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**Finger millet (*Eleusine coracana*):- Nutritional status,
health benefits and processing status - A review**

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Abstract

Millets are one of the major and important sources of food in the different parts of the world. India, China, some countries from Africa like Nigeria, Egypt, Niger and Burkina, are major millets producing countries. Some of the millets, which are growing in different parts of the world, are Finger Millet (*Eleusine coracana* (L.) Gaertn), little millet (*Panicum sumatrense*), foxtail millet (*Setaria italica*), Pearl millet (*Pennisetum glaucum*) and proso millet (*Panicum miliaceum* L.). Finger millet is one of the most important crops, which stands among the rice, oats and maize. It is a good source of dietary fiber, protein, calcium, minerals, phytates and some amino acids like riboflavin, thiamine, leucine and isoleucine etc. The presence of such important substances in the finger millet makes it nutritive and useful for health benefits. It has also anti diabetic, antiulcer and antioxidant properties, which makes it useful for patients. Finger millet has good grain quality, which makes it suitable for processing. It is used for milling, wetting, and dehulling operations as well as for fermentation, malting, glaking and roasting purposes. Finger millet can also be used as a substitute of rice in human feeding. In order to know about the significance of nutritional status, health benefits and processing status of finger millet, study of different characteristics of nutritional status as well as health properties, processing properties is required. The future of finger millet is really bright due to different properties. Finger millet and other millets are really good substitute crops in comparison to paddy, wheat, maize, oats and barley.

Keywords: Millets, Finger Millet, anti-diabetic, antiulcer, antioxidant.

Introduction

Finger millet (*Eleusine coracana*) is one of the most important species among the other millets, which includes pearl millet (*Pennisetum glaucum*), foxtail millet (*Setaria italica*), kodo millet (*Paspalum scrobiculatum* L.), bahiagrass (*Paspalum notatum*), little millet (*Panicum sumatrense*), proso millet (*Panicum miliaceum* L.), barnyard millet (*Echinochola crusgalli*). Finger Millet is largely grown in different parts of the world like India, Africa, Ceylon, Malaysia, china and Japan. It is also known as Mandua or Ragi in India.

This crop was originated in Africa from where it was domesticated to Asian regions around 5000 BC. Finger millet has two major cultivated species, *Eleusine indica*, which is a diploid species contains $2n = 2x = 18$ chromosome number and *Eleusine corana* and *Eleusine africana* are tetraploid species, containing $2n = 4x = 36$ chromosome number.

Finger millet belongs to Poaceae family and has a chromosome number of $2n = 2x = 36$. It is an annual herbaceous plant, which contains rich amounts of protein, calcium, fiber and energy as compared to other traditional crop like paddy, wheat, oat and sorghum. The seeds of finger millet are rich in dietary fiber, iron, essential amino acids (riboflavin, thiamine, leucine, isoleucine and trypsin inhibitory factors). Finger millet also has many medicinal properties like hypoglycemic properties, hypocholesterolemic and anti-ulcerative effects (Chethan S, Malleshi NG, 2007) [3]. Finger millet has also antioxidant properties.

Finger millet is cultivated up to an altitude of 2100 meter above the sea level. In India, It was grown in over an area of 1.19 million hectare with a production of 1.98 million tones with the average productivity of 1661 kg /ha in 2017. Karnataka leads the chart with 56.21 and 59.52% of area and production of finger millet, which is followed by Tamil Nadu (9.94% and 18.27%), Uttarakhand (9.40% and 7.76%) and Maharashtra (10.56% and 7.16%) (indiastat.com) [6]

Finger millet usually comes after sorghum, pearl millet and foxtail millet in terms of

importance. This is the crop which can be cultivated in different agro climatic zones. The most cultivated zones are Africa and Asia, especially South Asian region, which includes India and Cxhina. Finger millet is an important cereal crop but still underutilized in different parts of the world. But it is well resistant against the insects and diseases. It is also capable of growing in places with less irrigation facilities. Finger millet has a great yield potential. This crop has a high resistance to water logging and drought conditions. Finger millet has a great future prospect. Millets are capable to replace the traditional cereals. There is a great potential to process finger millet into different food products and byproducts. The grains of finger millet can be used for making flour, which can be used for making chappatis. Finger Millet does not contain gluten content, and hence can also be suggested to abdominal patients for consumption.

This review will emphasize on the importance of millets. In this review, vast information about the nutritional status, health status, processing status and future prospects have been summarized.

1. Nutritional Status: - Finger millet is one of the best sources of different nutrient contents which are necessary for human consumption. It is widely rich in dietary fiber, calcium, protein content, carbohydrates, minerals content, phytates and some phenolic compounds (Amadou *et al.* 2013) [2]. Table 1 represents the amount of different nutrient contents in finger millet and comparing it with other millets.

Table 1 suggests that finger millet have a good amount of dietary fiber (19.1g/100g), which is very useful content for human digestion. Besides this, Finger millet has a high amount of starch like other cereals. The important thing is that finger millet has lowest amount of fat content, which makes it a dietary source of food. Finger millet have 7 – 8 % protein, 1–2% ether contents, 70% carbohydrates, almost 20 % dietary fiber and 2.5–3.5% minerals. (Chethan S, Malleshi NG, 2007) [3].

Finger millet also have good amount of different minerals like calcium, phosphorus, potassium, sodium etc. Table 2 is showing the different concentration of minerals among the different minerals.

Table 2 suggests that finger millet have a great amount of calcium as compared to other millets, even higher than most of the cereals too (344 mg/100g). It shows the immense nutritional significance of finger millet.

Millets also have a good amount of vitamin B too. Vitamin B1, B2 and B3 are widely found in different millets. Finger millet has a good amount of all types of vitamin B. Table 3 given below shows the amount of different vitamins among the different millets.

Millets have significant amounts of essential amino acids specially those amino acids which contain Sulphur. Finger millet have a considerable amount of Arginine (0.300g), Histidine (0.130 g), Lysine (0.220 g), Tryptophan (0.100 g), Phenylalanine (0.310 g), Tyrosine (0.220 g) and Methionine (0.210 g) (USDA Database) [4].

Millets also have phytates (0.48%), tannins (0.61%), phenolic compounds (0.3–3%) and trypsin, which are inhibitory factors and responsible for its vast health benefits. These components which have anti-diabetic, anti-diarrheal, antiulcer, anti-inflammatory, antioxidant and antimicrobial properties prove the health benefits of finger millet.

2. Health benefits: - Health benefits can be classified on the basis of presence of different components inside the finger millet. Finger millet has polyphenols, gluten free, tannis and phytates, which makes it an important crop. Due to the presence of polyphenols, many beneficial properties are added to this crop such as antimicrobial, antioxidant and anti-diabetic properties. Fermented finger millet extract suppress the growth of *Salomonella* sp. (Antony *et al.*, 1998) [6]. The Finger millet grain is very rich in phyto chemicals, which includes phytic acid, responsible for lower cholesterol, and phytate, which reduces the chances of developing cancer. The consumption of finger millet is also highly beneficial for cardiac patients. Finger millet consumption controls blood sugar level. It improves antioxidant status of human beings leading to enhanced healing process of skin wounds in diabetic patients [7]. The balanced consumption of finger millet prevents mucosal ulceration in people. It also improves the hemoglobin status in the blood of children because it is a plant source of natural iron. Tannin content, which is present in the outer layer of finger millets act as a physical barrier to many kinds of fungal invasions. So it gives a great power to grain to resist any kind of fungal attack. High dietary fiber content and phenolic content makes this crop a very useful resource of food for diabetic patients. Finger millet also has low glycemic index (GI), which is responsible to prevent food thirst in night period. This glycemic index also helps in maintaining blood sugar ratio of sugar patients.

According to Ayur Veda, this crop helps in weight loss, making it useful for vegetarians. Its consumption provides mental relaxation to those people who are suffering with stress problems. It has lower triglyceroids, which ensures reduced blood pressure. It also has anti ageing properties that promotes reverting of skin aging. Consumption of finger millet is useful for pregnant women because it improves lactation. Its consumption promotes the growth of child. It is gluten free hence it lowers the risk of gall stones.

3. Processing status: - Finger millet is generally called as coarse grain and has a very good grain quality making it suitable for processing. The grains of finger millet can be processed for different operations such as includes milling and dehulling which are primary operations and other operations such as fermentation, glaking, roasting and malting etc which are secondary.

3.1 Milling: - It is primary processing stage for the grain of finger millet, in which the grain is pulverized in the form of flour for making different food products. It is generally done by some conventional or modern equipment like stone mill, ball mill, hammer mill or burr mill etc. At the household level, milling should be done by hand grinding. Before milling, the finger millet grains should be cleaned to separate any kind of mixture or foreign material like stones, chaffs etc. After cleaning, seeds should be passed through friction mills, so that glumes separate from it. After it, the grain can be used for pulverizing. Fine flour and coarse flour can be prepared based upon the requirement. The fine flour can be used for making Chapattis (millet bread), while the coarse flour of finger millet can be used for making Laddus (sweet balls). Apart from these, flour can be used for preparing some traditional dishes like mudde of Karnataka and pez of Bastar

(Patel and Verma, 2015) [8]. In recent years, the consumption of dishes from finger millet and other millets has seen rise in urban areas, because of awareness about the nutritional quality and health benefits. Industries are also getting attracted towards millets. Many companies are manufacturing their millet products. Table no 4 given below is showing the different products made up by the millets:-

3.2 Debranning: - This is the new process which is evolved for the processing of finger millet and is also known as decortication. This process involves hydration, steaming and drying of the grain (Gull *et al.*, 2016) [5]. Debranned finger millet can be cooked like rice.

3.3 Malting: - It is one of the most important process in which the seeds are soaked in the water for some time to make them hydrated. It will give rise to sprouting in the seeds. These sprouts should be dry in kiln. After that rootlets are manually removed from the grain. Such operation affects the malt quality. During soaking of seeds, germination takes place thereby giving rise to sprouting in the seeds which promotes the development of hydrolitic enzymes (Sakkamma *et al.* 2018) [10]. Hydrolitic enzymes increase the nutritional quality of the seed. This process is generally used for manufacturing many health products and beverages. This process generally enhances the quality of protein, carbohydrates and minerals like Ca, P, Na, Mg etc.

Table 1: Comparison of Nutritional Composition in different types of millets

Millets	Protein (%)	Fat (%)	Starch (%)	Ash (%)	Crude Fiber (%)	Dietary Fiber/100g	Carbohydrates (g)
Finger Millet	7.3	1.3	59.0	3	3.6	19.1	72.6
Pearl Millet	14.5	5.1	60.5	2	2	7.1	67.5
Proso Millet	11	3.5	56.1	3.6	9	8.5	70.4
Foxtail Millet	11.7	3.9	59.1	3	7	19.11	60.9
Kodo Millet	8.3	1.4	72.0	3.6	9	37.8	65.9
Barnyard Millet	6.2	4.8	60.3	4	13.6	13.0	65.5

Source: - Saldivar S (2003) [9]

Table 2: Comparison of mineral concentration among the millet group

	Ca (%)	P (%)	K (%)	Na (%)	Mg (%)	Fe (%)	Mn (%)	Zn (%)
Finger Millet	0.33	0.24	0.43	0.02	0.11	46.0	7.5	15.0
Pearl Millet	0.01	0.35	0.44	0.01	0.13	74.9	18.0	29.5
Proso Millet	0.01	0.15	0.21	0.01	0.12	33.1	18.1	18.1
Foxtail Millet	0.01	0.31	0.27	0.01	0.13	32.6	21.9	21.9
Kodo Millet	0.01	0.32	0.17	0.01	0.13	7.0	-	-
Barnyard Millet	0.01	0.28	1.86	-	-	-	-	-

Source: Salvidar (2003) [9]

Table 3: Comparison of vitamin contents in different Millets

	Vitamin B1(Thiamine) (Mg/100g)	Vitamin B2 (Riboflavin) (Mg/100g)	Vitamin B3 (Nicotinic Acid) (Mg/100g)
Finger Millet	0.48	0.12	0.30
Pearl Millet	0.38	0.22	2.70
Proso Millet	0.63	0.22	1.32
Foxtail Millet	0.48	0.12	3.70
Kodo Millet	0.32	0.05	0.70
Barnyard Millet	0.33	0.10	4.2

Source: Salvidar (2003) [9] and USDA database [4]

Table No 4: Different dishes of Millets

S. N.	Millets	Dishes
1	Pearl Millet	Onion muthias, Uppma, Roti, Pakoda, Halwa, Pesarattu, Thalipeeth, Khichidi,
2.	Finger millet	chapati, Laddu, Muruku, Mudde, Kheer, Upma, cake etc.
3	Foxtail Millet	Kheer, Mango Rice, Cutlet, Coconut rice, Biryani, Bread, Bisebelle Baat,
4	Kodo Millet	Upma, Methi rice, Pulao, Coriander rice, Payasam, Adai,
5	Barnyard Millet	Cutlet, Maheri, Pudina rice, Payasam, Pizza,
6	Proso Millet	Rawa Idli, Khaja, Burfi, Samsa, Payasam
7	Little Millet	Payasam, Curd Rice, Mushroom Biryani, Pudina rice, tomato rice, Roti, Paniyaram, Bhel, Patties, Khakra, Idli,

Source: - IIMR, Hyderabad [7]

Conclusion

From this review, it can be concluded that finger millet has a bright future prospects. Finger millet has a high nutritive value which makes it a good source of nutrients and energy. Finger millet and other millets can be a good replacement of traditional cereals like paddy, wheat and barley etc. Finger millet is rich in calcium content which is useful for bone formation in children. It is a solution for the diet of diabetic

patients. Finger millet is rich in Thiamine, Riboflavin, Potassium, Zinc, Magnesium, and Manganese minerals, which are required in treatment of diabetic patients. These contents occur in finger millet in natural form. It is a solution for those patients, who are suffering from high body mass index. Finger millet also has a great processing value. Different food products, which are prepared from finger millet, are presently used in defense services and normal

consumption by the people. Byproducts of finger millet are also getting attention in industries.

References

1. Amadou I, Gounga EM, Le Guo-Wei. Millets: Nutritional composition, some health benefits and processing - A review, Emir. J Food Agric. 2013; 25(7):501-508.
2. Antony U, Moses LG, Chandra TS. Inhibition of *Salmonella typhimurium* and *Escherichia coli* by fermented flour of finger millet (*Eleusine coracana*), World J Microbiol Biotechnol. 1998; 14:883-886.
3. Chethan S, Malleshi NG. Finger millet polyphenols: optimization of extraction and the effect of pH on their stability. Food Chem. 2007; 105:862-870.
4. <http://www.fao.org.in> (USDA Database)
5. Gull A, Gulzar Ahmad N, Prasad K, Kumar P, Technological, Processing and Nutritional approach of Finger Millet (*Eleusine coracana*) - A Mini Review. J Food Process Technol. 2016; 7:593.
6. <http://www.indiastat.com>
7. <http://www.millets.res.in> (IIMR)
8. Patel S, Verma Veenu. Ways for Better Utilization of Finger Millet through Processing and Value Addition and Enhance Nutritional Security among Tribals., Global Journal of Medical Research: Nutrition & Food Science. 2015; 15(1):22-29
9. Saldivar S. Cereals: dietary importance. Encyclopedia of Food Sciences and Nutrition. 2003, 1027-1033.
10. Sakamma S, Umesh BK, Girish RM, Ravi CS, Satish kumar M, Bellunndagi V. Finger Millet (*Eleusine coracana* L. Gaertn.) Production System: Status, Potential, Constraints and Implications for Improving Small Farmer's Welfare., Journal of Agricultural Science. 2018; 10(1):162-179.