

The International Year of Millets-2023, Millets as Nutri-cereals of 21st Centenary for Health and Wellness

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Abstract

Due to their nutritional value, major millets and minor millets are referred to as Nutri-cereals. These crops are short-lived and resource-efficient because they use little water, fertilizer, and emit little carbon during growth (Good for the farmer). Millets are locally grown health foods that have extra health advantages such as being a source of gluten-free protein, high in fiber, low glycemic index, and rich in bioactive chemicals. Nutri-cereals are a better option than cereal grains like rice and wheat because they contain a good amount of nutrients such as complex carbohydrates (Low GI), proteins with balanced amino acids, dietary fiber, good-quality invisible fat, and noticeably higher amounts of micronutrients like calcium, potassium, magnesium, iron, manganese, zinc, B complex vitamins, and bioactive phytochemicals. Although millet's nutritional benefits have been extensively documented, only traditional consumers in indigenous societies use it as food. This is primarily because there is no consumer-friendly, ready-to-use or ready-to-eat millet products like there are for wheat and rice. The recent resolution by the United Nations General Assembly to observe 2023 as the International Year of Millets to highlight the significance of nutrient-rich crops in climate-changing conditions is one step in that direction. Additionally, the development of new processing equipment and technological advancements for the production of convenient foods from nutri-cereals are gaining recognition on a global scale. In this review highlighted the scope of production, processing, and rural business development opportunities for nutria-cereals from India to the world market.

Keywords: Functional foods, Millets, Malnutrition, Nutri-cereals, Processing.

Introduction

The coarse cereals including sorghum, major millets, and other small millets have been rebranded as Nutri-cereals by the Ministry of Agriculture and Farmers Welfare, Government of India. By changing the name, it is hoped to dispel the lingering misconception that these grains are superior to rice and wheat and that they are also a rich source of phytochemicals and minerals [1]. Sorghum (*Sorghum bicolor*), major millet crops include bajra or pearl millet (*Pennisetum*

typhoides), mandua/ragi or finger millet (*Eleusine coracana*), and small millets comprising of kangni or foxtail millet (*Setaria italica*), kutki or sama or little millet (*Panicum miliare*), kodo millet (*Paspalum scrobiculatum*), jhangora or sawan or barnyard millet (*Echinochloa frumentacea*), cheena or proso millet (*Panicum miliaceum*), and korale or brown top millet (*Brachiaria ramosum*) are the major nutri-cereals grown in India and are nutritionally superior to other major cereals. Millets are Smart Foods [2]. Owing to their nutritional composition (Good for mankind), requires less water, and fertilizers and emit low carbon during crop growth (Good for the planet), and these are short-duration and resource-efficient crops (Good for the farmer). Compared to other major cereal grains, millets are more nutrient-dense and are a locally cultivated healthy food due to their added health benefits, which include being a source of gluten-free protein, being high in fiber, having a low glycemic index, and being rich in bioactive

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Table 1: Production of nutri-cereals during last five years

S.No	Grains	Production in million tonnes					
		2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
1	Sorghum	4.24	4.57	4.8	3.48	4.73	5.01
2	Bajra	8.07	9.73	9.21	8.66	10.28	9.57
3	Ragi	1.82	1.39	1.99	1.24	1.74	2.35
4	Small Millets	0.39	0.44	0.44	0.33	0.4	0.65
5	Nutri-cereals	14.52	16.12	16.44	13.71	17.15	17.58

Source: Ministry of Agriculture and Farmers Welfare, GOI.

compounds [3]. The average carbohydrate content of millets and sorghum varies from 56.88 to 72.97 g/100 g, protein content from 7.5 to 12.5% and lipid content ranges between 1.3 and 6 g/100 g. Millets are a rich source of calcium, especially finger millet or ragi (364 mg/100 g) contains 10 times more than that wheat or rice. The iron content of Pearl millet or Bajra (6.42 mg/100 g) and Barnyard millet (5.0 mg/100 g) is also higher compared to other staple cereals. They are also rich sources of crude fiber as well as dietary fiber and rich in vitamins and minerals [4]. Millets are grown on about 12 million hectares with an annual production of 13.7 million tonnes and contribute 10% to the country's food grain basket. Further, India is the major producer of millet followed by African countries. The production of Nutri-cereals has increased from 14.52 million tonnes to 17.58 million tonnes during the last five years (Table 1). Despite the many benefits of growing small millets and its health advantages, the cultivation of small millets is confined to a few pockets of India. The current small millet production in the country is 0.65 million tonnes during 2020-21 [5].

Nutritional and Health Benefits

Nutri-cereals contain a good amount of nutrients like carbohydrates (Low GI), proteins with balanced amino acids, dietary fiber, good-quality invisible fat, and have appreciably higher amounts of micronutrients like calcium, potassium, magnesium, iron, manganese, zinc, B complex vitamins and bioactive phytochemicals, making them a superior choice over the cereal grains like rice and wheat (Table 2 and Figure 1). Several research studies have

endorsed the role of polyphenols in antioxidant, anti-carcinogenic, anti-inflammatory, antiviral and neuroprotective activities which in all have shown to be beneficial against diseases like cancer and cardiovascular disease, diabetes, high blood pressure, high cholesterol, inflammatory diseases, metabolic syndrome and Parkinson's disease [6]. Millets are rich in dietary fiber and resistant starch which help in weight regulation. Due to the slow release of glucose, millets are an excellent choice of food for diabetics. The nonstarch polysaccharides found in millets act as prebiotics and stimulate the lactic acid bacteria (LAB) of probiotic cultures and produce short chain fatty acids and antimicrobial agents in the digestive tract.

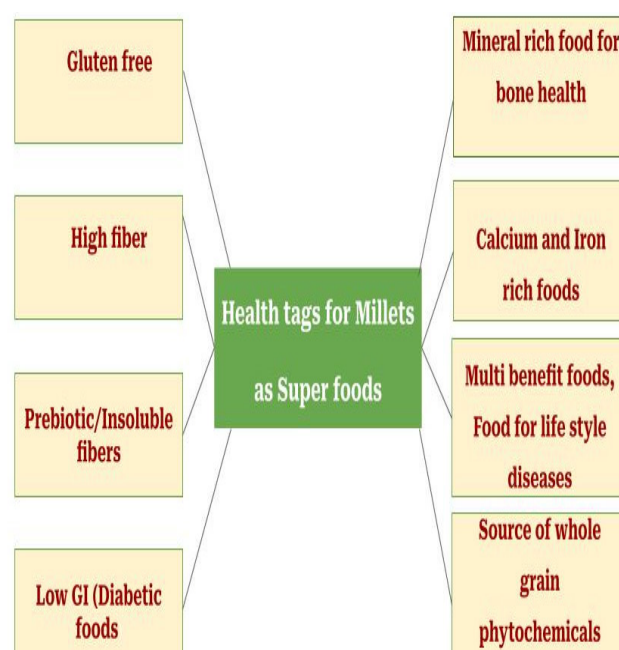
**Figure 1:** Health benefits of Nutri-cereals consumption

Table 2: Nutritional Composition of Nutri-cereals v/s staple grains [7].

Crop	Protein (g)	Fat (g)	Fiber (g)	CHO (g)	Minerals (g)	Iron (mg)	Calcium (mg)
Rice raw milled	6.8	0.5	0.2	78.2	0.6	0.7	10
Wheat	11.8	1.5	1.2	71.2	1.5	5.3	41
Sorghum	10.4	1.9	1.6	72.6	1.6	4.1	25
Maize	11.1	3.6	2.7	66.2	1.5	2.3	10
Foxtail Millet	12.3	4.3	8.0	60.9	3.3	2.8	31
Pearl Millet	11.6	5.0	1.2	67.5	2.3	8.0	42
Finger Millet	7.3	1.3	3.6	72.0	2.7	3.9	344
Kodo Millet	11.0	3.6	10.0	66.6	1.9	0.5	27
Little Millet	7.7	-	7.6		1.5	9.3	27
Proso Millet	12.5	4.2	2.2	73.0	1.9	0.8	14
Barnyard Millet	12.2	3.85	10.1	55.8	3.2	1.4	24

Despite substantial research on millet's nutritional advantages, only traditional consumers in indigenous societies eat it. Even though eating millets has many health benefits, the per capita consumption is very low because of the coarseness, colour, and general appearance of the grains, which are considered a staple food for the poor, the difficulty of processing at the domestic level, the lack of high-end processing technologies, the stigma associated with eating millets, the lack of ready-to-use or simple-to-cook millets in the market, and poor millets subsidies compared to major cereals [8]. There are certain recommendations to increase the consumption of millet in the country 1). Developing region-specific delicious products to satisfy the regional taste 2). Promotion of nutritional awareness and health benefits of millet through mass campaign programs 3). Low cost of production and improvement in accessibility and availability of Nutri-cereals in all kinds of markets and stores.

Millets for control of Malnutrition

Being smart Nutri-cereals or smart food, they were not being fully utilized, which resulted in malnutrition among children in the country. According to India's National Family Health Survey (NFHS-5 data, 2019-20) more than half the women age of 15-49 years (57%) have iron deficiency anemia. In addition, being underweight, wasting, and stunting are also prevalent in children under five (32%, 19%, and 36%, respectively). About 20.2 % of adult men and 23% of women have a Body Mass Index (BMI) [Weight in

kg/(Height in meter)²] below 18.5, which indicates Chronic Energy Deficiency or CED [9]. These figures hint at serious long-term consequences for human capital development and the productivity potential of the nation. Then the production and value addition of Nutri-cereals is a good option of crop farming and it also addresses the malnutrition problems at rural areas of the country. The presence of 65% of carbohydrates and around 6.0 –12.5% protein along with 1.5–5.0% fat makes them energy-dense, thereby making them an excellent choice for fortification for under-nutrition. The feeding study conducted in tribal areas of Adilabad Telangana state revealed that supplementing food of tribal children with 40g of energy-dense complementary weaning feed per day for 90 days observed increased the anthropometric measures like weight and height when compared to a non-test group of children[4]. Another supplementation study was conducted by ICRISAT, India by selecting 1500 teenage students at two schools in a peri-urban area of Karnataka, India. The children are supplemented with millet-based midday meals for a three-month period. Out of them, 136 were investigated as the experimental group and contrasted with 107 other students in two other schools that did not receive the millet-based foods as control subjects [10]. The intervention's design was identical to that of the superiority trial's parallel-group, two-arm, and 1:1 allocation ratio. Due to attrition, the end-line allocation ratio was 1.27:1. Stunting ($p = 0.000$) and body mass index ($p = 0.003$) both showed statistically significant improvement in

the intervention group but not in the control group ($p = 0.351$ and $p = 0.511$, respectively). These are positive outcomes of the preparation of complementary food from locally available Nutri-cereals and other pulses with science-backed solutions for nutrition that reflects nutrition-sensitive agriculture. Apart from the nutritional value, the potential health benefits of Nutri-cereals in helping control diabetes, anemia, cardiovascular, and celiac diseases are not properly availed. Thus, the Nutri-cereals can be consumed as a locally grown food for combating malnutrition and at the same time, exerting health and wellness [11].

Processing/Value Addition of Nutri-cereals

The harvesting of millets is mostly carried in manual methods, wherein a lot of admixtures in grains such as dust, debris, immature grains, chaffs, mud particles, stones, as well as animal excretes, etc. Hence, pre-cleaning is an important operation 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

Primary Processing

- Simple Pre-cleaning
- Decortication or dehulling or pearling
- Milling into atta and semolina

Secondary Processing

- Ready To Eat (RTE)
- Ready To Cook (RTC)
- Health mixes & beverages

Millet product	Raw material	Processing Technologies
Energy bar	Dehulled grain	Flaking and binding
Breakfast cereals	Whole grains	Roasting, grinding, milling and extrusion
Puffed and expanded products	Semolina	Milling and extrusion
Multi grain biscuits, Therapeutic biscuits	Dehulled grains	Milling and baking
Health drinks (e.g. weaning foods)	Whole grains	Roasting/Malting and grinding

Shelf-life of Nutri-cereals based Products

Due to the presence of invisible fats and sugars that quickly begin to oxidise after milling, the shelf-life of any raw millet flour is only 5 to 7 days, and it is even shorter for pearl millet. The shelf-life of millets can be extended to 6–12 months if they are processed into various value-added products using food processing techniques like parboiling, irradiation, and germination [2].

Nutri-cereals offer opportunities

The value chain for millet and millet-based foods, particularly the ready-to-eat category, needs to be promoted and reinforced in the context of 2023 being the UN-designated International Year of Millets. Millets are now becoming well-known as climate-smart crops with tremendous nutritional and health advantages. To improve the ecological balance and the health of the public, millet cultivation areas need to be expanded with a concerted effort to become more widespread. Incentives should be given to those who grow and buy Nutri-cereals, as well as also increase domestic consumption by raising consumer awareness [12]. Farmers need to be informed about millet cultivation practices, post-harvest management, storage, and processing capabilities. The detailed economic sustainability of millets processing units in rural areas is explained through SWOT analysis in Table 3.

Table 3: SWOT Analysis of rural entrepreneurship in Nutri-cereals

Strength	<ul style="list-style-type: none"> • Raising millets Production. • Rising per capita income coupled with increasing awareness among consumers . • Rapid urbanization is driving consumerism in Tier-II & Tier-III cities. • Growing penetration of food and beverages manufacturing companies in rural areas. • Tailor made flavors and region specific tastes.
Weakness	<ul style="list-style-type: none"> • Insufficient supply. • Lack of fully developed Grades and Standards for the sale of millets at a better price. • Nutritional claims haven't been validated fully.
Opportunities	<ul style="list-style-type: none"> • Rising business and product innovation • Untapped rural markets • Low-cost price strategy is adopted so as to make the product affordable to the consumers • Rising farm fresh produce and health foods • Better product packaging and preservation • India to be the youngest nation by 2025 • Seven Point Strategy for Doubling of farm income

Threats	<ul style="list-style-type: none"> • Product taste variations • Consumer experience of millet products not yet close to rice/wheat/corn-based alternatives • Safety of Processed foods and adulteration • Risk of Non-agro-ecology approach
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Conclusion

Nutri-cereals are projected as health foods due to their rich nutritional profile because of their reborn role in addressing malnutrition and lifestyle diseases, the advantages of including them in publicly funded flagship programs for the development of women and children, and the growing realization of the enormous potential for export markets, especially in the midst of the Covid-19 pandemic. The recent resolution by the United Nations General Assembly to observe 2023 as the International Year of Millets to highlight the significance of nutrient-rich crops in climate-changing conditions is one step in that direction. Furthermore, Nutri-cereals are rising to the frontline on a global level. It is assumed that the rest of the world is interested in India's traditional food basket, so the government of India was given the task of stepping up its efforts to increase millets production and area, diversify its processing equipment and technologies, grow the ecosystem of private food processors, and thus serve the needs of different domestic and international market segments.

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