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Review Article

The Marvelous World of Ragi: A Nutritional Odyssey Through Time and Tradition

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Abstract

Eleusine coracana L., sometimes known as Ragi/ finger millet, is a significant millet that is widely cultivated in India and Africa. It is similar to rice in terms of protein and fat, however it is better than rice and wheat in terms of mineral and micronutrient levels. It is high in dietary fiber, phenolic compounds, and calcium in terms of nutrition. Important amino acids including isoleucine, leucine, methionine, and phenyl alanine, which are lacking in other starchy foods, are available in this little millet. Owing mostly to its polyphenol and dietary fiber levels, it is also recognized for a number of health advantages, including antioxidant, anti-diabetic, anti-tumerogenic, and atherosclerogenic actions. Due to its native origin, malted and natural forms of this millet are utilized in a variety of culinary preparations. The grains are ground into flours and used to make porridge, puddings, pancakes, cookies, roti, bread, noodles, and other snacks. In addition, it is thought to be a healthful meal for those with diabetes and is used as a nutritious meal for neonates when malted.

Keywords: Dietary Staple; Finger Millet; Health Benefits; Nutrition; Nutritional Deficiencies

Introduction

The maintenance of good nutrition is a long-term factor in promoting health, growth, and genetic potential optimization in humans. As a result, it has been acknowledged that a community's nutritional state is a key predictor of its level of development. Malnutrition hinders national development and is considered a national issue. Dietary quality is an important factor in addressing the issues of chronic food poverty and malnourishment. Along with raising yields, food production diversification needs to be promoted at the national and household levels. One of the potentially effective strategies for enhancing household food security is the cultivation of traditional food crops appropriate for the region [1,2].

Millets are little grains in the Poaceae family of grasses. These are tiny, annual cereal grasses with small grains that may thrive in less nutritious soil. Many of them grow well in tropical and desert conditions. Sorghum (Jowar), pearl (Bajra), foxtail (Kakum), finger (Ragi), proso (Chena), small (Kutki), kodo (Kodon), barnyard (Sanwa), and brown top (Millets) are among the varieties of millets [3,4].

In many parts of India, ragi, also known as finger millet (*Eleusine coracana* L.), is a popular kind of millet. It has long been a significant millet staple food in several regions of eastern and central Africa as well as India. It is also referred to as Koracan in Sri Lanka and by various other names throughout Africa. In the past, finger millet was processed in India using techniques including grinding, malting, and fermentation to make drinks, porridges, roti (unleavened flat bread), dosa (fermented pan cake), and idli (fermented steamed cake) [5]. The first known reference of finger millet dates

to about 2300 BC and originates from Hallur in Karnataka, India. There was substantial disagreement over the finger millet's origins, with some ideas suggesting that it may have crossed the Indian Ocean in either way or come by sea from South Africa or Arabia to India. In his thorough review of the archeological research on the origins of *Eleusine*, Fuller [6] reported that the plant is African in origin and offers linguistic evidence for the term "ragi," which derives from the root term "degi" for finger millet in several Bantu languages from southern Tanzania and northern Malawi, as well as its other variants in the Indian subcontinent.

In several Indian states, finger millet was a well-domesticated plant known by local names such as "umi" in Bihar and "nachni" (meaning dancer) in Maharashtra. The grains were crushed, sieved, and gently roasted (sometimes after they had sprouted and dried). Eaten as a sphere or gruel, the pinkish flour (from red finger millet) was either salted or sweetened. Weaning meals like finger millet were also highly popular. The red finger millet is referred to as "Kelvaragu" in the ancient Indian Tamil literature "Kuruntogai." The term "Purananuru" from Sangam Tamil literature (600 BC–200 AD) describes the process of drying, husking, and frying finger millet grains [7,8].

Nutritional and phytochemical significance

In terms of nutrition, finger millet is an excellent supplier of calcium, other minerals, and fiber [1]. It has been] found that finger millet has a total carbohydrate content of 70–78 %., starch constitutes between 50% and 70% of the total carbohydrates. Granules of finger millet starch have a polygonal rhombic form. Amylopectin makes up around 75–85% of the starch in finger millet, with amylose making up the remaining 10–20%. Millets' high fiber content is responsible for their hypoglycemic impact. Diets high in fiber and complex carbs have a slower rate of absorption and digestion, thereby reducing postprandial hyperglycemia. Protein is the second predominant constituent in millet. Although there have been reports of significant differences in protein content from 5 to 12 %, finger millet comprises around 7% protein [9].

Due to finger millet elevated levels of lysine, threonine, and valine compared to other millets, it has a comparatively better balance of important amino acids. The protein content of the finger millet grain is negatively associated with the protein's lysine and methionine contents. A decent complement of essential amino acids may be found in the albumin and globulin fractions, whereas the prolamin fraction has lower amounts of arginine and glycine but larger amounts of glutamic acid, proline, valine, isoleucine, leucine, and phenylalanine. Finger millet has a significant amount of isoleucine. Leucine to isoleucine has a ratio of around 2, which is nearly comparable to that of rice to wheat [10,11].

Finger millet's phenolic content varies among different varieties. The brown species exhibit higher levels of phenolic compounds in comparison to the white variant. Numerous compounds found in finger millet, both in general and the seed coat in particular, may be beneficial to health. One excellent source of a wide range of phenolic chemicals is finger millet. In finger millet, phenolic acids have been identified in both free and bound forms. In an intravenous glucose tolerance test in rats, studies have demonstrated that caffeine can reduce fasting glycemia and attenuate the rise in plasma glucose. Additionally, it has been shown to enhance the absorption of glucose by mouse myoblasts and rat adipocytes. It was discovered that quercitin blocked glucose transport in the transfected oocyte model and rat glucose absorption, while catechin increased the glucose tolerance in rats [12].

Processing and health benefits

The displayed figure 1. shows the exceptional nutritional value and health benefits of finger millet (Ragi), highlighting its importance as a versatile and nutritious food source with the potential to address nutritional deficiencies in various populations. Food processing techniques advanced over time, aiming to enhance the flavor, consistency, appearance, and overall quality of the final product.. In addition to these customer preference factors, a number of techniques work to extend the shelf life of the product while maintaining its safety and wholesomeness. Common methods used in households to prepare these foods include grinding, fermenting, malting, sprouting, and boiling. The food's nutritional value is altered in a qualitative way by each of these procedures [13].

In South Indian cooking, finger millet is a prominent ingredient where it is utilized in various dishes. Examples of finger millet-

based delicacies prepared in Indian households include Finger millet onion chapati, finger millet laddu, finger millet murukku, soft mudde, finger millet rawa chocolate pudding, finger millet vermicelli kheer, finger millet vermicelli upma, and finger millet cake are among the foods made in Indian households. Traditional Indian recipes incorporate finger millet in dishes such as roti, kazhi (ragi balls), and kanji (thin porridge). Ragi is used to make a wide variety of meals, including chapatis, chakli, cheela, khichri, papads, noodles, vermicelli, and many regional specialties. Furthermore, ragi/finger millet grains can be processed into flour, baked products, baby weaning meals, and alcoholic and non-alcoholic drinks [14].

Due to its high nutritional composition, ragi exhibits a myriad of therapeutic benefits. Finger millet is used to alleviate conditions like depression, anxiety, migraines, and fatigue since it naturally relaxes the body. Additionally, finger millet has been shown to be a strong antioxidant in the process of diabetes-related cutaneous wound healing and to support aging well and the metabolic syndrome. Moreover, finger millet has antimicrobial, antibacterial, and anti-inflammatory properties (Figure 1). Ragi also contributes to bone strength due to its calcium-rich profile. Green finger millet is good for blood pressure, asthma, heart disease, and liver illnesses. It's also good for pregnant women since it helps with breastfeeding. Following sprouting, finger millet's vitamin C content rises, making it easier for the body to absorb iron [15].

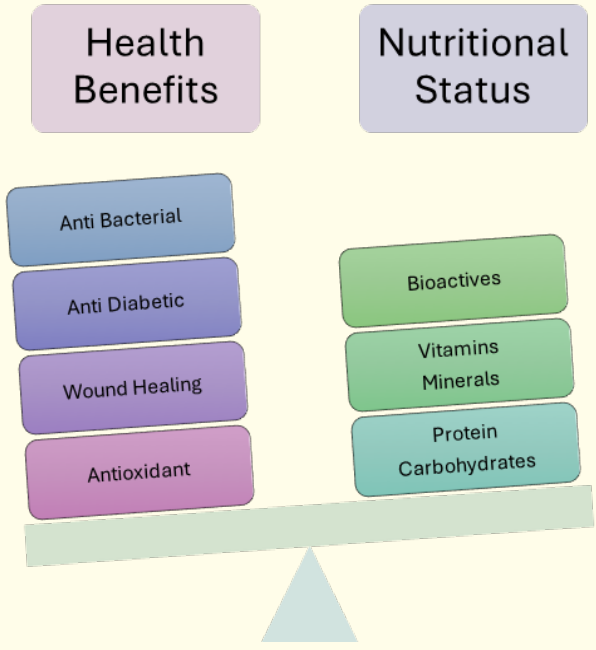

Figure 1: Nutritional and Health Benefits of Ragi.

A comprehensive overview of the multifaceted importance of millet

Millet, a group of small-seeded grasses, has been cultivated for thousands of years and holds significant importance across various dimensions, including environmental sustainability, dietary diversity, culinary innovation, community empowerment, and cultural heritage. This paper provides a comprehensive overview of these facets, emphasizing millet's potential to address contemporary global challenges such as food security, climate change, and economic development.

Environmental sustainability

Millet cultivation is known for its environmentally friendly attributes. Unlike many staple crops, millets require significantly less water and are more resilient to adverse climatic conditions, making them suitable for cultivation in arid and semi-arid regions [16]. For instance, pearl millet (*Pennisetum glaucum*) can thrive in low rainfall areas, often requiring only 300-600 mm of water annually [17]. This resilience not only promotes sustainable agriculture but also contributes to reducing the carbon footprint associated with

farming practices. The ability of millet to grow in poor soils without the need for chemical fertilizers further emphasizes its role in promoting sustainable land use practices [16].

Dietary diversity and food security

Integrating millet into diets enhances dietary diversity, particularly in regions where food security is a pressing concern. Millets are rich in essential nutrients, including proteins, vitamins, and minerals, which are critical for combating malnutrition [17]. The Food and Agriculture Organization (FAO) recognizes the importance of millets in improving public health outcomes, especially in developing countries where staple diets often lack diversity [18]. By promoting millet consumption, communities can improve nutrition and enhance food security, as millets can be cultivated in diverse agro-climatic conditions, ensuring a stable food supply.

Culinary diversity

Millet's versatility extends beyond traditional recipes, offering a wealth of culinary possibilities that cater to modern gastronomic trends. From being used in breads, porridge, and salads to innovative fusion dishes, millet is gaining traction in global cuisines [16]. Chefs and food enthusiasts are increasingly incorporating millet into their menus, recognizing its health benefits and unique flavors. The growing interest in ancient grains has led to a resurgence of millet in contemporary cooking, allowing for the exploration of diverse textures and tastes [18]. This culinary diversity not only enriches diets but also fosters cultural appreciation and innovation.

Community empowerment

The cultivation of millet has significant social and economic implications for local communities. Millet farming can generate income and employment opportunities, particularly in rural areas where agricultural livelihoods are vital [17]. Initiatives aimed at promoting millet cultivation often focus on providing training and awareness to farmers about sustainable practices, alongside financial support through soft loans. These efforts can lead to improved crop quality and productivity, fostering rural development [16]. Furthermore, encouraging the marketing of local millet products can enhance the income levels of communities, contributing to economic empowerment and resilience.

Cultural heritage

Millet holds deep cultural significance in various communities, playing a crucial role in preserving culinary traditions. In many cultures, millet is associated with rituals, festivals, and cultural practices that celebrate its importance [16]. For example, in India, millet is often featured in traditional dishes during harvest festivals, symbolizing abundance and gratitude. By recognizing and promoting the cultural heritage associated with millet, communities can strengthen their identity and foster intergenerational knowledge transfer regarding agricultural practices and culinary traditions [18].

Conclusion

Packed with health benefits, finger millet is a staple meal in many regions of India as well as globally. Through evaluation, it was discovered that it possessed the highest quality nutritional and functional characteristics of all the cereal grains. Its great contribution to human nutrition is attributed to its vitamins, minerals, fatty acids, and antioxidant qualities. Particularly in rural and marginal areas, where the majority of people suffer from energy-protein malnutrition, leveraging finger millet in diets can play a strategic role in addressing nutritional deficiencies. Finger millet's well-balanced protein profile and gluten-free characteristics make it suitable for use in a variety of food formulations to prepare value-added products. The consumption of millet is influenced by certain food designs that are thought to be acceptable by people of all ages, even if its consumption pattern is distinct and will remain that way. Therefore, there is a pressing need to promote the widespread adoption of millet to harness its nutritional benefits more comprehensively.

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