225

Factors Impacting Production of Millets Across Countries

Millet production is influenced by a variety of factors that can vary significantly by country. These factors include climatic conditions, soil quality, agricultural practices, government policies, and market access. Here's a detailed analysis of these factors:

➢ Climatic Conditions

Temperature and Rainfall: Millets are generally tolerant to high temperatures and low rainfall, making them suitable for arid and semi-arid regions. However, extreme weather conditions, such as prolonged droughts or unexpected heavy rains, can negatively impact yield. For instance, in India and West African countries like Niger and Nigeria, fluctuating rainfall patterns can affect millet production.

Climate Change: The increasing unpredictability of weather due to climate change poses a significant threat to millet production. In regions like the Sahel, where millet is a staple, changes in rainfall patterns and increased temperatures can reduce yields.

➢ Soil quality

Soil Fertility: Millets can grow in poor soils where other crops fail. However, soil fertility still impacts yield. Soil degradation and nutrient depletion, common in many developing countries, can limit millet productivity unless countered by proper soil management practices.

Soil Type: Different millets thrive in different soil types. For example, finger millet prefers well-drained loamy soils, whereas pearl millet is more tolerant of sandy soils. Understanding and managing soil types is crucial for optimizing production.

➢ Agricultural Practices

Traditional vs. Modern Techniques: In many regions, millet is still grown using traditional methods, which can limit yields. The adoption of modern agricultural practices, such as improved seed varieties, mechanization, and better irrigation techniques, can significantly boost production. For example, in India, government initiatives are promoting the use of high-yielding millet varieties and improved farming techniques.

Pest and Disease Management: Millets are relatively hardy, but they are still susceptible to pests and diseases. Effective management strategies, including the use of

resistant varieties and integrated pest management, are essential to minimize losses.

- **Government Policies and Support**

Subsidies and Incentives: Government support in the form of subsidies for seeds, fertilizers, and irrigation can encourage millet cultivation. In India, policies like the National Food Security Mission include components specifically for millets to enhance production and consumption.

Research and Development: Investment in research and development is crucial for developing high-yield and pest-resistant millet varieties. Countries with strong agricultural research institutions, such as India and China, are better positioned to improve their millet production through scientific advancements.

Food Security Programs: In many African countries, millet is included in food security programs to ensure a stable food supply during droughts. These programs often provide support for storage facilities and distribution networks to reduce post-harvest losses.

- **Market Access and Economic Factors**

Market Demand: The demand for millets, both domestically and internationally, influences production levels. Increasing awareness of the nutritional benefits of millets is driving demand in health-conscious markets, which can boost production incentives.

Price Stability: Fluctuating market prices can discourage farmers from growing millets. Ensuring stable and fair prices through government interventions or cooperatives can provide farmers with the confidence to invest in millet cultivation.

Infrastructure: Adequate infrastructure for transportation, storage, and processing is essential for maximizing the economic returns from millet production. Poor infrastructure can lead to significant post-harvest losses and reduced profitability.

Pharmacological roles of Millets

Millets are not only valuable for their nutritional content but also possess several pharmacological properties that contribute to health and disease prevention. Here are some key pharmacological roles of millets based on their bioactive components:

1. Antioxidant Properties

Millets are rich in phenolic acids, flavonoids, and tannins, which have strong antioxidant properties. These compounds help in neutralizing free radicals, reducing oxidative stress, and preventing cell damage. Antioxidants play a critical role in preventing chronic diseases such as cancer, cardiovascular diseases, and neurodegenerative disorder.

2. Anti-inflammatory Effects

The phenolic compounds in millets also exhibit anti-inflammatory properties. Chronic inflammation is linked to various diseases, including arthritis, heart disease, and cancer. Regular consumption of millets can help reduce inflammation in the body and mitigate the risk of these diseases.

3. Antidiabetic Activity

Millets have a low glycemic index, which means they cause a slower and lower rise in blood glucose levels compared to other cereals. This property makes them beneficial for managing diabetes. Studies have shown that millets can improve insulin sensitivity and help in maintaining stable blood sugar levels.

4. Hypolipidemic Effects

Millets help in lowering cholesterol levels. The high fibre content, especially soluble fibre, aids in reducing LDL cholesterol (bad cholesterol) and increasing HDL cholesterol (good cholesterol). This effect is beneficial in preventing and managing cardiovascular diseases.

5. Antimicrobial Activity

Certain compounds in millets exhibit antimicrobial properties, which can help in fighting off infections. These antimicrobial agents can inhibit the growth of various pathogenic bacteria and fungi, contributing to better overall health.

6. Anticancer Properties

The antioxidants and phenolic compounds in millets have been found to have anticancer properties. These compounds can induce apoptosis (programmed cell death) in cancer cells and inhibit the proliferation of cancerous cells. Research suggests that millets may be effective in preventing cancers of the colon, breast, and liver.

7. Gastroprotective Effects

Millets, particularly those high in dietary fibre, help in maintaining gut health. The fibre content promotes healthy bowel movements, prevents constipation, and supports a healthy microbiome. This gastroprotective effect can reduce the risk of colorectal cancer and other digestive disorders.

8. Neuroprotective Benefits

Millets contain essential amino acids and antioxidants that contribute to brain health. They help in protecting neurons from oxidative damage and improve cognitive functions. Regular consumption of millets may reduce the risk of neurodegenerative diseases such as Alzheimer's and Parkinson's.

Conclusion

In conclusion, it is evident that minor millets, also known as Nutri cereals, play a crucial role in addressing the growing concern of malnutrition and improving overall nutrition in the present scenario. These tiny grains are power packed with essential nutrients such as protein, fibre, vitamins, and minerals, making them an ideal food source for combating various health issues. Also, minor millets emerge as invaluable assets in addressing contemporary challenges in agriculture, nutrition, and sustainability. These humble grains, often overshadowed by major cereals, possess remarkable nutritional potency, packed with essential nutrients and dietary fibre crucial for

human health. Moreover, their resilience to diverse environmental conditions makes them a sustainable choice for agriculture, requiring fewer resources like water and fertilizers compared to conventional crops.

Culturally, minor millets hold deep-rooted significance, reflecting traditions of cultivation and consumption across various communities, thus preserving cultural heritage, and promoting community resilience. Embracing minor millets diversifies diets, enhances nutritional intake, and contributes to food security by reducing dependency on a few staple crops, thereby mitigating risks associated with monoculture and market fluctuations. Altogether, recognizing the importance of minor millets and integrating them into agricultural practices and diets is imperative for building a more resilient, equitable, and sustainable food system for current and future generations. With the current rise in lifestyle diseases and the need for a more sustainable and diverse diet, the re-introduction of minor millets in our meals is necessary. Not only do they provide vital nutrients but also have a low glycemic index and are gluten-free, making them suitable for people with diabetes and celiac disease. Furthermore, promoting the cultivation and consumption of minor millets can also have a positive impact on the environment, as they require less water and fertilizer compared to major crops. Therefore, it is crucial to recognize the importance of these tiny grains in our diet and incorporate them into our food habits for a healthier and more sustainable future.

References

1. Singh P & Raghuvanshi RS. Finger Millet for Food and Nutrition Security. African Journal of Food Science, 2012
2. Yang X, Wan Z, Perry L, Lu H, Wang Q. Hao C, Li J, Xie F, Yu J, Cui T, Wang T, Li M & Ge QH. Early Millet Use in Northern China. Proc. Nat. Acad. Sci. 2012; USA.
3. Bhat BV, Rao DB, Tonapi VA. The Story of Millets Karnataka State Department of Agriculture in Association with ICAR. Hyderabad, India: Indian Institute of Millets Research; 2018
4. Ahuja, K. G., Nath, P., & Swamy, K. R. M. (2010). Foods and Nutrition, 1st ed. New Delhi, India: Studium Press.
5. Amadou, I., Mahamadou, E. G., & Le, G. (2011). Millet-based traditional processed foods and beverages-A review. Cereal Food World, 56(3),115-121. https://doi.org/10.1094/CFW-56-3-0115
6. Amadou, I., Gounga, M. E., & Le, G. W. (2013). Millets: Nutritional com- position, some health benefits and processing-A review. Emirates Journal of Food and Agriculture, 25(7), 501-508.
7. Sharma, S., Saxena, D. C., & Riar, C. S. (2016). Anlysing the effect of ger- mination on phenolics, dietary fibres, minerals, and y-amino butyric acid contents of barnyard millet (Echinochloa frumentaceae). Food Bioscience, 13, 60-68. https://doi.org/10.1016/j.fbio.2015.
8. Rajshekar, S.C. and Raju, S. 2017. Introduction of millets in PDS- Lessons from Karnataka, Internal Report of the M.S. Swaminathan Research Foundation. Chennai, India.
9. Stanly, J.M. and Shanmugam. 2013. A study on millet-based cultivation and consumption in India. International Journal of Marketing, Financial Services and Management Research.
10. Padulosi, S. Bhag Mal O. I. King and E, 2015. Gotor, Minor Millets as a Central Element for Sustainably Enhanced Incomes, Empowerment, and Nutrition in Rural India. Sustainability, 7(7).
11. Amadou I, Mahamadou EG, Le G-W (2013) Millets, nutritional composition, some health benefits and processing—review. Food Sci Technology.
12. Saleh, A.S.; Zhang, Q.; Chen, J.; Shen, Q. Millet Grains: Nutritional Quality, Processing, and Potential Health Benefits. Compr. Rev. Food Sci. Food Saf. 2013, 12, 281–295.
13. Tripathi, M.K.; Jadam, R.S.; Kumar, A. Quality Management System in Millet and Sorghum. In Millets and Millet Technology; Springer: Berlin/Heidelberg, Germany, 2021.
14. Wheeler, T.; Von Braun, J. Climate change impacts on global food security. Science 2013, 341, 508–513.
15. Prasad, P.V.; Staggenborg, S.A. Growth and production of sorghum and millets. In Soils, Plant Growth and Crop Production; EOLSS Publishers Co., Ltd.: Oxford, UK, 2009; Volume 2.
16. Saini, S.; Saxena, S.; Samtiya, M.; Puniya, M.; Dhewa, T. Potential of underutilized millets as Nutri-cereal: An overview. J. Food Sci. Technol. 2021, 58, 4465–4477.
17. Sharma, N.; Niranjan, K. Foxtail millet: Properties, processing, health benefits, and uses. Food Rev. Int. 2017, 34, 329–363.
18. Saha, D.; Gowda, M.V.C.; Arya, L.; Verma, M.; Bansal, K.C. Genetic and Genomic Resources of Small Millets. Crit. Rev. Plant Sci. 2016, 35, 56–79.
19. Nishizawa, N.; Oikawa, M.; Hareyama, S. Effect of Dietary Protein from Proso Millet on the Plasma Cholesterol Metabolism in Rats. Agric. Biol. Chem. 1990, 54, 229–230.
20. S. Padulosi, B. Mal, O. I. King and E. Gotor, Minor millets as a central element for sustainably enhanced incomes, empowerment, and nutrition in rural India, Sustain, 2015, 7, 8904–8933.
21. B. Dayakar Rao, K. Bhaskarachary, G. D. Arlene Christina, G. Sudha Devi and A. T. Vilas, Nutritional and Health Benefits of Millets, ICAR_Indian Institute of Millets Research (IIMR), Rajendranagar, Hyderabad, 2017, pp. 1–2.
22. Anbukkani P, Balaji SJ, Nithyashree ML. Productionand consumption of minor millets in India- A structural break analysis. Ann. Agric. Res. New Series. 2017; 38(4):1-8.
23. Bhat S. Nandini C. Tippeswamy V. Prabhakar. Significance of small millets in nutrition and health -A review. Asian J. Dairy & Food Res. 2018; 37(1):35-40.