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An overview of Finger millet (*Eleusine coracana* L.)

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Abstract

Finger millet (*Eleusine coracana* L.) or ragi occupies significant position in India in terms of production and utilization and in entire world. It is one of the most stable food crop. Finger millet is superior to rice and wheat with respect to mineral, fiber and micronutrient contents. Its utilization in the daily dietary at present is very limited in rural areas only. Processing of finger millet using traditional as well as modern technique for the development of value added and convenient food products will be solution for its promotion and enhancement of consumption will increase profitability. Cake is one of the most popular bakery products. Generally it is prepared from refined wheat flour and is a rich source of protein, fat and carbohydrates but limiting in minerals and dietary fibres. Finger millet (mandua) flour is rich in minerals like iron, calcium, phosphorus, fibre and vitamin contents.

Keywords: Finger millet (*Eleusine coracana* L.), processing, utilization

Introduction

Finger millet (*Eleusine coracana* L.) is commonly or locally named as *ragi* or *mandua* is cultivated in various parts of India and in entire world. In India, finger millet is mostly grown or produced in southern parts and hilly areas in the northern regions like Karnataka, Andhra Pradesh, Tamil Nadu and mostly in Uttarakhand (Vijayakumari J, Mushtari BJ, Shamshad B, Sumangala G (2003) [14]. Finger millet is one of the most important staple food crops in various parts of central and eastern Africa and India. Finger millet ranks sixth in production crop after maize, wheat, rice, sorghum and *bajra* in India.

Finger millet is the most important cereal crop of the semi-arid zones of the world. In today's world, about 12% of the total millet area is under Finger millet cultivation, which mainly covers more than 25 countries of Asia and Africa. Finger millet is mostly known by different local names of the different countries like *ragi* or *mandua* in India, *koddo* in Nepal, *coracan*, *koracan* in France, African millet, finger millet in England, *tokuso* in Ethiopia, fingerhirse in Germany, *bulo* in Uganda *wimbi* in Kenya, etc. Finger millet are distributed in about 10 genera and 20 species in all (lupien, 1990) [10].

Finger millet can grow even in non-irrigated conditions and in very low rainfall regime between 200mm to 500mm. It is small-seeded minor cereal with light brown to brick red coloured or dark brown seed coat which is mainly rich in phytochemicals such as a polyphenol and dietary fibers. Finger millet is a good source of nutrients especially calcium, fiber, antioxidant properties, photochemical which makes it easily and slowly digestible. Finger millet efficiently helps in controlling the blood glucose level in diabetic patients. Therefore finger millet is considered to be Ideal food for diabetic individual due to its low sugar content and slow release of sugar/glucose in the body (kang et al, 2008) [9].

Finger millet flour can be used for the preparation of various nutrient rich or dense recipes which can be used for supplement feeding. Finger millet flour provide many health benefits like finger millet for losing weight, bone health, lowering blood cholesterol, for anaemia and other health conditions. Finger Millet is the rich source of calcium, phosphorus and iron. With the changes in scenario of utilization of processed products and awareness of the consumers about the health benefits, finger millet has gained importance because of its functional components, such as slowly digestible starch and resistant starch (Wadikar *et al.*, 2007) [15].

Some of the products made from finger millet that are easily available in market are multi-grain noodles, finger millet health drink, doodles, finger millet biscuits and cookies, finger millet vermicelli, etc. Due to advanced post harvest processing and value addition technologies of finger millet, its consumption is increasing day by day in urban areas. This finger millet has a good potential of providing nutritional sources to the consumers. Finger millet has best

quality protein along with the presence of essential amino acids, vitamin A, vitamin B and phosphorus (Gopalan *et al.*, 2004)^[6].

Finger millet is commonly used in the form of whole meal for preparation of traditional foods, such as *roti*, pancakes, dumpling, porridge, etc (Bennetzen *et al.*, 2003)^[1]. Finger millet is also used for the preparation of bakery products and is also beneficial food for infants and is good dietary source of nutrients for growing children.

The grain of finger millet has a fine aroma when cooked or roasted and have many health promoting qualities. Millets do not require any pesticide which means this crop can be stored without insects or pests damage or rodent damage, which makes it more valuable crop for the famine-prone areas. Finally and lastly, the crop is productive in a wide range of environmental and growth conditions. Due to excellent malting, its uniqueness is added to the grain and it has wide utility in food processing and value addition. At present, they are ranked among top 10 most important grains sustaining about one third of the world's population (Changmei and Dorothy, 2014)^[3].

Morphological features of Finger millet (*Mandua*)



Finger millet (*Mandua*) plant

Finger millet belongs to the family Poaceae and the genus *Eluesine*. It is a self-pollinated crop. (Goron and Raizada, 2015)^[7]. It is a grass crop grown in India, Africa, Nepal and many countries of Asia. Finger millet is rich in polyphenols, calcium and iron. Finger millet is one of the most staple food crop of Central and eastern parts of Africa, Nepal and India. The plant and grains are resistant to droughts, pests and pathogens. Finger millet are important crop in semi arid and tropical region and are short growing season crop and can produce under hard and drought conditions. The grain of finger millet has a fine fragrance when cooked or broiled and is known to have numerous wellbeing advancing characteristics. The grain can be put away for quite a long time without creepy crawly harm, which makes it an especially significant harvest for starvation inclined zones.

The harvest gives food grain just as straw which is esteemed creature feed, particularly in the rainfed regions. Among the significant food grains, finger millet is one of the most nutritious harvests for protein, minerals (calcium and iron) and amino acids (methionine, an amino corrosive ailing in the weight control plans of countless the poor who live on boring nourishments, for example, cassava, plantain, cleaned rice, and maize supper); and gives 8-10 times more calcium than wheat or rice. It contains rich amounts of protein, mineral nutrient as compared to other major cereals like wheat, rice, and sorghum (Gupta *et al.*, 2017)^[8].

It is an annual herbaceous cereal crop, growing to a height of 30-150 cm and maturation starts in 75-160 days. Leaves are narrow, grass-like and produce many tillers and nodal branches. The panicle consists of a group of digitally arranged spikes referred to as a finger. The inflorescence is a panicle with 4-19 finger-like spikes that takes after a clenched hand when developed, consequently the name finger millet (de Wet, 2006; Quattrocchi, 2006).

The seed pericarp is autonomous from the part and can be handily expelled from the seed coat. Finger millet is a staple food in numerous African and South Asian nations. It is additionally viewed as a supportive starvation crop as it is effectively put away for lean years. Finger millet is additionally used to make alcohol ("*arake*" or "*areki*" in Ethiopia) and brew, which yields results utilized for domesticated animals taking care of (FAO, 2012)^[5]. The pericarp is thin and papery. Its outer layer comprises isodiametric cell with wavy walls. The inner layer is less robust with deep coloured. Aleuronic cells are small and single layer. Endosperm is generally friable. The tannins are present in testa. The grains are round and oval in shape and light brown to reddish brown or dark brown colour.

Grain color: A wide range of grain colors (dark brown, light brown, ragi brown, reddish brown and white) were observed in finger millet germplasm collection introduced from Southern and Eastern Africa. Majority of the accessions were light brown (57.2%), followed by reddish brown (22.3%), dark brown (10.2%), ragi brown (8.4%) and white (1.9%).



Finger millet (*Mandua*) grains

Chemical composition and Nutritive value of finger millet

Finger millet grains has a high carbohydrate content of 81.5%, protein 9.8%, crude fiber 4.3% and mineral 2.7% which is comparable to other cereals like rice, wheat, maize and millet (Table 1). The crude fiber and mineral content of finger millet is remarkably higher than those of wheat (1.2% fibre, 1.5% minerals) and rice (0.2% fiber and 0.6 % minerals). About 80-85% of the finger millet starch is amylopectin and remaining (5-20%) is amylose. (Wankhede *et al.*, 1979)^[16].

The quality of protein is mainly its essential amino acids. Finger millet contains 44.7% essential amino acids (Mbithi *et al.*, 2000)^[11] of the amino acids. Among all of the cereals and millets, finger millet has the highest amount of calcium (344 mg %) and potassium (408 mg %). The total ash content

found in finger millet is nearly 1.7 to 4.13% which is higher than any other commonly consumed cereal grains. Finger millet is the good source of calcium and iron. Finger millet plays an important role in our diet as it is the richest source of calcium and iron, finger millet helps to overcome the calcium deficiency leading to bone and teeth disorder and iron deficiency leading to anemia.

Table 1: Composition of Finger millet (per 100g edible portion, 12% moisture content)

S. No.	Particulars	Finger millet (<i>Mandua</i>)
1.	Carbohydrate(g)	72.6
2.	Protein(g)	7.7
3.	Fat(g)	1.5
4.	Crude Fiber(g)	3.6
5.	Ash(g)	2.7
6.	Calcium(mg)	344
7.	Phosphorus (mg)	250
8.	Iron(mg)	6.3

*Source: USDA Nutrient database

The nutrient potential of the finger millet with maximum utilization is limited as by the presence of tannins, phenols, phytates and enzymes inhibitors. To reduced the effects of these antinutrients in finger millet several processing techniques are used like roasting of the grains, popping, malting, fermentation, etc. This processing technique helps to increase the bioavailability of certain specific minerals like calcium and iron. Finger millet is good for infants, elderly and pregnant women. It is also very good for lactating women as it helps in producing sufficient amount of breast milk for feeding their babies. Finger millet also helps to increase the level of haemoglobin and helps to fight against malnutrition and degenerative disease. (O.S.K.Reddy, 2017) [12].

Value added products from Finger millet

Finger millet can be used in a variety of ways in a substitution with other cereal grains and their flour such as rice and other starchy grains. Some of the commonly used processing technologies for finger millet are milling, malting, baking, popping, fermenting, roasting and combination of methods for product development. By these methods it will enhance the consumption of finger millet and makes it more valuable. Some of the value added products of finger millet are discussed below:

Mandua roti/chapati – The colour of the *ragi* roti are basically dark in colour as compared to other cereal grain *roti*. Fortification of finger millet in chapati not only improves the taste but also control the glucose level in diabetic patients.

Mandua Papad – Finger millet flour 15-20% (w/w) along with other basic ingredients like black gram flour, rice flour and spices has been prepared. The color of the *papad* is slightly light in color.

Fermented products – In India, fermented products like *dosa*, *idli* and *dhokla* are very popular as they are light and are common breakfast and evening snacks for the people. Finger millet is used as an essential ingredient which improves taste and enriches the value of the products.

Noodles/Mandua pasta – These are prepared by the different combination of noodles/ pasta, exclusively made from finger millet and wheat in the ratio of 1:1 and finger millet blended

with wheat and soy flour in the ratio of 5:4:1. Nowadays kids are demanding for pasta, the incorporation of finger millet flour with taste and nutritive values.

Extruded products – Extrusion technology is a good way of transforming ingredients into value added products. Finger millet flour blend with other legume flour ingredients in good proportion leads to a good balanced nutritional extruded food fortified with vitamin and minerals. Example- *kurkure*.

Bakery products – Baked products are very popular because of their availability, ready to eat, convince and having a good shelf life. Common bakery products include breads, cookies, pastries, muffins, cake, etc. Finger millet muffin have a familiar taste with other muffins and finger millet flour is incorporated which increase the nutritive value of muffins. Bread made from incorporation of *ragi* flour with wheat flour are very famous breakfast in Indian kitchen which increase the nutritional value and taste will remain as of other cereal bread.

Cake is a product obtained by baking a leavened and shortened batter containing flour, sugar, egg, milk, flavoring agents and other liquids. By the incorporation of finger millet flour it will enrich the taste and flavour of the cake and also increased the nutritive value of the cake.

Uses and Health Benefits of Finger Millet:

Finger millet straw is excellent source of animal fodder as it has 60% digestible nutrients. Finger millet is used as development of preventive drugs against osteoporosis. Finger Millet grains are used as flour for the preparation of cakes, pancakes, unleavened bread, porridge, pastry and other bakery products. Finger millet provides many health benefits like losing weight, lowering blood cholesterol, anemia, bone health, etc. The health benefits associated with high fiber foods are delayed nutrient absorption, increased faecal bulk, lowering of blood lipids, prevention of colon cancer, barrier to digestion, mobility of intestinal contents, increased faecal transit time and fermentability characteristics (Tharanathan and Mahadevamma, 2003) [13].

Fermented drink and beer is also made from the finger millet grains. *Ragi* is considered as especially wholesome food for diabetic patients. Finger millet helps in losing weight as it contain amino acid called Tryptophan which helps in lowering of appetite and helps in weight control. Fiber gives fullness feeling thus controlling the excessive food consumption (ICAR - Indian Institute of Millets Research, 2017) (IIMR).

1. Control blood sugar levels

The high fiber content slows down digestion, which keeps blood sugar levels down. It also has low glycemic index, making it ideal for snacking and protecting against blood sugar spikes.

2. Help in weight loss

Finger millet health benefits include weight management, which make it an important agent in various weight loss programs. The small grain contain large amounts of fiber and tryptophan, both reduce hunger pangs.

3. Reduce cholesterol

Finger millet has cholesterol reduction properties, which make it an ideal food for a healthy heart and circulatory

system. Finger millet contains three main amino acids- lecithin, methionine and isoleucine.

Medicine

The juice of the plant leaf is given to the women in childbirth and the plant is reported to be diaphoretic, diuretic and Vermifuge. Finger millet (*Mandua*) is a remedy for leprosy and liver disease. It also works in curing measles, pneumonia and small pox. It is also known for several health benefits such as anti-diabetic, anti tumerogenic, atherosclerogenic effects, antioxidant and antimicrobial properties. Finger millet do not contain gluten and highly recommend or advisable for celiac patients. (Chandrasekara and Sahidi 2010) [2].

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