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Nutritional analysis of ragi millet and buckwheat millet

Vindhyvasni and Alka Gupta

Abstract
Finger millet (*Eleusine coracana*) also known as ragi, nachni or Nagli is one of the important millets in India. The composite flour of ragi and wheat appears not only to improve the nutritional quality but promote the health benefits. It is also known for several health benefits such as anti-diabetic, anti-tumerogenic, atherosclerogenic effects, antioxidant, which are mainly attributed due to its polyphenol and dietary fiber contents. Being indigenous minor millet it is used in the preparation of various foods both in natural and malted forms. Grains of this millet are converted into flours for preparation of products like porridge, puddings, pancakes, biscuits, roti, bread, noodles, and other snacks. Besides this it is also used as a nourishing food for infants when malted and is regarded as wholesome food for diabetic's patients. Buckwheat belongs to a group of foods commonly called pseudo cereals. Buckwheat is processed into groats flour and noodles, or used in buckwheat tea. As The proximate composition, fatty acid analysis, total phenolic content and extraction yield were carried out. The antioxidant efficacies of DFMB extract were tested using 1,1-diphenyl-2-picrylhydrazyl (DPPH), 2,2-azinobis-3-ethylbenzothiazoline-6-sulfonic acid (ABTS), superoxide radical and reducing power. Iron rich flour was prepared by incorporating Ragi flour, Buckwheat flour. The dried samples were fine powder for further chemical evaluation. Moisture, protein, fat crude fiber, ash, protocols as mentioned in AOAC (2007) methods. While carbohydrate content of the flour was calculated by subtracting the moisture, protein, ash, fiber and fat values from 100 g.

Keywords: Finger millet, buckwheat, proximate composition, antioxidants, and DPPH, etc

Introduction
Finger millet is one of the most important food crops of the semiarid tropics, originated from India, and is now planted all over the world. It plays a very important role in the agriculture and food of many developing countries because of its ability to grow under adverse heat and limited rainfall conditions. It was reported that finger millet and buckwheat has many nutritious and medical functions. Millets are non-glutinous, like buckwheat and quinoa, and it is not an acid forming food, so it is soothing and easy to digest. Polyphenols are natural occurring substances and the most abundant antioxidants found in foods such as fruits, wine, tea, and cereals grains. Their total dietary intake could be as high as 1 g/day, which is much higher than that any polyphenols and known dietary antioxidants. Previous studies have shown that some phenolic compounds exhibit a wide range of pharmacological and medicinal properties, including anti inflammatory, anti-carcinogenic, vasodilatory actions, which have been mostly attributed to their free radical scavenging, metal chelating, and antioxidant activities. They may play an important role in human health, reducing the risk of various degenerative diseases, such as cardiovascular diseases, osteoporosis, and cancer. Proximate analysis, nutritional, and functionality of millets were widely studied. However, information on the phenolic antioxidant activity of foxtail millet bran is yet to be studied. Therefore, the objective of this research was to present the proximate composition, total phenolic content, and extraction yield of foxtail millet bran. During all steps of bread making, complex chemical, biochemical and physical transformations occur, which affect and are affected by the various flour constituents. The article focused also on the in vitro antioxidant assays, including reducing power of defatted foxtail millet bran extracts.

Material and Methods
Procurement of Raw Materials
Millets such as finger millet and buckwheat millets and other ingredients were procured from local market of prayagraj district.

Preparation of millet flour

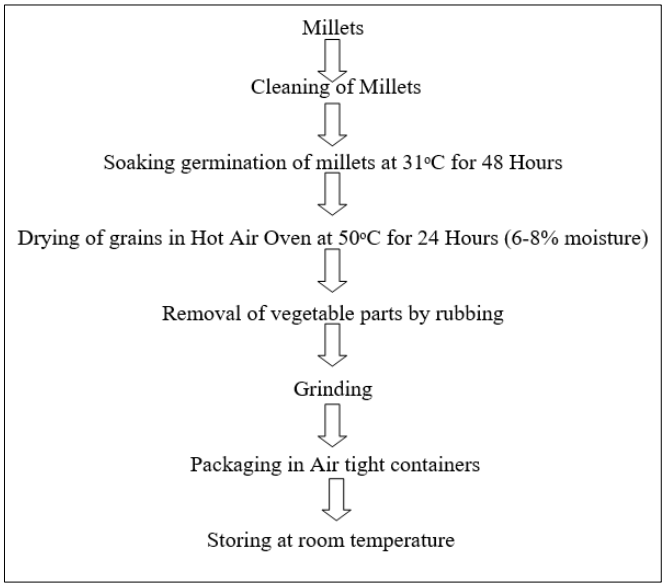
The small millets namely finger millet (*Local name- Ragi, and Botanical name- Eleusine Coracana*) and buckwheat (*Local name- Buckwheat, and Botanical name-Fagopyrum Esculentum*) were selected for the study based on their popularity, nutritional characteristics and other specific characteristics and manually cleaned thoroughly to remove the dust particles and dirt, and mud clay and unwanted particles.

Chemical analysis

The dried samples were fine powder for further chemical evaluation. Moisture, protein, fat crude fiber, ash, protocols as mentioned in AOAC (2007) methods. While carbohydrate content of the flour was calculated by subtracting the moisture, protein, ash, fiber and fat values from 100g. The protein determinitation, nitrogen content was measured by micro-Kjeldahl method and converted to prptein value using factor 6.25.

Processing of identified Ragi millet and Buckwheat millet

The grains were cleaned to remove the dust, dirt, chaff and stones by the method of sieving. For malting process, selected grains were soaked and germinated to increase micronutrient content and to decrease antinutritonal factors present. The soaking period (16 hours), germination temperature (31°C) and germination period (48 hours) was opted for malting. The malted millets and wheat were then dried in hot air oven at 50°C for 24 hours. Vegetative parts were removed by rubbing and the millets and wheat were ground to powder (Tripathi *et al.* 2013). The flour thus obtained was packed in food grade virgin plastic air tight containers which have excellent chemical resistance, good water vapors barrier and great impact resistance. The containers were stored at room temperature.



***Source*:** Tripathi *et al.* 2013

Preparation of the flour powder from the malted buckwheat millet, malted Ragi millet

The flour was developed from malted buckwheat millet, malted Ragi millet by mixing these flours in different proportions after random trials based on kneading.

Table 1: Percentage of prepared millet flour

Composition of millet flour	
Flour type	**Amount**
Malted Ragi	50g
Malted Buck Wheat	50g
Total	100g

Result and Discussion

Table 2: Nutritional composition of the selected millets-

Millets	Nutrients								
	Moisture (%)	**Ash (g)**	**Protein (g)**	**Fat (g)**	**Fiber (g)**	**Iron (mg)**	**Calcium (mg)**	**CHO (g)**	**Energy (Kcal)**
Finger Millet (*Eleusine Coracana*)	6.01±0.01	1.80±0.15	10.5±0.50	1.2±0.01	4.0±0.05	6.01±0.04	257.66±0.03	78.43±1.65	312±5.10
Buckwheat (*Fagopyrumsculentum*)	8.56±0.62	2.34±0.03	11.34±0.05	2.02±0.42	9.35±1.18	16.83±2.68	203.80±0.57	66.35±1.48	329±8.11

Results are mean ±SD of three determinations

Moisture

Moisture content of finger millet and buckwheat were ranged between 6.01 ± 0.01 and 8.56 ± 0.62 g per 100 g respectively. Similar amount of moisture in Ragi was also reported. Low moisture content in food samples enhance storage ability of food products, while food spoilage is inevitable in high moisture content foods as they support microbial growth.

Ash

Ash content of finger millet flour and buckwheat were found to be 18.38 ± 0.28 7.69 ± 0.13 g per 100 g respectively. The ash content is an indication of a crude mineral elements content of food. The ash content in this study agrees with the findings. Protein Finger millet 10.5 ± 0.50 and buckwheat 11.34 ± 0.05 g per 100 g as indicated in table 4.2. As Millets are rich in amino acids like methionine and cysteine which are usually a deficit in pulses, a judicious combination of millets like little millet and pulses would provide proteins that are of high value both in terms of quality and quantity. Owing to these factors millet would help to combat protein deficiency disorders effectively and economically.

Fat: Fat content was found to be 1.2 ± 0.01 g per 100 in Finger millet which is slightly lesser than Buckwheat (2.02 ± 0.42 g per 100g).Fat in ragi is consist of oleic acid, linoleic acid as reported by Singh and Sarita (2016). Buckwheat grains contain from 1.5% to 4% of total lipids, but the content of raw fat in buckwheat flour exceeds 3% (Karolina CHRISTA and Maria SORAL-ŚMIETANA, 2008). The fatty acid profile showed the total amount of saturated fatty acids present is 17.9–21.6% while unsaturated fatty acids content is 78–82%.

Fiber

The fiber content of finger millet (10.08 ± 0.05g/100g) was slightly higher in comparison to buckwheat (9.35 ± 1.18 g per 100 g). According to the Bansal and Kaur (2018) studied that 100g of raw ragi millet has 14.8±1.10 crude fibre. Dietary

fibre e has a large number of positive health implication like maintains GI tract function, lower blood sugars and cholesterol thus reducing the risk and complications of diabetes and cardiovascular diseases. Dietary fibre also helps improve immune functioning by increasing the proliferation of B- cells of the immune system.

Iron

The iron content of finger millet (18.01 ± 0.04mg/100g) was observed higher than buckwheat (16.83 ± 2.68 mg per 100g). Mineral content of millets is quite comparable to other cereals such as sorghum, but the content of calcium and manganese was found to be very high. The total mineral matter or ash content was higher in common, little, foxtail, kodo, and barnyard millets than most commonly consumed cereal grains including sorghum. Dassenko observed significant losses of calcium, magnesium, and sodium but not of iron and potassium on milling pearl millet to flour with an extraction rate of 67%.

Calcium

The calcium content buckwheat was found to be 203.80 ± 0.57 mg per 100 g and that of finger millet was 257.66 ± 0.03. Finger millet was shown to be rich in calcium with approximately 350 mg/100 g. The calcium content of ragi (344mg) is higher than oats (54mg) according to the Sreedhar and shaji (2017). Buckwheat may be an important nutritional source of such microelements as iron (Fe), manganese (Mn), and zinc (Zn). Calcium is essential for bone and teeth formation and development, blood clotting and for normal functioning of heart, nervous system and muscles. Calcium deficiency can lead to rickets, Osteomalacia and tooth decay.

CHO

Thecarbohydrate content was found high in finger millet 78.43 ± 1.65 g/100g and low in buckwheat flour 66.35 ± 1.48 g per 100 g. According to the (Mathanghi&Sudha, 2012) in the CHO value of ragi ranged between 5.52 g/ 100g and buckwheat ranged 71.5g /100g.

Energy

The lowest energy content was found in Finger millet (312 ± 5.10 Kcal/100g) whereas Buckwheat (329 ± 8.11 Kcal per 100g) had the highest amount of energy.

Table 3: Antioxidant Activity of Selected millets

Antioxidant activity	Finger Millet (*Eleusine coracana*)	Buckwheat (*Fagopyrumsculentum*)
DPPH (Free radical scavenging activity) (%)	38.95±0.14	23.80±0.10

* Results are mean ±SD of three determinations.

Shows the Antioxidant activity of selected millets. The DPPH radical scavenging activity ranged from23.80±0.10 to 38.95±0.14 percent. Finger millet flour possessed the highest DPPH radical scavenging activity (38.95±0.14 per cent) followed by Buckwheat flour (23.80±0.10 per cent). Millet could also be enriched with antioxidants (such as peptides) via fermentation and germination.

Hejazi et *al.* (2016) found that germination slightly decreased the phenol content, DPPH, and ABTS activity of finger millet by as much as 25%. Malting induced dynamic alterations in the phenolic acid content of finger millet and affected its antioxidant activity. The presence of phyto chemicals like flavonoids, phenolic compounds and other antioxidants proves minor millets to be a good nutra ceutical food when consumed regularly can protect us from the chronic complications like Diabetes mellitus, cardiovascular diseases and cancer.

Conclusion

Now it is an established fact that the whole world is facing many health challenges because of fiber-less foods. That is for breakfast, lunch and dinner and removing refined foods like rice, wheat, refined flours, processed meats, refined oils, packed & ready to consume -kind of foods and milk. Millets have multiple health benefits to include these ancient prized grains-like seed in our regular diet. Most of the civilized people have not even heard about millets and much less understand the benefits of millet nutrition. And yet, millet is one of the best-kept secrets of our ancient ancestors. Traced back to its origin in India, millets have been used throughout the ages and across many countries. Their good protein content which helps in aneamic women and development, with calcium content which helps in the bone development in both children and geriatric people, with good iron content helps in ailing of anaemia and with gluten free characteristics helps the celiac disease patients and helps in gluten insensitivity. Phytosterols and policosanols are cardio-protective compounds present in the waxy layers of the millet. If these millets are ground into flour without de-hulling, then one can have multiple benefits.

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