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Exploring the nutritional and health benefits of pearl millet: A comprehensive review

¹Raveena Rani, ²Priyanka and ³Veenu Sangwan

¹Department of Foods & Nutrition I.C. College of Home Science, CCS Haryana Agricultural University, Hisar, Haryana, India

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Corresponding Author: Raveena Rani

Abstract

In Asia and Africa's dry and semi-arid regions, pearl millet (*Pennisetum glaucum*) is a grain crop that is widely grown. For ages, millions of people, particularly in India and Africa, have relied on it as a staple diet. Protein, fiber, vitamins, and minerals are all abundant in pearl millet, which is also a good source of energy. Additionally, it does not contain gluten, making it a perfect food for those who are gluten intolerant or suffer from celiac disease. Given that it contains 11-14% protein by weight, pearl millet is a rich source of plant-based protein. It is crucial for vegetarians and vegans who acquire all of their protein from plant-based sources. Additionally, dietary fiber, which aids in better digestion, prevents constipation, and lowers the risk of chronic illnesses including heart disease, diabetes, and cancer, is present in pearl millet. People who have celiac disease or gluten intolerance can safely switch to pearl millet because it is naturally gluten-free. Additionally, iron, zinc, magnesium, phosphorus, and potassium are all vitamins and minerals that are abundant in pearl millet. These vitamins and minerals are crucial for preserving good health and avoiding chronic illnesses. Because pearl millet has a low glycemic index and releases sugar into the bloodstream gradually, it helps to regulate blood sugar levels. It is therefore a healthy meal option for those who have diabetes. Antioxidants, which aid in lowering inflammation and preventing the accumulation of plaque in the arteries, are also abundant in pearl millet. This lowers the chance of developing heart disease and stroke. In addition, phytochemicals such lignans and phytosterols, which have been demonstrated to have anti-cancer properties, are present in pearl millet. These substances aid in limiting the development and spread of cancer cells.

Keywords: Pearl millet, energy, dietary fiber, gluten free, diseases, nutrients, health, cancer, antioxidants.

Introduction

The word millet is a French word that literally translates to "thousand," signifying that a single handful of millet contains thousands of grains (Taylor & Emmambux, 2008) [29]. Millets, a type of cereal from the Poaceae grass family, are among the earliest crops still grown today. Generally speaking, finger millet (*Eleusine coracana*) and pearl millet (*Pennisetum glaucum*) are the two most common millets used for food and feed (Gari, J. 2002) [10]. Millets can be a significant source of critical nutrients such amino acids, minerals, and trace elements, according to various researchers (Anitha *et al.* 2019) [2]. Millets are a great source of vitamins and phytochemicals. Millets include a variety of phytochemicals including lignans, glucan, insulin, resistant starch, phytates, sterols (Liu & Adom 2007) [16], tocopherol, dietary fiber, and carotenoids. Phenolics, such as bound phenolic acid, ferulic acid and free phenolic acid-protocatechuic acid, are also found. The principal polyphenols are phenolic acids and tannins, while flavonoids, which act as antioxidants and have a variety of functions in the immune system of the body, are only found in trace amounts (Chandrasekara & Shahidi, 2010) [5]. One of the first crops that have been farmed and used by our ancestors is pearl millet (*Pennisetum glaucum*), often known as bajra. In many regions of the world, pearl millet has been consumed as a staple meal for thousands of years. The most popular variety of millet is pearl millet, which is also the

sixth-most significant crop in the world. In India, Rajasthan, Gujarat, Haryana and Maharashtra are typically where pearl millet is grown. India was the world's top producer of pearl millet in 2013-2014, followed by Nigeria (Malik, 2015) [17]. Whereas other grains might not produce a profit, pearl millet can be produced in low-rainfall regions (Satyavathi *et al.* 2017) [23].

Nutritional Benefits

In comparison to other cereal crops that are grown extensively, including wheat and rice, pearl millet is a rich source of many essential elements. Many macro and micronutrients are abundant in pearl millet. In pearl millet, the proportions of the amino acid profile, vitamins, minerals, dietary fibers, and antioxidant phytochemicals are more evenly distributed. According to the report Nutritive value of Indian foods (NIN, 2003) [18], pearl millet has a high energy content (361 Kcal/100g), making it comparable to other regularly eaten grains like wheat (346 Kcal/100g), rice (345 Kcal/100g), maize (125 Kcal/100g), and sorghum (349 Kcal/100g) (Fageria *et al.* 2010) [6]. According to Suma & Urooj (2017) [9] pearl millet includes 9 to 13 percent protein, 5 to 8 percent fat, and 62 to 70 percent starch. Calcium and phosphorus, which are minerals necessary for bone formation and development, are found in pearl millet (Patni & Agrawal, 2017) [20]. Rich in calories, pearl millet has been demonstrated to improve children's

and teenagers' rates of growth (Anitha *et al.* 2019) ^[2]. The body needs a variety of critical micronutrients, which pearl millet contains. Pearl millet has a higher overall mineral content than other regularly consumed cereals, with 2.3 mg/100g. According to NIN (2003) ^[18], it is abundant in B vitamins, potassium, phosphorus, magnesium, iron, zinc, copper, and manganese. Vitamin C is absent from dried, developed kernels, while the B vitamins are concentrated in the aleurone layer. Decortication, which removes the hull, reduces the amount of thiamine, riboflavin, and niacin in the flour by around 50%. Niacin can be produced from tryptophan and is present in cereals in both free and bound forms. The hulled millet seed still contains a sizable amount of niacin. This explains why pellagra, a disease caused by a lack of the PP vitamin, is uncommon in locations where millet is widely consumed. Oxalic acid, found in pearl millet and other grains, binds to calcium to form an insoluble compound, lowering the mineral's biological availability. The relatively low calcium content of pearl millet can be made worse by the presence of oxalate (Irén Léder, 2004) ^[15]. Magnesium, which is present in pearl millet, aids in the prevention of diabetes and lowers blood sugar levels. Magnesium and potassium, which are essential elements for avoiding Type II diabetes and lowering the risk of migraines, heart attacks, and blood pressure, are abundant in pearl millet (Ambati & Sucharitha, 2019) ^[1]. The fiber in pearl millet aids with cholesterol reduction, weight loss, and the treatment of gall bladder stones and stomach ulcers. According to Rao *et al.* (2018) ^[22], pearl millet contains vitamin B3 (niacin), which lowers blood cholesterol levels and lowers the risk of cardiovascular illnesses. According to research by Rani *et al.* (2018) ^[21], sprouting is the most efficient method for lowering the anti-nutrient content of pearl millet. It is a typical household procedure that does not require any pricey tools. In pearl millet, sprouting decreases tannins by up to 1.6 percent boosts *in vitro* protein digestibility by 14 percent to 26 percent, and increases *in vitro* starch digestibility by 86 percent to 112 percent (Singh *et al.* 2018) ^[21]. Many minerals, including calcium, iron, and zinc, are made more bio-accessible through sprouting (Krishnan & Meera, 2018) ^[13].

Health Benefits

Pearl millet's high iron content aids in regulating blood hemoglobin levels. Due to the easy bioavailability (absorption) of iron in pearl millet, it has the potential to lower the prevalence of anemia and malnutrition. According to recent research, pearl millet has a high adequate bioavailability (absorption) of iron to meet more than half of the daily need (Scott *et al.* 2018) ^[24]. According to a study conducted on children in Maharashtra, India, between the ages of 12 and 16, 40 percent of the iron-deficient children who had regular pearl millet by the end of the study were iron replete (Finkelstein *et al.* 2015) ^[8].

Pearl millet and Cancer

Pearl millet has significant levels of phenolic antioxidants, which may have anticancer properties. According to Sripriya *et al.* (1996) ^[28], pearl millet and sorghum, respectively, have phenolic contents of 51.4 and 43.1 mg/100g DW. According to Sharma & Kapoor (1996) ^[26], there are 608.1 mg of phenols per 100 grams of pearl millet

grains and 761 mg per 100 grams of pearl millet flour. According to Huang & Ferraro (1992) ^[11], phenolic compounds, particularly flavanoids, have been shown to prevent the growth of tumors. The pericarp and testa are where these substances are concentrated. Since the entire pearl millet grain is typically ground into flour, foods produced with the flour would benefit from the flavonoids and phenols.

Pearl millet and allergies

Pearl millet is the only grain that retains its alkaline qualities after being cooked, making it the perfect grain for persons who have wheat allergies. It is also a gluten-free grain. Due to the rising prevalence of celiac disease and gluten intolerance, there is an increasing need for food products that are free of gluten. Gluten is naturally absent from pearl millets. For those who have celiac disease or gluten intolerance, it is appropriate (Shaivya & Sunita, 2016) ^[25]. According to Aanchal *et al.* (2015) ^[12], celiac disease is more common in Indian states like Punjab, Rajasthan, Bihar, Uttar Pradesh, and Madhya Pradesh where wheat eating is more common. Modern millets-based multigrain and gluten-free food products are particularly well-liked by consumers (Bouajila *et al.* 2020) ^[4].

Since pearl millets are rich in vitamins, minerals, antioxidants, and dietary fiber that may help fight malnutrition, including them in our daily diet may have a significant impact on our health. Millets can be prepared in a variety of ways in daily dishes. Pearl millets can readily take the place of commonly consumed cereals like wheat and rice. Millets provide a variety of opportunities for use in creating delectable meals. By using pearl millet to create palatable meals, food and nutrition security may be attained. For appropriateness and taste, they can be prepared using a variety of cooking methods, including boiling, steaming, sprouting, etc. (Kumar *et al.* 2018) ^[14].

Millets are thought to have health advantages for nutraceuticals. These include, but are not limited to, an improvement in the health of the muscular system and digestive system, a decrease in cholesterol, protection against diabetes and heart disease, a lower chance of developing cancer, and an increase in energy levels. Gluten consumption in people with certain genetic predispositions causes celiac disease, an immune-mediated enteropathy. Millets are free of gluten, making them a great alternative for celiac disease patients and those who are sensitive to it and get upset when wheat and other more popular cereal grains contain it.

After maize, wheat, rice, barley, and sorghum, pearl millet is ranked as the sixth highest producing crop in the world (FAOSTAT, 2014) ^[7]. It is also regarded as one of the crops that can offer small-scale farmers good nutrition and revenue, helping to support their livelihoods and the availability of food (Patel *et al.* 2015) ^[19].

Magnesium and phosphorus are both abundant in millets. While phosphorus is a crucial part of adenosine triphosphate (ATP), the body's precursor to energy, magnesium has the ability to assist lessen the effects of migraines and heart attacks (Badau *et al.* 2005) ^[3].

Conclusion

A wholesome grain with numerous health benefits, pearl

millet is nutrient-dense and tasty. It is gluten-free and abundant in vitamins, minerals, dietary fiber, protein, and other nutrients. The risk of heart disease and cancer is decreased, digestion is improved, and blood sugar levels are better managed. We can maintain a healthy lifestyle and stave against chronic diseases by include pearl millet in your diet.

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