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Assesing The Health Benefits Of Finger Millet- A Review

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Abstract: *Eleusine coracana*, commonly known as finger millet or ragi belongs to the minor cereals of the grass family (Poaceae) are characterized by their ability to survive in less fertile soil, resistance to pest, drought resistant, short growing season. Finger millet has an outstanding properties as a subsistence food crop. It is rich in calcium, dietary fibers, phytates, proteins, minerals, amino acids and have higher proportion of glutamic acid, proline, isoleucine and leucine. Its fat consist of oleic acid, linoleic acid and linolenic acid. The abundance of these phytochemicals enhances the nutraceutical properties of finger millet and other health beneficial nutrients such as antidiabetic (type 2 diabetes), antioxidant, antimicrobial, prevents osteoporosis and atherosclerosis effects. This review highlights the need for increased consumption of finger millet in global diets, particularly in developing regions, to leverage its health benefits and improve nutritional security.

Index Terms **-** Antidiabetic, Antioxidant, Polyphenols, Finger Millet, *Eleusine coracana*

1.Introduction

Millet refers to a diverse group of small seeded grains primarily from the family *Poaceae* ,cultivated globally as a staple food source. The family *poaceae* of the monocotyledon group include grasses such as finger millet (*Eleusine coracana*), pearl millet (*Pennisetum glaucum*), foxtail millet (*Setaria italica*), kodo millet (*Paspalum scorbiculatum*), little millet (*Panicum sumatrense*), proso millet (*Panicum miliaceum*), barnyard millet (*Echinochola crus-galli*) (FAO, 2013). Finger millet,is serves as a primary food source for millions of economically disadvantaged groups in African and Asian nations. Known by various local names, it is commonly referred to as ragi in India, a term that has gained widespread acceptance (Kennedy et al.,2006). Taxonomically, finger millet is classified under the Poaceae family within the monocotyledon group. India, is considered a hub for these minor crops, leads to global millet production, contributing approximately 41% of the world's output in 2021 with an annual yield of 10.08 million metric tons (Kumar et al.,2023)

Finger millet, also known as ragi or mandua in India, is a minor cereal originating from Ethiopia but extensively cultivated in various regions of India and Africa (Chandra D et al.,2016). Archaeological findings provide compelling evidence that its cultivation dates back as early as 7000 BCE in China (Bestel et al., 2014). It is a staple food, providing a significant portion of calories and protein to large populations in these countries, particularly for low-income groups. Karnataka, an Indian state, is the leading producer of finger millet, accounting for 58% of its global production. In India, finger millet ranks sixth in production area after wheat, rice, maize, sorghum, and bajra. Globally, it holds the fourth position among millets, following sorghum, pearl millet, and foxtail millet. (Devi et al.,2014).

Finger millet, extensively grown in various ago-climatic regions of Africa and South Asia, is believed to account for roughly 10% of the global millet production, which totals 30 million tons. The crop's domestication dates back to approximately 5000 BC. As an allopolyploid, finger millet possesses a chromosome count of 2n = 4x = 36. Its evolution can be traced to a hybridization between two diploid species:

Eleusine indica (AA) and either Eleusine floccifolia or E. tristachya (BB), which served as genome contributors [Chennaveeraiah et al.,1973), Hiremath et al.,1992 and Chandrashekhara et al.,2010].

Millets cultivated in tropical and semiarid regions. They resist pests and diseases, adapt to various environments, and yield well. These crops can tolerate high salinity, grow in short time period, resist water logging, endure drought, require minimal inputs, and are vital for future human use given the rising global population and dwindling water supplies. Finger millet's drought tolerance may result from its efficient antioxidants and, making it easy to cultivate under stress without significantly affecting productivity. There is considerable potential to process millet grains into value-added foods and beverages in developing countries. Additionally, millets are gluten-free, suitable for individuals with abdominal sensitivities (Chandrasekara et al., 2010).

2. Nutritional composition of finger millet

The nutritional composition of food is vital for human health. Finger millet is notably rich in carbohydrates, vitamis, minerals,rich in calcium,fibers, phytochemicals, phenolic compounds and also has antinutritional factors(Shobana et al.,2013). For instance, finger millet has a higher calcium content than wheat and rice. It has three times amount of calcium than milk and also rich in antioxidants. Finger millet also contain high fiber which helps to maintain gut health, reduce the risk of colorectal cancer and prevents constipation (K Ambati et al.,2021). Due to high nutrition profile it also contribute to the prevention and management of chronic diseases. It is gluten free, hence providing excellent food source for individual with celiac disease or gluten sensitivity. (MDL et al.,2020, Mahod et al.,2023).

2.1 Carbohydrate

The total carbohydrate content of finger millet is reported to range from 72% to 79.5%.(Pore & Magar, 1971). However, its carbohydrates consist of slow-digesting starch, dietary fiber, and resistant starch, resulting in a lower glycemic index compared to commonly consumed cereals like rice and wheat (Gull et al.,2014, Singh P et al.,2012). Approximately 81 to 85% of finger millet starch is composed of amylopectin, with the remaining 15 to 20% being amylose. Non-starch polysaccharides contribute to 20 - 30% of total carbohydrates in finger millet, which also contains about 1.5% reducing sugars and 0.03% non-reducing sugar (Bhatt et al.,2003). The total dietary fiber (TDF) in finger millet is 12%, with 11% as insoluble dietary fiber (IDF) and 2% as soluble dietary fiber (SDF). Fiber reduce blood sugar and cholesterol level. (Rao et al.,1997).

2.2 Protein

Finger millet contains the amino acid tryptophan. Essential amino acids in finger millet include isoleucine (4.4g), leucine (9.5g), methionine (3.1g), and phenylalanine (5.2g). Compared to other millets, it has a balanced ratio of valine, threonine, and lysine (Ravindran G,1992). Millet grain proteins include lysine and methionine. The predominant protein component contains higher concentrations of proline, valine, isoleucine, leucine, and phenylalanine than arginine and glycine. Albumin and globulin fractions are also significant (Lupien J.R, 1990).

2.3 Fat

The fat content of finger millet varies between different varieties, comprising 1.2 to 1.4% of fat. (Seetharaman A. 2001). Various types of lipids are present, including free, bound, structural, and phospholipids. The primary fatty acids are oleic acid, palmitic acid, and linoleic acid. About 25.6% of all fatty acids are saturated, while 74.4% are unsaturated (Sridhar and lakshminarayan G. 1994). Additionally, millets contain B vitamins such as niacin, folic acid, and pyridoxine, as well as minerals like calcium, iron, potassium, magnesium, and zinc (Dykes et al.,2006).

2.4 Mineral

Finger millet contain a high mineral elements such as calcium, iron, zinc and potassium. It has a high concentration of calcium (159-364.6mg/100g)), sodium (107-268.23mg/kg), potassium (26-284mg/100g) and iron (10.2-424.16mg/100g) (Barbeau et al.,1993). Minerals plays an important role in metabolism regulation

in the body. Popped finger millet has less bioaccessibility to calcium but more bioaccess to iron and zinc. Zinc, iron and calcium were more bioaccessible after finger millet was malted (K Rateesh et al.,2012).

2.5 Antinutritional factors

Finger millet contains several anti-nutritional factors such as tannins, oxalic acid, phytates and polyphenols. These antinutritional factors impair the absorption, digestion and consumption of nutrients and limits the bioavailability of minerals (Palanisamy et al., 2012).

3.Health benefits of finger millet

Millet offers a wide range of nutritional benefits, rendering it a superior alternative to conventional cereal grains. (Hassan et al.,2002). Its low glycemic index, low simple sugar content, and high fiber composition contribute to its health-promoting properties. (Kumari & Sumathi et al.,2002). While the nutritional profile of millet may vary slightly depending on the specific variety, it generally provides a comprehensive array of essential nutrients. (Geetha et al.,2020).

Millet's gluten-free nature makes it suitable for individuals with gluten sensitivities or celiac disease (Selladurai et al., 2023). Incorporating millet into a balanced diet offers numerous health benefits. Its high dietary fiber content supports digestive health, regulates cholesterol, and enhances satiety, aiding in weight management. Millet's rich mineral content is essential for bone health, muscle function, and energy metabolism. Additionally, its antioxidants combat oxidative stress and promote overall well-being (Patil et al., 2023).

3.1 Antidiabetic

Millet's antidiabetic effects arise from its complex carbohydrates and fiber, which regulate blood sugar and address diabetes and chronic vascular issues. Millet's polyphenols inhibit digestive enzymes like lipases, glucosidase, pepsin, trypsin, and amylase. These phenolics may help manage type 2 diabetes by acting as amylase and glucosidase inhibitors, thereby reducing postprandial hyperglycemia. Finger millet consumption has been shown to lower C-reactive protein and triglycerides, improve serum lipid profiles, and reduce blood sugar levels (S Chethan et al., 2008).

3.2 Antioxidant

The antioxidant properties of millet are attributed to phenolic acid compounds and their derivatives, such as tannins and flavonoids, found in the seed coat. These compounds act as multifunctional agents, serving as chelators and reducing agents. (Shahidi et al.,1992, Sripriya et al.,1996, Devi B et al.,2014).

3.3 Antimicrobial

Millet also exhibits antimicrobial activity, which is particularly relevant given the increasing prevalence of inflammatory-mediated diseases worldwide. Various research suggests that finger millet extracts may serve as natural anti-inflammatory agents by inhibiting arachidonate 5- lipoxygenase, a enzyme in the production of inflammatory mediators and extract also inhibit the growth of pathogenic fungi such as Rhizoctonia solani, Macrophomina phaseolina and fusarium oxysporum (S.A Jayawardana et al.,2021, Radhajeyalakshmi, et al.,20023, Xu, et al.,2011).

3.4 Improves bone health and prevent osteoporosis

The high calcium, vitamin D, phosphorus, and vitamin B12 content in finger millet contributes to improved bone health and osteoporosis prevention. These nutrients are easily digestible, leading to high bioavailability and calcium retention. Osteoporosis, a common bone disorder characterized by weakened bones and increased fracture risk, can be addressed through the consumption of nutrient-rich foods such as finger millet which is rich in calcium (R.G Nishane et al.,2023).

3.5 Colorectal carcinoma and breast cancer

Studies on the impact of finger millet's phenolic compounds on colorectal carcinoma and breast cancer cell lines have revealed promising results. These phenolic fractions demonstrated the ability to reduce ferric ions and showed potential in scavenging DPPH radicals, suggesting possible anticancer properties. (Kuruburuet al.,2022).

3.6 Cardiovascular disease

Finger millet may help prevent cardiovascular disease by lowering plasma triglycerides in hyperlipidemic rats. (Lee, et al.,2010). Finger millet has reduced levels of serum triglycerides and is beneficial for heart and circulatory health due to its ability to lower cholesterol (Karki et al.,2020). The primary amino acids in finger millets - methionine, threonine, and lecithin - contribute to the removal of excess fat from the liver and the reduction of cholesterol levels. Additionally, finger millet contains low concentrations of serum triglycerides. The consumption of finger millets may decrease the risk of cardiovascular disease through the reduction of plasma triglycerides (Lee et al., 2010).

3.7 Treatment of celiac disease

Finger millet is a best alternative food for celiac disease patients (Kakade and Hathan,2015). Celiac disease is an immune-mediated disorder triggered by the ingestion of gluten in genetically susceptible individuals. As a gluten-free grain, finger millet presents a suitable alternative for people with celiac disease and those who are gluten-sensitive. These individuals often avoid the gluten content found in wheat and other commonly used cereal grains (Saleh et al., 2013).

4. Conclusion

Cereals are a fundamental food source, providing vital nutrients like protein, carbohydrates, and lipids. Millets, especially finger millet, are rich in vitamins and minerals. This review highlights the significance of finger millet as a nutritious food source, containing high-quality protein, carbohydrates, lipids, dietary fiber, vitamins, minerals, antioxidants, and phytochemicals. Thus, improving millet nutrients to enhance health while reducing anti-nutrients that hinder nutrient digestibility and bioavailability. The study underscores finger millet's nutraceutical properties and its potential as an alternative cereal for therapeutic foods, including gluten-free diets, protein and energy-rich diets, and diets for diabetes and cardiovascular disease management. The research indicates that millets can act as "food medicine." Finger millet is a source of antioxidants like phenolic acids and glycated flavonoids. Millet-based foods are also potential prebiotics, enhancing the viability of probiotics with associated health benefits. Increased global interest in nutritious diets calls for further research and promotion of finger millet, which could improve public health and support sustainable agriculture**.**

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