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Antioxidant Activity of Value Added Ready to Eat Millet Based Food Products

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Abstract: ***Nutritionally the millets are good sources especially in micronutrients and fiber. Health benefits of millets are known from historic days. Millets are nutritious food and they are rich in phytochemicals, fiber and minerals. Antioxidant activity was highest in sports food mix compared to flakes and cookies. Bran fractions obtained as milling by-products may be used as a natural source of antioxidants and as a value-added product in the preparation of functional food ingredients and/or for enrichment of certain products.***

Keywords: Antioxidant activity, sports food mix, millets, micronutrients, fiber and phytochemicals

1. Introduction

Nutritional well being is a sustainable force for health and maximization of human genetic potential. The nutritional status of a community has therefore been recognized as an important indicator of national development. Little millet (*Panicumsumatrense*) is one of the important minor cereals grown extensively in the tropics and a staple food for the low income groups in some countries of the world. Globally the millet production is more concentrated in the Asian and African countries. There has been systematic decline in the production of millets after the Green revolution. This can be understood by the production trends of millet vs. other crops such as rice and wheat which were relentlessly promoted for intensive cropping. Over the years the cultivation area of millets has also decreased. The decline in production may be due to reduced cultivation area, which is shifted to other crops like rice, wheat, maize etc (Anon., 2009).

Nutritionally the millets are good sources especially in micronutrients and fiber. Health benefits of millets are known from historic days. Millets are nutritious food and they are rich in phytochemicals, fiber and minerals. Magnesium in millet can help to reduce the affects of migraines and heart attacks, Niacin (vitamin B3) in millet can help to lower cholesterol, Phosphorus in millet helps with fat metabolism, body tissue repair and creating energy (phosphorus is an essential component of *adenosine triphosphate* or ATP, a precursor to energy in body), millet can help to lower the risk of type 2 diabetes, fiber from whole grains has been shown to protect against breast cancer and whole grains have been shown to protect against childhood asthma. Many studies have been conducted to explore the health benefits. The concepts of food are changing from a previous emphasis on survival, hunger satisfaction, absence of adverse effects on health, and health maintenance to a current emphasis on the use of nutraceutical foods which promise to promote better health and well-being, thus helping to reduce the risk of chronic illnesses such as cardiovascular diseases, some cancers and obesity. An important factor of the nutraceutical food which is required to reduce the risk of chronic illness is "antioxidants". In recent years the powerful antioxidant properties of phenolics aroused more interest. The small millets are cheap sources nutrients for poor and the working class people and hence their health depends on the quality of food consumed.

The qualitative analysis for different bioactive phytochemical compounds reveals that, all the small millets tested were found to contain phenols, tannins, alkaloids, flavonoids and saponins and reported to possess anti-carcinogenic properties, immune modulation activities and regulation of cell proliferation as well as health benefits such as inhibition of the growth of cancer cells and cholesterol lowering activity. In the light of these observations the presence of phenols, tannins, alkaloids, flavonoids and saponins in the millets samples indicates that they have medicinal properties. Recent studies (Juntunen et al., 2000, Karppinen et al., 2003 and Rieckhoff et al., 1999) have shown that cereal grains contain constituents that have demonstrated health benefits for humans, such as antioxidants and anti-disease factors. For instance, phytic acid was found to play a major role in the treatment of cancer, hypercholesterolemia, hypercalcuria and kidney stones (Plaami, 1997). Other studies have also demonstrated that diets high in carbohydrate, rich in dietary fiber, and largely of cereal origin, allowed withdrawal of oral hypoglycaemic agents or a reduction of insulin dose in diabetic subjects. Additionally, several health claims on grain dietary components have been approved by the FDA in the USA. Hence, the present study was undertaken with the objective to evaluate the millets and millet based products for antioxidant activity.

Free radicals are inevitably produced in biological systems and also encountered exogenously, and are known to cause various degenerative disorders, like mutagenesis, carsinogenesis, cardiovascular disturbances and ageing. Antioxidants are the compounds which combat the free radicals by intervening at any one of the three major steps of the free radical mediated oxidative process viz., initiation, propogation and termination (Cui et al., 2004).

Natural antioxidants have gained considerable interest in recent years for their role in preventing auto oxidation of fats and oils. Both synthetic and naturally occurring substances may possess health-promoting potential. Grains contribute to the significant supply of antioxidant to prevent oxidative stress due to the fact that they used as a

staple food and are consumed in larger amount in our diets (Choi et al., 2007). Recent epidemiological studies have suggested that increased consumption of whole grains, fruits and vegetables is associated with reduced risks of chronic diseases (Hu, 2002). This may be attributed to the presence of natural antioxidants from plant foods such as vitamin C, tocopherol, carotenoids and polyphenols which prevent free radical damage (Diplock et al., 1998). Millets are known to contain phenolic acids, which are located in the pericarp, testa, aleurone layer and endosperm (Hahn et al., 1984). Millets are rich in phenolics, tannins and phytate which act as 'antioxidants' (Thompson, 1993). The antioxidant activity in grains was influenced by genetic and environmental factors .

2. Materials and Methods

Antioxidant activity was evaluated in ready to eat little millet products developed under NAIP project.

Evaluation of antioxidant activity of ready to eat little millet products

RTE (Ready to Eat) little millet flakes

The tempered grains were subjected to controlled partial gelatinization in steamer under pressure of 20 to 24 lbs/psi for 20 min, followed by air cooling to surface dryness. The grains were then passed through a roller with an aperture size of 0.25 mm to press the grains in to flakes. The rolled flakes were dried under sun optimally and extruded in single screw extruder. The extruded strands were cut in to grits that were dried in shade for 4 to 8 h and rolled. The rolled flakes were toasted in a roaster to procure the RTE flakes.

Sports food mix

Selection of Ingredients

Based on the physico-chemical and functional properties, Sukshema little millet genotype was selected. Commercially available soybean, sugar powder and skimmed milk powder were procured from local market.

Processing of ingredients

The cleaned grains of little millet and soybean were roasted separately for 16.5 and 12 minutes, respectively until pleasant aroma developed. The roasted grains were pulverized into fine flour in mini mill.

Formulation of sports food mix

Roasted flours of little millet, soybean, sugar powder and skimmed milk powder were mixed in different proportions such that the protein energy ratio of the mix was more than 15, as per the guidelines of ICMR. The mix was passed through 60 mesh sieve.

Cookies:

Refined flour -50 , little millet flour -50g , Butter – 60g , Sugar -30 , Baking powder - 1/4 th t. ,Curd - 2½ t.

- Add baking powder to refined flour and sieve it thrice.
- Cream butter and sugar till it gives smooth consistency.
- To this add essence and curd and again cream it till light and fluffy.
- Add sieved flour to cream part by part and mix to smooth dough.
- Cut into different shapes with the help of cookie dispenser.
- Bake in commercial oven with top temperature of 180 ºC and bottom temperature 150 ºC for 20 minutes.

Antioxidant activity

Antioxidant activity was evaluated in three products developed under NAIP project. Antioxidant activity was measured using a modified version of the method explained by Brand-Williams, Cuvelier, and Berset (1995). This involved the use of free radical 2,2-diphenyl- 1-picrylhydrazyl (DPPH) solution in the methanol. Ground samples (1 g) were extracted with 10 ml methanol for 2 h and centrifuged at 3000g for 10 min. The supernatant (100 µl) was reacted with 3.9 ml of a of DPPH solution. Absorbance (A) at 515 nm was read at 0 and 30 min using a methanol blank. Antioxidant activity was calculated as % Antioxidant activity.

% Antioxidant activity = (1-(A of sample $_{t=30}$/A of control $_{t=0}$) x 100

Statistical Analysis

Antioxidant activity was statistically analyzed. ANOVA was used to test the significant differences in millet based food products for antioxidant activity.

3. Results

% Antioxidant activity of little millet based food products

Antioxidant activity in little millet based products ranged from 17.77 to 34.08 per cent. Sports food mix had highest antioxidant activity (34.08%) followed by flakes (21.68%) and least was observed in cookies (17.77%).

4. Discussion

Antioxidant activity of little millet based food products

Antioxidant activity of little millet based food products are given in Fig.1. Sports food mix had highest percent of antioxidant activity compared to flakes and cookies and the values are statistically significant. Antioxidant activity was highest in sports food mix because it contains ingredients like soya, cardamom, little millet and skim milk powder and these ingredients are rich sources of protein, fat and phytochemicals. Similarly, Kurahatti et al.

(2010a) developed little millet (50%) based composite mix with green gram dhal (20%), Bengal gram dhal (15%) and peanut (10%). To enhance micronutrients viz ., iron, calcium and β-carotene, dehydrated amaranthus and chakramuni leaves were incorporated in powder form at 5 per cent level. The mix had 5.3 per cent swelling power and 15.6 per cent solubility. When the porridge from the mix was organoleptically evaluated, the mix received the scores between 7 and 8 on 9 point scale. The millet based mix compared well with multigrain supplementary food in sensory scores and nutritive value. The mix contained 357 K cal of energy, 14.6 g protein, 7.5 g of fat, 8 g of fiber, 57.5 g of carbohydrate, 7.4 g of iron, 65 mg of calcium and 313 µg of β-carotene.

Enrichment of RTE flakes with several ingredients such as Garden cress seeds for iron enrichment, Chakramuni leaves (Sauropus androgynus) for β-carotene enrichment , Green gram dhal for Protein enrichment and Linseed (Linum usitatissimum) for ω-3 fatty acid enrichment were used and the final product was rich in iron, β-carotene,protein and ω-3 fatty acid similarly Yeu et al. (2008) explored that possibilities of increasing protein content in soy based cereal incorporating 54 per cent soy flour. The total protein content ranged from 8.60 to 11.20 g per serving with soy protein per 30 g serving ranged from 6.50 to 9.50 g, claiming high protein content (FDA guidelines) and was higher compared to commercial cereals. Papaya cereal flakes were developed by Rai and Chauhan (2008) employing drum drying technique. The other ingredients were refined flour, sucrose, glucose and pectin. It was revealed that ascorbic acid and total carotenoid contents were 46.55 and 4.29 mg/100 g in papaya fruit, respectively which increased to 241.61 and 7.34 mg/100 g, respectively in papaya flakes blended with cereal. Similarly total and reducing sugars which were 8.69 and 6.40 per cent in papaya fruit found a significantly ($P \leq 0.01$) increased to 60.52 and 56.78 per cent in papaya cereal flakes.

The antioxidant activity of cookies exhibited lowest compared to other products but when compared with refined wheat flour cookies, the addition of little millet increases the antioxidant activity in cookies. Blend flour of soy and corn (30:20) was substituted with carrot flour (5 to 50%) for cookie preparation by Akubor (2005). The blend flour cookies exhibited highest scores for sensory attributes. The carrot flour incorporated cookies (5 to 10%) were comparable to blend flour cookies. However, the substitution of carrot flour beyond 10 per cent adversely affected the sensory attributes of cookies.

Table 1: % Antioxidant activity of littlemillet based food products

Sl. No	*Name of product*	*% antioxidant activity*
1	Little millet Cookies	17.77
2	Little millet Flakes	21.68
3	Sports food mix	34.08
	SEm±	0.365
	CD	1.263*

Note: Values are mean of three replications, SEm±- standard error of mean,
CD-Critical difference,*-significant @ 5%

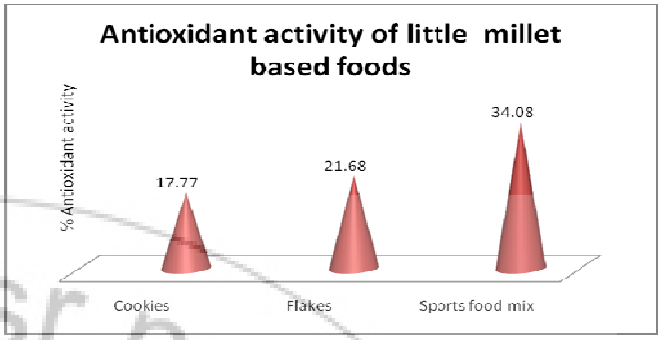

Figure 1: Antioxidant activity of little millet based foods