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Proso Millet: Forgotten food for the future

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Abstract

Proso millet (*Panicum miliaceum*) is a 'star cereal' highly nutritious and loaded with good quality proteins, vitamins, minerals, and phytochemicals. Among several millets, proso millet is termed as broomcorn millet, hog millet, red millet, white millet, kashfi millet, and Hershey millet. Proso millet has significant benefits as a drought-resistant crop, limited demand on soil nutrients, low water requirement, short growing season compared to other millets, and can be cultivated in very different climatic conditions. Since prehistoric times proso millet has been harvested in North Africa and Asian countries. The protein content in proso millet is identical to wheat. Including proso millet in the diet is an excellent option for celiac patients as it's a gluten-free millet. Consumption of millet may help to reduce the risk of cancer, heart disease, diabetes and improves the digestive system, and detoxifies the body. The Food and Agriculture Organization (FAO) has declared 2023 as the "International Year of Millets". There is a need for promoting millet and enhancing millet usage in order to increase production. Due to the unawareness of people, millets are being used as livestock feed or bird seed mixtures instead of human essential food.

Keywords: Proso millet, drought-resistant, gluten-free, history & origin, nutritional benefits

Introduction

Millets: Millets are climate-resilient crop, extensively grown in semi-arid tropics of Asian, and African countries, which constitute a prolific source of nutrients and comprise 6-10% carbohydrates, 60-70% dietary carbohydrates, 12-20% dietary fiber, 6-10% protein, 2-4% minerals, and 1.5-5% fat compared to wheat or rice^[1]. Millets are essential foods in many underdeveloped countries, because of their potential to grow under detrimental weather conditions like drought and limited rainfall^[2]. The millets can be classified into two categories major, and minor millets. The four major millets are Pearl millet (*Pennisetum glaucum*), which constitutes 40% of the world's population, foxtail millet (*Setaria italica*), Proso millet or white millet (*Panicum miliaceum*), and Finger Millet (*Eleusine coracana*)^[3]. Among these four, pearl millet is the most frequently used for human consumption. The minor millet or small millet refers to a class of minor cereals that include Kodo millet (*Paspalum scrobiculate*), Barnyard millet (*Echinochloa* spp.), Guinea millet (*Brachiaria deflexa* = *Urochloa deflexa*), Browntop millet (*Urochloa ramosa* = *Brachiaria ramosa* = *Panicum ramosum*), fonio (*Digitaria exilis*) and Teff (*Eragrostis tef*) are also generally called as millets^[4, 5].

Millets' distribution in India

Among global countries, India is the top leading producer of millet. In India, eight species of millets are generally cultivated during rain-fed conditions including foxtail millet, proso millet, barnyard millet, kodo millet, pearl millet, sorghum, finger millet, and little millet. Subject to cultivation, pearl millet, and sorghum are planted as primary and inter-crop in Gujarat and the desert & eastern parts of Rajasthan. Sorghum is planted as a primary crop in Telangana, Maharashtra, Andhra Pradesh, and parts of central India^[6]. Finger millet is commonly cultivated in many states of India, including Orissa, Maharashtra, Uttar Pradesh, Bihar, Gujarat, Karnataka, Tamil Nadu, and Andhra Pradesh. More than 98.13% of the nation's total production of finger millet is produced in the following states. Karnataka and Tamil Nadu are the main producers among them, contributing 56.17 percent of the overall production. The other remaining minor millets are primarily grown in Gujarat, Uttar Pradesh, Maharashtra, Orissa, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, and Karnataka.

The yields in Tamil Nadu, Maharashtra, and Karnataka contribute higher than the national average. The biggest yield is in Tamil Nadu, followed by Maharashtra and Karnataka [7]. The Government of India has designated 2018 as the "National Year of Millets" and 2023 as the "International Year of Millets" by the United Nations in recognition of their resilience to climate change and their importance for nutritional and health security.

Proso Millet - History & origin

Proso millet is a small seeded, annual herbaceous plant in the genera *Panicum* and it has a chromosome number of $2n = 36$ with a basic chromosome number of $x = 9$. (8) macro-botanical evidence of proso millet (*Panicum miliaceum*) in modern-day Hungary have been proclaimed dating as early as the Neolithic. (6th millennium BCE; [9]) The primitive history of proso millet comes from the yellow river valley site of Cishan, China dated between 10,300 cal years BP and 8,700 cal years BP. [10] Modern AMS-Dating of charred proso millet has, however, disclosed that the primitive deposition of millet in Hungary dates to the 15th-century cal BCE (the outset of the Late Bronze Age), citing the re-deposition of the small grains in distinction to younger to older archaeological layers [11] PM has been used as a primary food in India and Africa for thousands of years. Evidence Related to land use and Diet in Mongolia from the 13th to 15th Century unveils, Proso millet fitted to four of the most persistent cereal spices [12]. Proso millet is mainly cultivated in India, China, and also in

Romania, Turkey, Iran, Iraq, Syria, and Afghanistan [13]. It is highly compatible to dry climates such as the Middle East, central Russia, Northern India, Manchuria Africa, and great plain areas of North America. In Korea, proso millet is commonly utilized in animal feed, as bird seed, and as human foods. Additionally, its flour is also used as an additive in the preparation of rice cake and cloudy liquor. Despite being a staple crop in the past, particularly until the 1960s, it is now primarily cultivated in the Gyeongsangbuk-do and Kangwon-do provinces, which account for almost 55% and 37% of the production, respectively [14].

Drought resistant

Proso millet is the most significant millet crop grown after foxtail millet and pearl millet and it is well suited to a variety of soil types and temperature climatic conditions up to altitudes of 3500 m. [15] It can be widely grown in semi-arid regions of the world where rainfall is irregular and poor, with sporadic droughts, and also, during the full growth season (plant to harvest), it can produce a large yield with water requirements as low as 20 to 50 cm which is significantly lower compared to wheat (30-100 cm) and rice (100-300 cm) [16]. Millets are crucial foods in many developing nations due to their ability to grow in challenging climates with little rainfall and it's a drought-resistant crop it can be preserved for a long period without insect damage [17].

Table 1: Nutritional Value of millets (composition per 100 g edible portion)

Millets	Energy (Kcal)	Fat (g)	Protein (g)	Fiber (g)	Carbohydrates (g)	Minerals (g)
Proso millet	341	1.1.	12.5	7.2	70.4	1.9
Finger millet	336	1.5	7.7	3.6	72.6	2.7
Foxtail millet	331	4.3	12.3	8.0	60.9	3.3
Pearl millet	361	5	11.6	2.3	67.5	2.3

Source: [18, 19]

Nutritional benefits of millets

The primary factor determining a grain's dietary significance and its relevance towards human health. Compared to major cereal grains Proso millet contains high nutritional content and is renowned for its potential health benefits. Minerals like potassium, phosphorous, magnesium, manganese, iron, and zinc. It also contains methionine, phenylalanine, valine, tryptophan, and all other essential amino acids found in proso

millet [20]. Compared to wheat, the essential amino acid index was observed to be higher [21]. The epidemiological finding proves that the consumption of millet may reduce the risk of cancer, and cardiovascular diseases, protects from diabetes, increases energy levels, improves neural system and muscular system, enhances muscular and brain systems, boosts energy levels, prevents various kinds of degenerative conditions such as Parkinson's disease and metabolic syndrome [22, 23].

Table 2: Mineral composition of millets (mg/100g)

Millets	Calcium (mg)	Zinc (mg)	Phosphorous (mg)	Potassium (mg)	Magnesium (mg)	Iron (mg)
Proso millet	14	1.4	206	113	153	0.8
Finger millet	344	2.3	283	408	137	3.9
Foxtail millet	31	2.4	290	250	81	2.8
Pearl millet	42	3.1	296	307	137	8.0

Source: [24]

Health benefits of proso millet

Diabetes Mellitus: Clinical findings reveal that proso millet protein may be a possible therapeutic option for type-2 diabetes, and it has also been demonstrated that, when fed to genetically obese type-2 diabetic mice under high-fat feeding conditions, proso millet can improve insulin sensitivity and glycemic responses [25].

Cardiovascular disease: Compared to main cereal grains, Proso millet has a significantly greater mineral content. High fiber and antioxidant content in proso millet are beneficial in

preventing cancer and cardiovascular disease [26]. A study finding revealed the antiproliferative capabilities of proso millet against MDA human breast cancer cells and HepG2 human liver cancer cells, which were originally obtained as members of the MD Anderson series of breast cancer cells. The risks of numerous hormone-dependent malignancies, CVD, and breast cancer can be decreased by raising HDL and adiponectin levels [27].

Cancer: Non-digestible carbs present in proso millet promote the development of beneficial bacteria in the gut. Including

proso millet in the diet, may prevent constipation and acts as a preventive food by reducing the risk of colon cancer ^[26].

Pellagra and celiac disease: Niacin deficiency causes pellagra disease, in which the skin becomes scaly and rough, and begins to peel off. Consuming proso millet could aid in pellagra disease prevention ^[27]. Celiac disease is one of the most prevalent genetic diseases, caused where the immune system attacks the small intestine after consuming gluten protein. Since Proso millet is gluten-free, it's a great alternative for those with celiac disease to consume ^[29].

Conclusion

In the modern era, food security and agriculture are expected to confront significant challenges because of socioeconomic effects such as rising food prices, water scarcity, population growth, and climate change. The poor populations of farmer's families would be particularly affected by these difficulties. Due to their abundance in nutritionally and biologically significant elements, millets must be integrated into the mainstream of cultivation and value addition in order to be promoted for nutritional and health security. Millet grain is currently generating more interest among scientists, technologists, and nutritionists since it contributes to national food security and may have positive health effects. They are conducting various research on processing and enhancing the nutritional content of small millets in order to provide ready-to-eat and ready-to-cook goods that the general public can use. Nowadays millets play a crucial role in the production of modern foods including the production of confectionary food products like multi-grain cookies, biscuits, beverages, and gluten-free cereals. Our traditional grains, such as pearl millet, finger millet, sorghum, and foxtail millet, have been pushed to the back because of wheat and polished rice, as they are easy to cook and rich in texture. In India, Minor millets are used to make a variety of traditional dishes and beverages, including idli, dosa, papad, chakli, porridges, bread, snack foods, and infant food. Minor millet value addition also provides rural and tribal farmers with a strong potential to increase their income, and supporting the development and marketing of minor millets among the general population notably among younger generations may help to protect food and nutrition, creates employment, and motivates entrepreneurs to bring their brainstorming ideas into reality. In order to increase domestic millet production, the Indian government designated 2018 as the national millet year. In response to a proposal from the Indian government, the UN Food and Agriculture Organisation (FAO), Rome, has announced 2023 as the International Year of Millets. Other millet-growing nations require comparable national and international multidisciplinary public sector programs for their promotion to increase awareness and enhance the consumption of millets. Since Proso millet is one of the under-researched and underutilized millet, there is a need for promoting and educating people about the nutritional properties and health benefits of Proso millet. The proso millet should be promoted as the "forgotten food for the future".

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