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Nutritional and therapeutic potential of finger millet

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Abstract

Ragi, also called finger millet, is a cereal crop that has been cultivated for centuries in dry regions of Africa and Asia. This resilient and water-efficient grain has garnered attention for its outstanding nutritional value and possible positive effects on health. Finger millet is well-known for its high nutritional value, especially in terms of important micronutrients like iron, calcium, magnesium, and zinc. Additionally, it serves as a valuable source of dietary fiber, protein, and antioxidants, making it a versatile and nutritious staple for millions of individuals, particularly in areas with limited availability of diverse food sources. There are numerous health advantages associated with the consumption of finger millet. With its rich iron content, this food is a great option for addressing iron-deficiency anemia, a common health problem, particularly in developing nations. In addition, the product's low glycemic index and high dietary fiber content help maintain steady blood sugar levels, which is beneficial for people with diabetes. In addition, finger millet shows promise in terms of its antioxidant and anti-inflammatory properties, which may contribute to its potential in preventing chronic diseases. The gluten-free nature of the grain makes it an attractive option for people with gluten sensitivities or celiac disease. Ultimately, finger millet emerges as a valuable crop with exceptional nutritional qualities and a multitude of health advantages. Its cultivation and consumption have the potential to address food security issues and improve nutrition, offering a promising solution to global challenges in food and health.

Keywords: Ragi, exceptional, micronutrients, consumption, deficiency, dietary, gluten-free and malnutrition.

Introduction

Millets, belonging to the Poaceae family of lesser-known grains, provide a crucial alternative food source to sustain the increasing global population. Their significance has escalated as a result of factors such as water scarcity, escalating food prices, and broader socioeconomic impacts that impact both humans and animals. Due to this rationale, millets are frequently recognized as essential basic foods for disadvantaged populations living in arid and semi-arid regions (Saleh *et al.* 2013) [1]. These plants are perennial grasses that produce microscopic seeds, and many of them are well-suited to tropical and arid environments. The millets have a reputation for being able to thrive in infertile soils (Hulse *et al.* 1980) [2]. Millets, in addition to wheat, rice, and maize, are classified as cereals. Millets serve as crucial dietary staples for a significant number of individuals, especially those residing in warm and humid regions. They are primarily cultivated in marginal regions where major cereal crops are unable to generate substantial yields. (Adekunle 2012) [17]. Millet presently accounts for approximately 11.4% of the total area allocated to cereal crops and contributes 4.1% to the overall cereal production. Cereals are a substantial component of the human diet, supplying vital starch and other dietary carbohydrates including dietary fiber, which are important for energy and nutrient consumption (Chandra *et al.* 2018) [4]. Millet is a significant staple crop in various countries of Africa and India. It has been farmed for thousands of years and is able to thrive in challenging conditions such as poor, sandy soils with limited rainfall (Purseglove, 1972) [5].

India largely cultivates small millets, including finger millet, kodo millet, foxtail millet, proso millet, and little millet, with a total yearly planting area of 2.5 million hectares. Karnataka contributes 58% of the entire production of finger millet, which makes up 40-50% of the global cultivation area for tiny millets. Finger millet is the sixth most cultivated crop in India, following wheat, maize, sorghum, rice, and bajra, in terms of cultivation area. On a global scale, it is considered the fourth most significant type of millet, after pearl millet, sorghum and-foxtail-millet.

Millets are important staple crops in numerous developing countries because they have the ability to thrive in harsh climatic circumstances, such as regions with low levels of rainfall. Conversely, millet serves as the main supplier of both energy and protein for a significant number of individuals residing in arid regions. Millet has been documented to possess a multitude of nutritional and therapeutic characteristics. Millets have a nutritional profile that is advantageous when compared to popular cereals like rice, wheat, and barley, in terms of their carbohydrate, protein, and energy content. Millets are distinguished by their elevated dietary fiber content in comparison to other cereals (Malleshi *et al.* 1996) [6] and possess greater mineral content than rice or wheat. The indigenous minor millets are widely utilized in the preparation of meals for the elderly, infants, and health-conscious adults, both in their original

form and as malted goods. Millet grains are frequently pulverized into flour to produce a diverse range of food items such as porridge, puddings, pancakes, biscuits, roti, bread, and snacks (Hulse *et al.* 1980) [2]. Malted millet is highly regarded as a nutritious diet for newborns and is deemed advantageous for diabetic patients owing to its wholesome characteristics.

Finger millet

Finger millet (*E coracana* L), commonly known as ragi and mandua in India, kaddo in Nepal, fingerhirse in Germany, and dagussa, tokuso, and barankiya in Ethiopia, is a widely consumed staple food in eastern, central Africa, and India. Finger millet ranks as the fourth most significant millet globally, following sorghum, pearl millet, and foxtail millet. Finger millet comprises around 10% of the global millet production, which amounts to around 30 million tons. Finger millet is a crucial crop that serves as a primary source of sustenance and a staple grain in several Asian nations (Gari *et al.* 2001) [20]. The implementation of this approach has the capacity to enhance nutritional consumption, enhance the availability of food, promote the growth of rural areas, and contribute to the sustainable management of land (Oduori COA 2005) [21]. Millet seeds are a rich source of calcium, phytochemicals, dietary fibers, and polyphenols, making them suitable for consumption. (A.K.*et al.* 2012). Finger millet is rich in essential amino acids such as isoleucine (4.4 g), leucine (9.5 g), methionine (3.1 g), and phenylalanine (5.2 g), which are lacking in other starchy foods. Millets are rich in B vitamins, including niacin, B6, and folic acid, as well as calcium, iron, potassium, magnesium, and zinc (Vachanth *et al.* 2010) [24].

Nutritional Composition

Nutritionally, finger tail millet is a good source of calcium, other minerals, and fiber. The total carbohydrate content of finger millet has been found to be between 72 and 79.5% (Bhatt *et al.* 2003) [22]. Finger millet (*Eleusine coracana*), also known as ragi, is a good source of carbohydrate, protein, dietary fiber, and minerals, and is an important staple food for people in low socioeconomic groups (Sripriya *et al.* 1997) [26] and those suffering from metabolic disorders such as diabetes and obesity (Mathanghi *et al.* 2012) [27].

This is an important aspect to consider because of its impressive nutritional value and remarkable ability to be preserved for long periods of time (Shashi *et al.* 2007) [28]. It has a higher nutritional fiber and mineral content compared to wheat and rice (Ravindran *et al.* 1991) [29]. Additionally, it contains a fairly well balanced protein. Millets possess a remarkable ability to lower blood sugar levels as a result of their abundant fiber content. Slowly digested carbohydrates and fiber have been found to have a positive impact on postprandial glucose levels (Geetha *et al.* 1990) [30].

Processing of Finger Millet

Similar to other cereal grains, finger millet undergoes fundamental primary processing steps that include cleaning, grading, and separating. These operations are necessary to eliminate undesirable materials like stones, soil particles, stalks, chaff, and grains of other crops. Ensuring these steps are thorough is critical not just for maintaining quality but also for increasing the value of the final product, leading to higher returns upon sale.

Milling

For the purpose of preparing culinary goods, finger millet is often processed into flour. It is first cleaned to get rid of any extraneous objects like stones, chaff, and stalks. After that, the non-edible cellulosic tissue or glumes is separated out using abrasive or friction mills. Next, the millet is ground into a fine powder, usually with the use of stone mills, iron disks, or disks covered in emery. Alternatively, the husk can be separated from the grain by pearling or decortication techniques, which will pulverize the endosperm and seed coat. By using this method, whole meal flour is produced with finger millet and seed that are both evenly ground. Centrifugal shellers are also useful for decorticating or dehulling tiny millets (Gull *et al.* 2015) [7].

Roasting

The traditional practice of roasting grains primarily aims to enhance flavor, along with secondary benefits such as reducing anti-nutritional factors (Khan *et al.* 1988) [9] and extending shelf life (Huffman *et al.* 1994). Both roasting and grinding processes improve the digestibility of the grain while preserving its nutritional integrity (Krantz *et al.* 1983) [12]. Puffing and roasting, while similar in nature, differ in that puffing results in greater volume expansion (Srivastava *et al.* 1994) [23]. In experiments involving finger millet, various roasting temperatures and durations were tested before milling the grains into flour for porridge preparation. It was observed that as roasting time and temperature increased, the viscosity of the resulting porridge decreased. Roasted finger millet exhibited a viscosity reduction of 50-60%, yet these roasting conditions did not significantly alter its proximate composition (Auko, 2009) [14].

Puffing

Puffing or popping cereals is an ancient cooking method used to prepare grains as snacks or breakfast cereals, either plain or seasoned with spices, salt, or sweeteners. According to Wadikar *et al.* (2007) [15], puffed grains from various types of finger millet were produced by conditioning the grains for 2 hours with 20% moisture content and puffing them using hot sand at temperatures ranging from 220 to 230 °C. The study found that the changes in fatty acid composition were not statistically significant. However, during puffing, neutral lipids decreased by 9.3%, while there was an increase in glycolipids by 21.92% and phospholipids by 33.3%. Research on the varietal effects of finger millet indicated that brown-seeded varieties are more suitable for puffing, whereas white-seeded varieties yielded puff of superior organoleptic quality (Shukla *et al.* 1986) [16].

Health benefits

Ragi (*Eleusine coracana*) is high in carbohydrates, proteins, dietary fiber, and minerals, making it an important staple meal for low-income people and those suffering from metabolic disorders such as diabetes and obesity (Mathanghi *et al.* 2012) [27]. It is important because of its superior storage capacity and nutritional value (Shashi *et al.* 2007) [28]. Millets have a hypoglycemic effect due to their high fiber content. Postprandial glucose levels are lower due to

prolonged digestion and absorption of complex carbohydrates and fiber (Geetha *et al.* 1990) [30]. Phenolics, namely phenols, which are plentiful in plant diets consumed by people and animals, are one of the most diversified dietary supplements available worldwide. These chemicals have a variety of effects, including antioxidants, anti-mutagenicity, anti-carcinogenity, anti-inflammatory properties, anti-oestrogenic properties, and anti-viral qualities. (Ferguson *et al.* 2001) [31].

Finger millets for Diabetes

The phytochemicals included in finger millet slow digestion, which helps to manage blood sugar levels while also increasing antioxidant levels in the body (Hegde *et al.* 2005) [32]. In comparison to wheat and rice, finger millet has higher fiber content, and a low reaction to the glycemic process indicates a lower potential to increase blood sugar and starch absorption (Kumari *et al.* 2002) [33]. The phenolic seed coat of finger millet works as an inhibitor, assisting in the reduction of postprandial hyperglycemia by limiting the role of enzymes involved in the breakdown of complex carbohydrates (Singh E 2016) [34].

Finger millet for Celiac disease

Celiac disease is an immune-based disease caused by gluten absorption in genetically sensitive people. Finger millet is gluten-free, making it a suitable option for those with celiac disease and gluten sensitivities, who often detest the gluten content of wheat and other cereal grains (Saleh *et al*. 2013) [1].

Finger millets for cardiovascular disease prevention

Methionine, threonine, and lecithin, two amino acids found in finger millets, aid to eliminate excess fat from the liver, lower cholesterol levels, and prevent fat production. Again, finger millet has low blood triglyceride content. The use of finger millets reduces the risk of cardiovascular disease by lowering plasma triglycerides (Mutshinyani *et al*. 2020) [35].

Finger millets for anti-aging

Finger millets are high in antioxidants and phenolics, which are important for overall health, aging, and metabolic syndrome. Finger millets prevent collagen cross-linking and glycation, both of which cause aging in humans (Shobana *et al*. 2007) [36].

Recipes of finger millet

Finger millet has a wide range of applications, such as substituting traditional cereal grains and their flours such as rice and other starchy grains with finger millet. Common processes employed include milling, roasting, baking, popping, fermenting, and various methods for product development. By utilizing these techniques, finger millet can be integrated more frequently into diets and increase its overall value. Some of the value added products of finger millet are discussed below:

Papad

In millet-growing parts of South India, adding finger millet to the tune of 15-20% (w/w) together with other vital ingredients like as black or green gram, rice, and spices has become a tradition. According to a report, up to 60% finger millet can be added to papad in some parts of Karnataka (Begum *et al*. 2007) [37].

It is also possible to make papad with finger millet flour, which is blended with spices and salt. The flour is first boiled in water until gelatinized before the dough is made. The dough is thinned by rolling it and cutting it into appropriate shapes and sizes, then drying it. These papad chunks should have a moisture content of 7-8% (db). Because the pericarp is not separated from the starch, the papad has a little dark color that, when fried or roasted, turns lighter and more consumer-acceptable.

Soup

Soup is made by combining ragi flour and water (1 part ragi flour to 2.5 parts water). While combining or stirring, enough care should be made to avoid lump formation and to leave a smooth and thick body of mix. This mixture is then heated for 15-17 minutes on medium heat, or until done. Continuous stirring is required during heating to avoid further lump formation. After cooking, remove the mixture from the heat and stir in the curd (half a tea cup) and salt to taste. After another 5 minutes, it is ready to serve warm. In the case of chilly serving, more chilling is required.

Pakora

Cut the onion lengthwise. Crush the garlic with a knife. Set them aside. In a mixing bowl, combine the ragi flour, crushed garlic, cumin seeds, red chili powder, and salt. Mix in 1/2 to 3/4 cup water to form a more liquid-like paste. Coat the cut onion in the flour mixture. In a skillet, heat the oil. When the oil is hot enough, add the flour-coated onion and fry until crispy. Serve hot.

Puffed finger millet

Puffed finger millet grains can be ground into powder, which can then be enhanced with additional ingredients. A variety of components can be combined and thoroughly mixed together to produce RTE meals. The components are chosen and combined based on the needs of the target groups, such as children, pregnant and lactating moms, and so on. The ingredients are chosen in such a way that no additional cooking is required, and they are hygienically packed in appropriate packing materials. The table below is an example of such a blend; comparable additional combinations of elements can be chosen that are both nutritious and acceptable to the target population. The blend provides more protein, energy, calcium, and iron with higher bioavailability.

Chapatti (Roti)

A blend of wheat and finger millet in a ratio of 7:3 (wheat: finger millet) is suitable for making chapatti (roti). Despite the reduced gluten content in this blend, it does not affect the ability to make well-rounded chapattis. Additionally, the chapatti tends to have a slightly darker color due to the presence of finger millet.

Fortifying chapattis with finger millet not only enhances their flavor but also effectively regulates glucose levels in diabetic patients. The slower digestion rate and high fiber content of finger millet contribute to a feeling of fullness with fewer calories, which may help prevent overeating. Moreover, the fiber content in finger millet is beneficial for

individuals experiencing constipation (Gull *et al.* 2014) [39].

Noodles

The evolving dietary preferences among children and teenagers have created a thriving market for noodles in both India and abroad. There is a growing demand for millet noodles, especially those made from finger millet, driven by increased awareness of their nutritional benefits. Noodles, a type of pasta and convenience food, are produced through a cold extrusion process that results in them becoming firm and brittle after drying. Cooking these noodles is convenient and requires only a few minutes. Various combinations of noodles are prepared, including those exclusively made from finger millet, a 1:1 blend of finger millet and wheat, and a blend of finger millet, wheat, and soy flour in a ratio of 5:4:1. For exclusive millet-based noodles, pretreatment of the millet flour is essential to facilitate smooth extrusion and maintain texture during drying and cooking. Typically, wheat flour is a crucial component in noodle preparation due to the presence of gluten, which aids in easy extrusion and contributes to a smooth, crack-free texture in the noodles. Further exploration of different blends is encouraged in noodle production, considering the nutritional profiles of ingredients and their availability (Thapliyal *et al.* 2015) [40].

Conclusion

Finger millet is a nutrient-dense super food and it is rich in vital minerals like iron and calcium that promotes healthy bones and raises hemoglobin levels. Its high fiber content facilitates gastrointestinal health and aids in digestion. Finger millet, which is high in antioxidants such polyphenols, helps fight oxidative stress and may reduce the incidence of chronic illnesses. Because it has a low glycemic index it stabilizes blood sugar and it can be used to control diabetes. Finger millet is an environmentally beneficial and hardy crop that can withstand a lot of hardship. People who are gluten intolerant can also benefit from it because it is gluten-free. In conclusion, finger millet is a diverse, sustainable, and health-promoting food that should be a part of everyone's diet in addition to being a nutrient-rich crop.

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