



Nutritional security and value added products from finger millets (ragi)

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ABSTRACT

The present paper describes some of the important facts relating to nutritional properties of millets with few examples for their conversion into health and novel foods, which make their consumption acceptable to the common mass, particularly the urban population. Millets are the oldest foods known to humans and possibly the first cereal grain to be used for domestic purposes. Millets can be stored for many years without any substantial changes in properties under normal room temperature. Millet contains more fiber, minerals and vitamins, which are normally deficient in the Indian diet and has eight times more calcium than other cereals. Millets are generally converted to flour for the preparation of various food items. They can also be exploited for their nutritional benefits and value added nutritive health foods. Millet contains high amount of calcium (344 mg 100 g⁻¹ in case of ragi millet). This makes ragi based processed food products like malt, biscuits and cakes more suited for the growing children, expectant mothers and elderly who need more calcium and iron in their diet. Millets are also considered to be an ideal food for diabetics because of slow release of sugars to the body. Their high fiber content also checks constipation, high blood cholesterol and intestinal cancer.

Keywords: Cereal grains; Millet, Nutritional properties, Value added products and Processing.

INTRODUCTION

Millet is a collective term for the grain of a large number of small-seeded grasses that are grown as cereal crops. Millets grow well in arid and semi-arid environments, requiring less water than any other grain. While developing countries in Asia still produce the majority of the world's millets, Africa is becoming the hub of production. Millet production in Africa has risen 25% since the early 1970s, and its place in domestic diets there is growing steadily. Today millet ranks as the sixth most important grain in the world, sustains one third of the world's population and is a significant part of the diet in northern China, Japan, Manchuria and various areas of the former Soviet Union, Africa, India, and Egypt. Millets are the basic cereals in India and eaten by a large section of the poor community residing in the areas where these millets are grown. Minor cereals consisting of maize, sorghum, pearl millet, finger millet and other millets constitute a little less than 25 per cent of the total food grain production in India. However, they are generally regarded as coarse grains, their potential for augmenting the grain supplies and bridging the protein gap is increasingly realized in the countries like India, America and other European countries [1]. Besides being staple

foods, they are also the raw materials for the preparation of various food including fast foods and industrial products. The nutritional composition of small millets compares well with the other cereals and some of them are even nutritionally superior to rice and wheat.

Bastar in Chhattisgarh is a tribal population dominated region. Next to rice kodo, finger and little millets are the second major crops grown in the region. The topography and soil condition of large area of Bastar is such other remunerative crops are not grown and also difficult. Millets are an important ingredient of household food security and nutrition particularly in draught years as the millets are harvested well even in the substantial low rains. Millets play very specific role in human nutrition because of their multiple qualities. They have high content of calcium and are suitable for diabetic patients [2] due to low glycemic index. Millet is gluten-free and safe to eat for those who suffer from Celiac disease or for those who experience gluten sensitivity. It is a healthy alternative to gluten containing grains such as wheat. Millet is most recognized nutritionally for being a good source of the minerals namely, magnesium, manganese and phosphorus. Research has linked magnesium to a reduced risk for heart attack and phosphorus is important for the development of body tissue and energy metabolism. Since still millets are grown by almost all the tribal farmers for mostly their own consumption, it is important to develop these crops and relook issues and strategies related with production, utilization/ collection, processing-value addition and marketing for sustainable development of tribal community. However, current research results have been established that this crop can prove as boon for food, nutritional security and good for health to tribal region. This manuscript outlines some of the key issues and possible interventions that could help in the enhancement of millet consumption and thereby millet production in Bastar.

MATERIALS AND METHODS

In the present work two basic millets (*kodo* and *ragi*) of Chhattisgarh were considered for study. Samples of *kodo* and *ragi* were obtained from the local market. Samples were cleaned well before taking any experimental work. In order to determine the nutritional characteristics of these millets standard methods [3,4] described below were followed.

Moisture content: Moisture content was determined using oven following the method described in AOAC [5].

Protein: Nitrogen content was determined following the Micro Kjeldal method using Gerhardt Digestion and Distillation (model VAP-30), W Germany. Nitrogen was converted into protein by multiplying protein factor 6.25 ($N \times 6.25$). Defatted sample was taken for the estimation.

Total Carbohydrate: Carbohydrate determination was done [6]. It is hydrolyzed into simple sugars using dilute hydrochloric acid. In hot acidic medium, glucose is dehydrated to form hydroxy methyl furfural which gives green color with anthrone reagent (1mg ml^{-1}) at 630 nm. Glucose ($1 \times 10^{-2} \text{g ml}^{-1}$) is used as standard.

Fat: It is determined by solvent extraction method through Soxhlet Apparatus using petroleum ether as solvent.

Iron: It is determined by AAS method.

Magnesium: It is determined by following Agte, et al. method[7].

Calcium: It is determined through Flame Photometric method .

Phosphorus: Phosphorus is determined by Colorimetric method at 660 nm .

Crude fiber: Crude fiber consists mainly of cellulose and lignin (97%) plus some minerals. It can be estimated by treatment of sample first with acid and subsequently with alkali. The loss in weight gives the crude fiber content .

RESULTS AND DISCUSSION

Nutritional characteristics : The nutritional characteristics of the two millets are presented in Table 1. Table also gives the comparison of properties of these millets with two major cereals of the world, wheat and rice. From the table it is clearly seen that the *ragi* millet is nutritionally superior compared to other three crops. *Ragi* millet contains fiber, more mineral and more vitamins, which are normally deficient in Indian diet and has eight times more calcium than other cereals. It is comparable to rice with regard to protein (6-8%) and fat (1-2%) and is superior to rice and wheat with respect to mineral and micronutrient contents. The calcium, phosphorus and iron contents of the millets were analyzed as these three minerals are of nutritional importance in the diets of population who consume millet as staple food. It is a major source of dietary carbohydrates for a large section of society belonging to millet growing areas. In addition to these, millets contain few other micro-nutrient compounds such as lignin, manganese, niacin etc. which are also important for human diet. However, their determination could not be done due to non-availability of the facilities locally.

Table 1: Composition of *kodo* and *ragi* millets (per 100 g edible portion, 12% moisture content)

S. No.	Particulars	<i>Kodo</i> millet	<i>Ragi</i> millet	Wheat*	Rice*
1.	Carbohydrate (g)	66.6	72.6	71.2	78.2
2.	Protein (g)	9.8	7.7	11.8	6.8
3.	Fat (g)	1.3	1.5	1.5	0.5
4.	Crude fibre (g)	9.0	3.6	12.9	5.2
5.	Minerals (g)	2.6	2.7	1.5	0.6
6.	Calcium (mg)	27	344	41	10
7.	Phosphorus (mg)	188	250	306	160
8.	Iron (mg)	5.0	6.3	3.9	0.5
9.	Manganese (mg)	3.3	3.5	13.3	1.0
10.	Magnesium (mg)	228	130	120	32

* Source : USDA Nutrient database

Effect of Millets on Health : Magnesium from millets not only help to reduce the severity of asthma and migraine attacks, but also helps to reduce high blood pressure, diabetic, heart disease, atherosclerosis and heart attack. Niacin has been used since ages to reduce high cholesterol levels in the human body. Phosphorus from millets is an important mineral for energy production and is an essential component of Adenosine Triphosphate (ATP) – the energy store of the body[8]. It also forms an essential part of nervous system and cell membranes. A cooked cup of millet provides 26.4% daily value for magnesium and 24% daily value for phosphorus required for an average human body. Magnesium from millets also helps to relax blood vessels, enhances nutrient delivery by improving the blood flow and maintains the blood pressure and thus further protects the cardiovascular system. Lignin present in millets is converted to mammalian lignins by the healthy gut micro flora in our body which is thought to protect against breast cancer as well as heart diseases. The insoluble fiber from millets helps in gallstones prevention. A study proved that including insoluble fiber in diet lowers the risk of getting gallstones by 17% compared to women whose diet lack in fiber. This gallstones protection from fiber is dose related, with every 5 g increase in insoluble fiber the risk drops by 10%. Millets helps to lower blood glucose levels and improves insulin response. Besides the magnesium present in millets is a co-factor in various enzymes involved in the secretion of insulin and metabolism of glucose in the body. Postmenopausal women with signs of cardiovascular disease like high blood pressure, increased cholesterol and obesity can benefit from eating whole grains especially millets by eating them six diets in a week regularly. Whole grains like millet may have health promoting effects equal to or even in higher amount than fruits and vegetables and have a protective effect against insulin resistance, heart diseases, diabetes, ischemic stroke, obesity, breast cancer, childhood asthma and premature death [9].Finger millet is a humble grain with low glycemic index which makes it more suitable for diabetic patients .They maintain the sugar level of diabetic patient. Additionally, it is a rich source of calcium (344 mg 100g⁻¹) and helps in supplementing the calcium in human body.

APPLICATIONS

Primary Processing and Value Addition: Among the food grains, millets are the cheapest and widely available source of energy and their intake is the highest among the poor income families. Traditional preparations of millet foods are common among tribals in the millet growing areas. The habit of millet consumption in tribes is since time unmemorable but the nutritional facts are not popular among the common mass. Unawareness of nutritional facts of these millets restricted its consumption in non-millet growing areas particularly the urban population. Some of the millet based preparations are suggested in the following paragraphs to make the millet foods acceptable to all depending on the food habits of the area or region. The ingredients other than millets can be suitably selected as per the taste of the target groups or the area. From the results it is clearly seen that millets are highly nutritious and have vast medicinal importance, though it is not popular to common mass. To enhance the consumption of millets in common mass the value addition of millets to convert them in acceptable form could be one of the solutions. In addition to these, value addition in millets has great potential in increasing the profitability in cultivation as these millets have remained as non-profitable crops due to lesser known in different segments of the society.

Composite Flour : The concept of multi-grain flour/composite flour is not new to the mankind. Mixing of two-three types of grains or grain and pulses has been in practice since long ago depending upon the availability of such commodities locally or the food habits, but in such cases, the understanding of nutritional security is not necessarily linked. Multi-grain flour by combining wheat and finger millet in the ratio of 7:3 (wheat: finger millet) is one of the

simple semi-finished products suitable for making chapatti (roti), as no Indian meal is complete without Indian style bread or roti. In the proposed blend, though the gluten content is reduced significantly the making of chapatti while flatter is not affected. However, the color of the chapatti turns to slightly dark. Fortification of finger millet in chapattis not only improves the taste but also helpful in controlling glucose levels in diabetic patients very efficiently. The bulkiness of the fibers and the slower digestion rate makes us feel fuller on, fewer calories and therefore may help to prevent from eating excess calories. Its high fiber content is further helpful to the individuals having the problem of constipation. *Ragi* is also considered to be ideal food for diabetics individual due to its lower sugar content and slow release of glucose/sugar in the body [10,11]. Its processing is followed by washing, grinding, screening and packaging method.

Ragi Malt Powder : Traditionally the millet malt is utilized for infant feeding purpose and also to prepare beverages either with milk of Luke warm water with the addition of sugar since pretty old times. Finger millet being good malting characteristics, its malting is popular in the area of cultivation particularly in Karnataka and part of Tamilnadu. Malting of finger millet improves its digestibility, sensory and nutritional quality as well as pronounced effect in lowering the antinutrients [12]. Finger millet has some of the inherent qualities which make it superior compare to other cereals and also qualify for malting and preparation of malted foods. It is resistant to fungal infection and elaboration of alpha and beta amylase during germination and during roasting/ kilning a desirable aroma as well as is developed which makes it an ideal grain for malt foods. In addition to these, finger millet is a good source of sulphur amino acids and calcium. An example of composite malt flour (malted weaning food) preparation combining finger millet, green gram and Bengal gram is presented in this paper. This blend is nutritional in addition to rich source of protein and calcium. The malted weaning food is mixed with powdered sugar, milk powder or whole milk along with flavoring agents to make as milk based beverage. This preparation is a good source of nutrition and suitable for all the age groups. This preparation is popularly known as '*ragi* malt' and can be used as health drink or energy drink. Now-a-days about 5% *ragi* malt is invariably blended with the energy food to improve its texture and mouth feel.

CONCLUSIONS

In conclusion it can be stated that *kodo* and finger millets staple food in different pockets of India and abroad are also important from the nutritional point of view. Apart from meeting the food requirements of the population of the cultivation catchment, they have sound nutritional and medicinal values. These properties however have not been focused to the residents of the non-millet growing regions. Though the consumption patterns of these millets are very specific and continue to remain regional specific, there popularization in the broader range is essential. Specific design of foods acceptable to the population of the region specific and group specific can help in promoting the millet consumption and thereby nutritional intake of the consumers significantly. This will also contribute to the food basket of the nation in addressing the food security.

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