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CHAPTER 9

Eleusine coracana (L.) Gaertn (Finger Millet): An Important Sustainable Food Supplement

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Abstract

One of the oldest millets grown in India since 2300 BC is *Eleusine coracana* (L.) Gaertn referred to as finger millet. This review focuses on the applications, nutritive makeup, processing, and health benefits of this ancient grain. Of the various millets and grains, finger millet possesses the highest amount of calcium. In comparison with wheat, rice, which is currently India's main staple grain, it includes more nutritional fiber, minerals, and amino acids that contain sulfur. Even though finger millet has a high nutritional profile, recent studies reveal that urban Indians eat less millets overall. The purpose of this study is to increase awareness of finger millet, its health benefits, and how it may continue to be a sustainable food supply in the context of population growth and declining water supplies.

Keywords: Finger millet, health benefits, sustainable food supplement

Introduction

Among the underused varieties of cereal grains are millets. Even with their high nutritional value and nutraceutical content, they are still regarded as poor people's diet. Finger millet is oldest millets grown in India since 2300 BC and is a gluten-free cereal grain belonging to the Poaceae family (Gebre, 2019). In terms of ranking behind other millet varieties worldwide, finger millet is placed fourth. The nutritional qualities of food have an impact on the elements that support human health. The scientific community has expertise in the word "nutraceutical" and after being developed by Stephen DeFelice in 1989 (Stephen, 2000), the term "nutritional and pharmaceutical food" was only briefly available to the general people. A material that is categorized as food or a component that provides extra health advantages is called a nutraceutical, such as boosting wellness and preventing conditions including diabetes, cancer, heart disease, and hypertension, in addition to possessing an average dietary value (Rajasekaran et. al., 2008).

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It is estimated that 9.6 billion people would be living globally by 2050, which brings up a variety of global problems, the most important of which being food safety and security. The foundation of national development and human well-being is adequate and healthy eating, which raises living standards by stimulating the economy of any nation (Kumar et al., 2022). Malnutrition still affects billions of people worldwide, even in spite of abundant agricultural production. The United Nations estimates that 800 million people are undernourished and 2 billion are obese as of 2021. Malnutrition poses a severe danger to national economies since it stunts children's growth and development (Webb et al., 2018).

Out of 250,000 edible species of plant, the world is flourishing on only 1% with the predominant dominance of three crops – rice, wheat and maize. Currently, the scientific community is eager to discover alternative resources as a result of the assumption that there will be a minimum 14% decrease in the number of grains produced per person by 2030 (Cheng, 2018).

The term "coarse grains" was once used, like millet, is now referred to as modern nutri-cereals. Since they are able to withstand most pests and illnesses as well as the harsh circumstances present in arid and semi-arid regions, they are referred to as the "future crops". One of the major sources of nutrition and sustainable food supplements is finger millet.

Morphology

Annual herbs. Culms are tufted, compressed, 30-80cm tall, upright, stout, branched or unbranched, 2-3 noded; glabrous. Leaves: compressed sheaths, loose; the leaf blades 220-500 mm X 6-10 mm in size. They are strongly keeled additionally difficult to break. The usual green color of the leaves and culms features a noticeable look that is flattened. The leaf sheaths have ciliate margins and are glabrous and open. Since the entire stem is covered in a leaf sheath, only small sections of the internodes are visible. The length of the internodes varies, and they are relatively short at the base. The term "finger millet" comes from the panicle-like inflorescence that has four to nineteen finger-like spikes sub-erect with ends mostly incurved arranged in a bird's foot pattern that, when fully grown, resembles a fist. Spikes may be either closed or open. The spikelets are very crowded, 3-5 flowered and laterally compressed. Glumes lanceolate, persistence, scabrid along the winged keel. Lemmas are lanceolate, 3-5 mm in length, with three nerves and narrow wings. Upper glumes with 3–7 nerves and lower glumes has only one. Palea ovate, keeled and winged. Lodicules 2, stamens 3, grains globose, finely striate and dark brown (Naik, 1998: Gaikwad and Garad, 2015).

Flowers & Fruiting: November to February

Origin: Originated in Ethiopia. Native of west tropical Africa and Angola.

Vernacular Names: English: Finger Millet/African Millet; Marathi: *Nachani;* Sanskrit: *Madhulika/ Nrityakundala/ Mattakam;* Hindi: *Madua;* Telagu: *Ragi/Ragulu/Keppai/Chodi;* Tamil: *Kezhvaragu/Keppai* Urdu: *Ragi;* Gujarati: *Bhav;* Assamese: *Maruba Dhan;* Kannada: *Ragi;* Kokani: *Naachani/ Nachane/ Nasne;* Oriya: *Mandia;* Kashmiri: *Ragi/Marua;* Punjabi: *Mundal/Mandhul/Mandal;* Bhojpuri: *Marua;* Bengali: *Madua*

Classification

Plantae
Magnoliophyta
Liliopsida
Poales
Poaceae
Chloridoideae
Eleusine

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coracana

Scientific name: *Eleusine coracana* (L.) Gaertn.

Varieties: Finger millet comes in three primary varieties: black, white and reddish brown. (Gebre, 2019). Only the red variety of finger millet is frequently cultivated globally among the other varieties. (FAO, 2013).

Cultivation: Indian farmers cultivated on small scale for the food grains (Kennedy et. al., 2006). India's Karanataka produces 58% of the finger millet consumed worldwide, making it the country's top producer (Upadhyaya et.al., 2007).

International Status of Finger Millet Production

Finger millet is ranked as the fourth most important millet grown worldwide. It is cultivated in several regions of South Asia, including India, and several African nations, including Ethiopia and Zimbabwe (Opole, 2019). After sorghum, wheat, maize barley and teff, finger millet is Ethiopia's sixth-most important crop, taking up over 4% of the entire area used for cereal planting (CSA, 2018). Over 25 nations in Africa and Asia cultivate finger millet, accounting for more than 12% of the world's total millet acreage (Bora, 2013; Kumar et al., 2016). Finger millet is a staple food for people living on marginal land and with little resources (Kumar et al., 2016). There are 55 and 60 percent of the total world's supply comes from Africa (Ramashia et al., 2019).

National Status of Finger Millet Production

Approximately 81% of the small millets grown in our nation are made up of this crop. One million hectares of finger millet are grown in India, producing 1.76 million tons of grain per year with the average productivity of 1747 kg/ha. It ranks sixth among Indian cereals, behind rice, wheat, maize, sorghum, and bajra, and third among millets, behind pearl millet and sorghum (Thakur, 2023). Karnataka is the nation's leading producer of finger millet, holding 58 percent of the world's output, despite the fact that only a small portion of Indians are aware of its health benefits and nutritional value (Upadhyaya et.al., 2007).

Processing Methods

Agricultural crops are transformed into consumable goods through a sequence of mechanical and physical processes known as crop processing. In Indian homes, processing finger millet can be carried out in several ways, comprising cooking, sprouting, soaking and fermenting (Shobana et al., 2013). Grain, pulse, and oilseed roasting is a more straightforward and widely utilized technology at the home and village levels that is said to lengthen storage life and eliminate the majority of harmful or antinutritional effects, including hemagglutinin, trypsin inhibitors, goitrogenic compounds, cyanogenic glycosides, alkaloids, and saponins (Huffman & Martin, 1994; Gopaldas et al., 1982). According to Singh and Raghuvanshi's 2012 study, during the millet's fermentation process, there was an increase in the availability and accessibility of minerals such as iron, zinc, calcium, and phosphorus found as 27 %, 26 %, 26 %, and 26 % respectively. Their findings showed that the germinated millets had a far lower rate of fungal infection than the regular ones. Because there was a significant impact on the biochemical alterations, the results also indicate an improvement in nutritional value. The grain is made digestible through the roasting and milling processes without losing any nutritive elements (Krantz et al., 1983). Popped grains have a nice scent and a decent flavor, especially finger millet. In addition to being a handy snack, popcorn may be used as a nutrient-dense food component in nutrition intervention programs (Malleshi, 1997). The oldest and most efficient food preservation and processing technique is fermentation, which also lowers the antinutritional elements from millets (Michaelsen et al., 2009).

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Nutritional Profile

The endosperm, seed coat, and embryo (germ) are the three main botanical parts of a millet kernel. There is hardly much nutrients in the millet's pericarp, or outermost layer. The testa, or seed coat, of this millet is multilayered, unlike that of other millets such as foxtail millet, proso millet, pearl millet, and sorghum. It is composed of five layers. The high concentration of carbohydrates (65%–75%), dietary fiber (18%), calcium (0.38%), protein (6–13%), minerals (2–5–3–5%), tannins (0–61 %), phytates (0–48%) and phenolics (0–3 %) found in finger millet makes it a valuable source of nutraceuticals and trypsin inhibitors. Along with these and other health benefits, it is also well-known for having antibacterial, antitumorigenic, anti-diabetic, anti-ulcer, anti-inflammatory qualities (Devi, et al. 2014; Chethan and Malleshi (2007); Sripriya and et al, 1996)

Experimental studies

A few researches on finger millet have suggested that it may have some therapeutic use in treating some food-dependent illnesses, including obesity, diabetes, and digestive system issues. Various researchers worked on finger millets for their bioactivities. Lei et al. (2006) described utilizing fermented finger millet drink as a home remedy for diarrhea caused by natural probiotics. Hegde et. al., (2005) found that phytates, tannins, and phenolics are abundant in finger and kodo millet and can function as antioxidants. Therefore, it was determined if a millet-based diet may help prevent oxidative stress and keep blood glucose levels stable in vivo in individuals with type II diabetes. In Wistar rats, oxidative stress caused by alloxan and hyperglycemia can be prevented by diets containing whole grain millet meal flour.

A extremely nutritious cereal, finger millet has long been used to treat a variety of illnesses, including leukemia. Recently, finger millet seed purified extract has gained significance for its anti-proliferative activity on K562 chronic myeloid leukemia. This is because finger millet seeds contain a bifunctional complex of an inhibitor of trypsin and amylase, also known as ragi bifunctional inhibitor, or RBI, which simultaneously inhibits trypsin and amylase (Sen and Dutta, 2012).

Tatala et al. (2007) revealed that children who were fed finger millet-based meal showed improvements in their hemoglobin status used approach to evaluate how feeding children in rural Tanzania a meal supplement made of germinated finger millet affected their hemoglobin level. For six months, the youngsters were fed a diet consisting of ragi flour, crushed peanuts, kidney beans and dried mangoes. Key results indicated a general improvement in hemoglobin status in newborns supplemented with the finger millets-based diet that had germinated.

Health Benefits

Many rural smallholder farmers and their families depend heavily on finger millet as a major food crop for their survival. Finger millet's high dietary fiber, low glycemic index, minerals content, phytochemical makeup and gluten-free nature, all contribute to its health benefits (Amadou et al., 2013; Chandra et al., 2016; Kumar et al., 2016; Xiang et al., 2018,). Finger millet's remarkable composition makes it a great meal against gastrointestinal diseases, allergies, cancer, heart attacks, strokes, type II diabetes, anemia, and constipation (Bora, 2013; Ramashia et al., 2019 and Rathore et al., 2016). According to the research done by Kandel et al. (2019), Ragi is believed to be a safe diet for treating animal diarrhea and for expectant mothers. The numerous health advantages of finger millet are displayed in Fig. 1.

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Fig. 1: Health benefits of finger millets

Food items and dishes

Finger millet grain is a highly nutritious diet that is perfect for diabetics, expecting mothers, nursing moms, kids, and the sick. Grain millet (finger mill) can be used to manufacture many different things. It is used to make a variety of dishes in India. Foodstuffs like soups, papads, sweet mixtures, and vermicelli noodles. More than 75% of the grain of finger millet produced is used to make traditional dishes like keelsa, dosa, idli, porridge, roti, papad, and others. It is used to make papad, ambil, and bhakhari in Konkan area of Maharashtra and Goa. Malted finger millet, or sprouted seeds, is a nutrient-dense, easily digested diet that is especially suggested for infants and the elderly (Swagath Thakur 2023). There are both traditional and commercial uses for finger millet throughout the world. Traditionally, alcoholic as well as nonalcoholic beverages have been made with finger millet grain, and numerous dishes, such as bread and porridge, are prepared with its flour (Ramashia et. al., 2019). Pasta made by combining semolina and millet flour with vegetable paste offers superior nutritional qualities in addition to being firmer, less sticky, and requiring less enhanced shelf life combined with gruel loss (Kaushik et al., 2021). A key ingredient in bread, nankhatai, biscuits, and muffins is ragi. The quality of these baked goods has been preserved and attempt has been done to standardize the recipe (Varma and Patel, 2013).

Conclusion

The finger millet has high dietary fiber content; nutrients, polyphenols as well as high mineral content have been demonstrated to offer several health benefits, such as defense against diet-related chronic illnesses, anti-diabetic and antioxidant properties. Ragi exhibits a number of qualities, including antibacterial, anti-inflammatory, and enzyme-inhibitory effects. Due to its gluten-free nature and well-balanced protein profile, finger millet can be used in a number of high-value food components. Finger millet is prized for its exceptional nutritional and therapeutic qualities and its outstanding storage qualities. Finger millet is a promising crop for future food security because of these characteristics.

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