

## Millets in Meeting the Nutrition Security: A Review

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### Abstract

The world is experiencing an unprecedented increase in extreme weather conditions and India is not an exception. In this context, millets are most useful as it is a nutritious, climate change-ready crop with enormous potential for yielding higher economic returns in marginal conditions. Also, millets are nutritionally superior to other major cereals as they are rich in dietary fibres, resistant starches, vitamins, essential amino acids, storage proteins and other bioactive compounds. Considering that there is increasing realization of the importance of millets, the current review aims to focus on the possible role that millets could play in promoting dietary diversification and balanced diets and suggest the way forward to use millets in addressing food and nutritional security issues in India.

**Keywords:** Diversification, Higher Economic Returns, Millets, Nutritional Security

### Introduction

Main motto of the agricultural research is to maintain the food security throughout the world. Development and selection of high yielding variety, use of synthetic fertilizers and pesticides, mechanization and irrigation facilities, have resulted in sufficient availability of food. Though these short-sighted measures were partly able to increase the food production but without any sustainable package of practices we are not going to achieve food stability. Due to climate change and global warming many countries faced considerable changes in their agroecological zones. Low fertile soils are predicted to elevate up to 50–56% in 2100 AD. According to the World Bank report, hunger is a challenge for 815 million people through the world. According to International crops research institute for the semi-arid tropics (ICRISAT) millets can play a significant role in attaining the nutritional security in the adverse climatic condition. This intuition is now focusing on increasing the productivity of millets and has included finger millet (*Eleusine corcana*) as sixth mandatory crop.

### Types of millet

According to the presence and absence of huskmillet can be divided into two broad categories

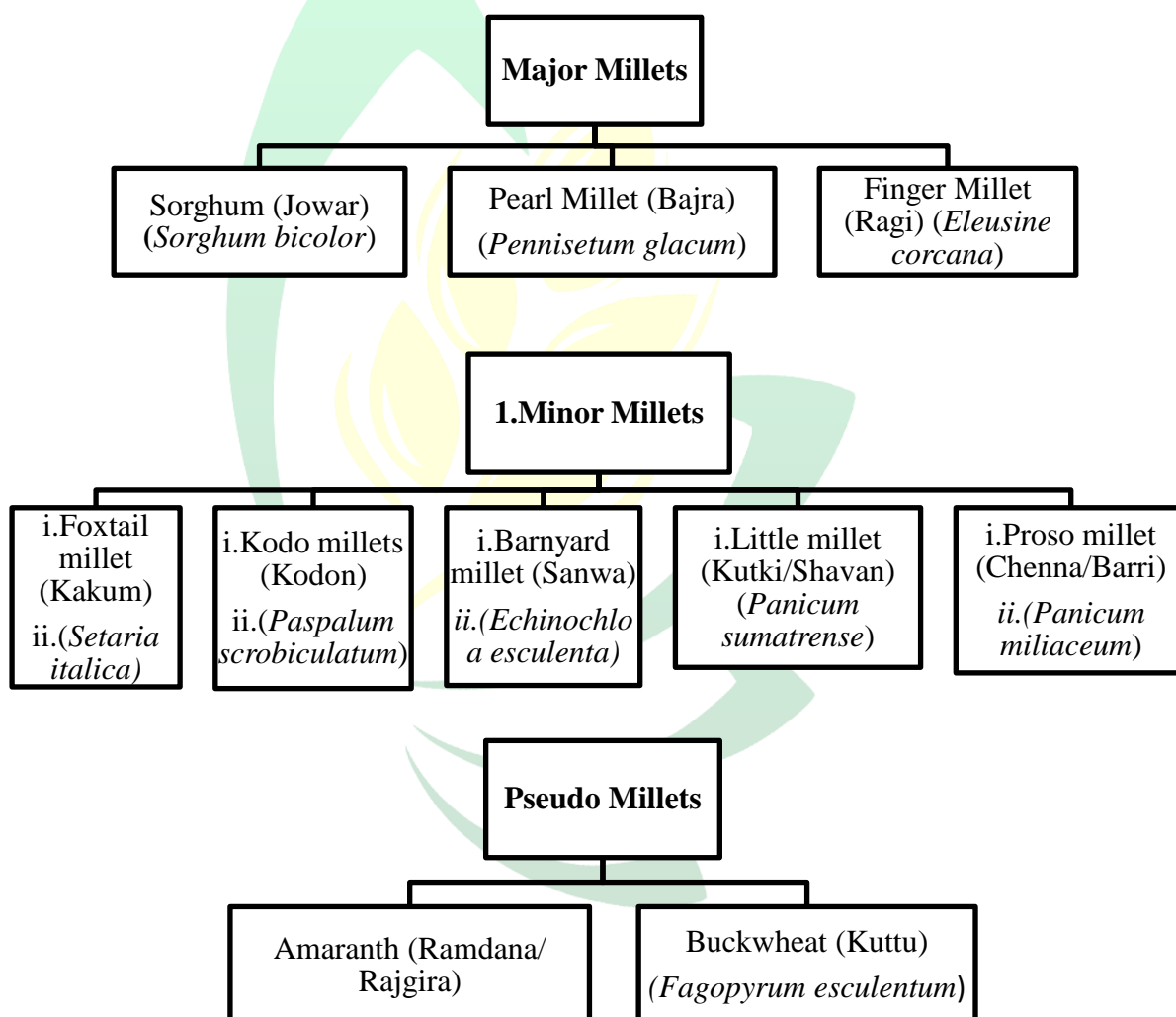
✓ **Naked grains**

Naked grains refer to the millets devoid of the tough, indigestible husk, namely, Ragi, Jowar, and Bajra.

✓ **Husked grains**

These types consist of an indigestible seed coat that has to be removed before consumption. Foxtail millets, little millets, and Kodo millets belong to this category.

✓ **Another classification**



**Advantages of cultivation of millet over traditional cereal crops**

Less water consumption –

Most of the millets are generally drought tolerant crop. They require very less amount of water for their growth as compared to the other cereals. According to the Crops Research Institute for the Semi-Arid Tropics (ICRISAT) a single rice plant requires nearly 2.5 times the amount of water required by a single millet plant of most varieties. The rainfall requirement of certain millets like pearl millet and proso millet is very low like 20 cm. Where in case of rice the average rainfall lies between 120-140cm. Proso millet has the ability to escape the terminal drought which generally occurs at the late growing season since it matures within three months [9]. Though pearl millet can't tolerate drought like sorghum but in that condition, it generally reduces its life cycle comes to flowering very rapidly. This interesting phenomenon is known as drought escaping mechanism.

#### **pH adaptability in millet –**

Millet is adapted to wide pH range. In acidic soil wheat can easily be replaced with millet. Pearl millet shows some salinity resistance. Rice which is very much sensitive to salinity its yield is reduced when the salinity is more than 3ds/m, but pearl millet can be cultivated up to the salinity range 11-12 ds/m [1]. The pH range of millet cultivation is 4.5 (in case of acid soil) to 8 (in basic soil).

#### **1.1. Physiological and morphological advantages –**

##### **✓ C-4 crop**

As millets are the C-4 crops they consume more amount of carbon dioxide and convert it into oxygen. Thus, millets can help to mitigate climatic uncertainties by reducing atmospheric carbon dioxide. For being a C-4 crop their photosynthetic rates at warm conditions and water use efficiency (WUE) and nitrogen use efficiency (NUE) is also very high, which are ~1.5 to 4-fold higher than C3 photosynthesis [4].

##### **✓ Dense and deep root system**

Foxtail millet produces dense and long fibrous roots with large rhizomes which help to penetrate deep into the soil. Depending on the availability of water pearl millet can adjust its root length from 140 cm – 3m with lateral root spreading [10].

##### **✓ Short life cycle**

The short lifecycle of millets helps in escaping from stress as they require 12–14 weeks to complete their life-cycle (seed to seed) whereas traditional cereals like rice and wheat require a maximum of 20–24 weeks [5].

✓ **Leaf and plant structure**

Short plant structure, small leaf area thickened cell wall helps the plant become stress resistance. Balsamo et al. (2006) observed an increase in leaf tensile strength in teff during drought.

✓ **Low carbon footprint –**

Among all the major cereal crops, wheat produce the highest amount of greenhouse gases of around 4 tons CO<sub>2</sub> eq/ha followed by rice and maize (around 3.4 tons CO<sub>2</sub> eq/ha) [2]. Millet also mitigates the effects of climate change by their low carbon footprint of 3,218-kilogram equivalent of carbon dioxide per hectare. The carbon equivalent emission (CEE) of millets has the lowest carbon emissions (878 kg C ha<sup>-1</sup>) [4].

✓ **Economic security –**

It is low investment crop. As it ac grow in stress condition the cost for field preparation and fertilizer application is also very less. For being a short duration crop millet growing field can be utilized multiple number of times as compare to the other crops. Millets can be stored for a considerable amount of time under appropriate storage conditions, these phenomena reduce the cost of post-harvest storage and also maks them 'famine reserves.

**2. Nutritional importance of millet –**

According to WHO 1.9 billion adults are overweight or obese, while 462 million are underweight (year 2021). As per 2016 Global Nutrition report, 44% population of 129 countries is under very serious levels of undernutrition, adult overweight and obesity [1]. These data show the world-wide nutritional imbalance in the diet of the people. As per the U.N. report (2019-2021) the number of undernourished people in India is 224.3 million and number of children under 5 years of age having stunted growth is 36.1 million. According to the 2017 Global Hunger Index report, India ranked 100th among 119 countries [1]. Achieving only the food security will not solve the problem of malnutrition. For that we need nutritional security which involves providing access to adequate quantity of 'quality food' at affordable prices to all people, at all times. For meeting the nutritional stability balanced diet is important which includes different types of food in such quantities and proportions so that the need for calories, protein, fat, vitamins and minerals are adequately met. India is the

largest producer and the largest consumer of millets with more than 40% of the world millet consumption.

### **2.1. Macronutrients**

The energy value, protein and macro nutrient contents of millets is very high and sometimes higher than conventional cereals. Among all the millets, pearl millet has highest content of macronutrients. Millet has gluten-free protein, high fibre, low glycaemic index and it is rich in different bioactive compounds.

#### ✓ **Carbohydrates**

Carbohydrates are present in the millet in different forms like soluble sugar, starch, dietary fibre etc. Pearl millet grain contains starch around 71.82 to 81.02%, soluble sugars range from 1.2 to 2.6% and amylose from 21.9 to 28.8% [8]. On an average the carbohydrates content of millets varies from 56.88 to 72.97 g/100 g.

#### ✓ **Proteins**

It is the second major component in millet. The average protein content in millet is ranging between 8.5% – 12.5% except Adlay millet (6.7%) (a minor millet) [7]. Proso millet contains highest amount of protein among the millets i.e., 12.5%. The protein content of pearl millet is believed to be about 11.6%, which is higher than the 7.2% protein found in rice, and maize (11.1%) [8]. Presence of polyphenol and tannin in millet lowers the rate of in-vitro protein digestibility (IVPD), though it can be corrected by thermal processing methods like cooking in case of Foxtail millet, Finger millet and Proso millet and through the removal of the anti-nutritional factors [7].

Millet contains many essential amino acids in a wide range. Foxtail generally has the highest amounts of essential amino acids which are estimated to be almost 3g/100g with leucine alone amounting to nearly 1g/100g. Kodo millet was found to have the least amount of essential amino acids (1.8 g/100g). Finger millet is also rich in amino acids which contains methionine, valine and lysine and 44.7% of the total amino acid present in it is essential amino acid.

#### ✓ **Dietary fibre**

On an average one person should intake fibre about 28 – 35 g/day. Millets are also a rich source of both crude fibre as well as dietary fibre. Little millet (*Panicum sumatrense*) and kodo millet (*Paspalum scrobiculatum*) contains highest amount of dietary fibre i.e., 38%

and 37% respectably and Barnyard millet is the richest source of crude fibre (12.8 g/100 g ) [1]. This percentage of fibre is 785% higher than rice and wheat. As it is a low glycaemic food, a good choice for diabetic patients.

#### ✓ **Lipids**

Most of the millets does not content very high amount of fat generally it ranges between 2-6% with over 80% being unsaturated fatty acids, but this value is higher than the rice which is having 0.5g/ 100g and wheat having fat content 1.7g/100g. Among the millets little millet has the highest fat content 5.9% and finger millet has the lowest 1.8. Though finger millet is low in lipid content but it is high in PUFA (polyunsaturated fatty acids) (Antony et al. 1996).

#### **Micronutrients**

According to WHO (World Health Organisation) micronutrients are vitamins and minerals needed by the body in very small amounts. Though their impact on the human health is critical, and deficiency in any of them can cause severe and even life-threatening conditions. Millets are general very rich source of different minerals and B- complex vitamins. The range of mineral in millet is 1.7 to 4.3 g/100 g which is several times higher than wheat (1.5%) and rice (0.6%). The iron content of barnyard millet is nearly 17.47 mg/100 g. Foxtail millet contains highest content of zinc among all millets i.e,4.1 mg/100 g. Apart from these millets are also a good source of  $\beta$ -carotene and B-vitamins especially riboflavin, niacin and folic acid. Though the phosphorous content of millets is lower than wheat (355mg/100g) but higher than that of rice (160mg) [6]. Millet contains different types of polyphenols such as phenolic acids and tannins which are believed to act as antioxidants and play a vital role in boosting the body's immune system.

#### **Health benefits of millets**

From different epidemiological studies we come to know that millets have the potential to protect the human body from different nutritional disorder. As millet is an alkaline forming food it is often recommended to achieve optimal health. This alkaline nature of millet helps to maintain a healthy pH balance in the body, crucial to prevent different disease.

#### ✓ **Millets in Obesity**

Now a days Obesity has become a biggest emerging problem not only in India but also throughout the world. Intake of high dietary fibre decreases the incidence of obesity. Millet is a rich source of dietary fibre which is comparatively higher than other cereals. Consumption of high fibre food helps in improving the bowel function and reduce the prevalence of Obesity by improving the digestive function and absorption in the body thereby reducing the risk of chronic diseases.

#### ✓ **Millets in Diabetes**

Different studies shows that consumption of millet reduces the chance of Diabetes. phenolics inhibits present in millet like alpha-glucosidase, pancreatic amylase reduces postprandial hyperglycaemia by partially inhibiting the enzymatic hydrolysis of complex carbohydrates.

#### ✓ **Millets in Cancer**

Millets is a rich source of “antinutrients” like phenolic acids, tannins, and phytate. However; these antinutrients reduce the risk for colon and breast cancer in animals. Millet also has linoleic acid which contain anti-tumor activity.

#### ✓ **Millets in Celiac Disease**

Celiac disease is an immune reaction to eating gluten and it is a genetically susceptible problem which is triggered by the consumption of gluten. As the Millets are gluten-free, they are an excellent option for people suffering from celiac diseases and gluten-sensitive patients often irritated by the gluten content of the common cereal grains.

#### ✓ **Millets in Gastrointestinal Disorders**

As the fibre content in millets is very heigh it helps in eliminating different Gastrointestinal disorders like constipation, excess gas, bloating and cramping.

#### ✓ **Other health benefits**

Different studies shows that the aqueous and ethanolic extracts of kodo millet produce a dose-dependent fall in fasting blood glucose. Good amount of antioxidant presents in finger millet prevent tissue damage and stimulate the wound healing process.

#### **Millet based food products**

Millets are known as nutri-cereals for its high amount of nutrient. In this section let's discuss on some millet-based food products.

#### ✓ **Bread**

Report submitted by Devani et al., (2016) shows that if the wheat flour is substituted by finger millet flour up to a concentration of 20% do not have any adverse effect on the quality of bread.

✓ **Biscuits**

Anju and Sarita prepared biscuits by using foxtail and barnyard millet. There they replaced 45% refined wheat flour with millet flour. In another experiment pearl millet flour-based sweet, salty and cheese biscuits were prepared.

✓ **Alcoholic beverages**

A gluten free whiskey known as Koval single barrel millet whiskey is also produced using millets.

✓ **Snack foods**

Potato and barnyard millet-based oil free, microwave puffed ready-to-eat fasting foods were developed by Dhumal et al.

**Conclusion**

According to the National Health Survey 2017 approximately 19 crore people in our country were compelled to sleep on an empty stomach every night and approximately 4500 children die every day under the age of five years due to hunger and malnutrition. India holds 101st position in the Global Hunger Index (GHI) 2021 of 116 countries. From this data it is clear that we have to emphasize in the agricultural production but the way should be sustainable so that farmer can fight against the climate change. Millets have substantial potential to contribute toward food and nutritional security. Millets possess immense potential in our battles against climate change and poverty, and provide food, nutrition, fodder and livelihood security. Cultivation of millet not only improve the economic condition of the farmers but also improve the health of the community as a whole.

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