Antioxidant activity, mineral content and dietary fiber of grains

Neha Rana* and Saroj Dahiya

Department of Foods and Nutrition, Chaudhary Charan Singh Haryana Agricultural University, Hisar-125 004, Haryana, India.

Received: 31-12-2018 Accepted: 15-04-2019 DOI: 10.18805/ajdfr.DR-1421

ABSTRACT

The aim of this investigation was to evaluate the antioxidant activity, mineral content and dietary fiber of unprocessed and processed pearl millet, sorghum and mung bean grains. The methanolic extracts of different grains flours were analyzed for 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical scavenging activity. The samples were also evaluated for dietary fiber, mineral content and available mineral. The results indicated that the highest amount of total, soluble and insoluble dietary fibre content was present in mung bean. Maximum iron and zinc content was observed in unprocessed pearl millet whereas mung bean had highest amount of calcium content. Processing of grains improve the availability of minerals. Germinated mung bean showed DPPH free radical scavenging activity and total phenolic content.

Key words: Antioxidant activity, Available mineral, Dietary fiber, Mineral content.

INTRODUCTION

Antioxidants are substances that protect cells from damage caused by unstable molecules known as free radicals. Cellular damage or oxidation injury caused by these free radicals or reactive oxygen species which are generated through normal metabolism of drugs, environmental chemicals and other xenobiotics as well as endogeneous chemicals appears the fundamental mechanism underlying a number of human diseases such as neuro-degenerative disorders, diabetes mellitus, nephritis, rheumatism, Alzheimer disease, cataracts, cardiovascular diseases, acute liver toxicity, inflammation, viral infections, digestive system disorders and DNA damage that can lead to carcinogenesis.

Millets contain phytic acid, tannins, and phenols which can contribute to antioxidant activity, important in health, ageing and metabolic diseases. Pearl millet and grain sorghum are staple foods that supply a major proportion of calories and protein to large segments of populations in the semi-arid tropical regions of Africa and Asia. Nutritionally, pearl millet is superior to major cereals with reference to energy value, high quality proteins, fat and minerals such as calcium, iron, zinc. Besides, it is also a rich source of dietary fiber and micronutrients (Anu et al. 2006). Its health-promoting properties, in particular its antioxidant activity and its use as nutraceuticals and in functional foods.

Nutritional properties of sorghum (Sorghum bicolor (L.) Moench) are more or less limited to major entities like carbohydrates, protein, fat and fiber. Polyphenols, fiber and phytoxides were considered as anti-nutritional factor earlier. But, with increasing knowledge about their health promoting attributes, these can now be considered as nutraceuticals, factors such as polyphenols add promising antioxidant capacity to sorghum and coupled with fiber content of the cereal indicates its potential as functional food.

Mung bean [Vigna radiata (L.) Wilczek] is one of the most important short-season, summer-growing legumes grown widely throughout the tropics and subtropics. Mung bean cultivars were a potential source of essential fatty acids, antioxidants, minerals and proteins. The seeds and sprouts are excellent examples of functional foods that lower the risk of various diseases. Legumes contain dietary fibre in the range of 8 to 27.5 per cent, with soluble fibre in the range of 3.3 to 13.8 per cent. Dietary fibre has protective effect against the various diseases such as constipation, diverticular disease, large bowel cancer, diabetes, coronary heart disease, obesity and gall stones. Today there is an increasing interest in Western countries in the sprouting of seeds as consumers demand minimally processed, additive-free, more natural, nutritional and healthy foods.

MATERIALS AND METHODS

Source of raw material: The samples of pearl millet (Pennisetum glaucum) (WH-901-445) were procured from Bajra section, sorghum (Sorghum bicolor (L.) Moench) (HC-125) from Forage section, mung bean (Vignaradiata) (MH-125) from Pulses section, Department of Genetics and Plant Breeding, College of Agriculture, Chaudhary Charan Singh Haryana Agricultural University, Hisar. The seeds were cleaned and made free of dust, dirt and foreign materials prior to processing and product development. Raw materials were stored in clean and hygienic condition for further use.

Preparation of sample

Blanching of pearl millet: Blanching of pearl millet was done by the process of Chavan and Kachare (1994). Distilled
water was brought to boiling to 98°C in an aluminium container. The grains were subjected to boiling water (1:5 ratio of seeds to boiling water) for 30 seconds and dried at 50°C for 60 minutes.

**Germination of mung bean:** Mung bean grains were first cleaned and free from broken seeds, dust and other foreign materials and then soaked in tap water for 12 h at 37°C. Seed to water ratio of 1:5 (W/V) was used. The unimbibed water was discarded. The soaked seeds were germinated in sterile petri dishes lined with wet filter paper for 48 h at 37°C with frequent watering. The sprouts were rinsed in distilled water and dried at 50-55°C.

Unprocessed sample of pearl millet, sorghum, mung bean, blanched pearl millet and germinated mung bean were ground to fine powder. The resultant flours were packed in air tight plastic containers.

**Nutritional evaluation of raw and processed sample of pearl millet, sorghum and mung bean:** Total, soluble and insoluble dietary fibre constituents were determined by the enzymatic method given by Purda (1981). Calcium, iron and zinc in acid digested samples were determined by Atomic Absorption Spectrophotometer according to the method of Lindsey and Norwell (1969). Available calcium and zinc was extracted by the method of Kim and Zemel (1986). Available iron in the sample was extracted according to the procedure of Rao and Prabhavathi (1978).

**Antioxidant activity**

**Sample extraction:** The samples for antioxidant activity were extracted by the method of Serrano et al. (2007). The moisture free ground powder of sample was accurately weighed in 300 mg and then 5 ml of methanol: water (80:20, v/v) extraction solvent was added. The mixtures were shaken for 30 minutes using a mechanical shaker at 150 rpm. The content of the flask was centrifuged at 5000 rpm for 10 minuits at 4°C and supernatant was collected. 5 ml of the same solvent was added again to each flask and process was repeated. Both supernatants were combined, filtered using whatman filter paper no. 1 and used to determine total phenol and total antioxidant capacity by DPPH.

Total phenolic contents were estimated by the method of Singleton and Rossi (1965). DPPH free radical scavenging activity (RSA) of sample extracts was evaluated by the DPPH method of Hatano et al. (1989). The DPPH solution was prepared daily at a concentration of 0.1 mM or 0.04 g/L in 100 % ethanol. For this, in 0.2 ml of methanol extract (sample extracts), 3.0 ml of DPPH was added and mixed thoroughly for 5 min. A control was also made contain 0.2 ml of solvent (methanol) instead of extract (at zero min). The absorbance of the sample as well as control was measured at 517 nm after 30 min. of incubation in dark at room temperature using the UV-VIS double beam Spectrophotometer against a blank containing respective solvent. Three replications were carried out for each sample. The percent of DPPH radical discoloration of the sample was calculated according to the equation (%) discoloration:

\[
\text{DPPH RSA} (%) = \frac{A_{\text{control}} - A_{\text{sample}}}{A_{\text{control}}} \times 100
\]

Where,

- \( A_{\text{control}} \) = absorbance for the control,
- \( A_{\text{sample}} \) = absorbance for the sample

**Statistical analysis:** To verify the statistical significance, mean±SD of three independent measurements were calculated. Differences between groups were tested by ANOVA using the SPSS Statistical Package. The P values of\(<0.05\) were considered significant.

**RESULTS AND DISCUSSION**

**Dietary fiber:** A significant difference was observed in the dietary fibre constituents of different grains Table 1. Highest amount of total (38.79g/100g), soluble (8.10g/100g) and insoluble (30.70 g/100g) dietary fibre content was present in mung bean, followed by germinated mung bean, pearl millet, blanched pearl millet and sorghum. Total dietary fibre content of mung bean (20.06mg/100g) are within the range reported by Khan et al., (2007) who investigated that total dietary fibre content in lentils ranged from 18.34 to 26.35g/100g.

**Total minerals:** The results of total calcium, iron and zinc content of grains are presented in Table 2.

Concentration of total calcium in different grains ranged from 63.10 to 117.03 mg/100g. As most of the seed calcium is located in the seed coat, because of which whole mung bean had highest amount of total calcium (119.42 mg/100g). Similar trend in calcium content of mung bean was also reported by Paul et al. (2011). Maximum iron and zinc content was observed unprocessed pearl millet followed by

Table 1: Dietary fibre content of grains (g/100g, dry weight basis).

| Grains             | Total dietary fibre | Soluble dietary fibre | Insoluble dietary fibre |
|--------------------|---------------------|-----------------------|-------------------------|
| Pearl millet       | 12.30±0.23          | 0.70±0.09             | 11.80±0.11              |
| Blanched pearl millet | 11.66±0.03      | 1.02±0.06             | 10.64±0.03              |
| Sorghum            | 9.60±0.15           | 1.01±0.07             | 8.75±0.04               |
| Mung bean          | 20.06±0.07          | 3.50±0.11             | 16.56±0.06              |
| Germinated mung bean | 14.50±0.01        | 2.11±0.01             | 12.39±0.02              |
| CD (P<0.05)        | 0.36                | 0.14                  | 0.18                    |

Values are mean ± SE of three independent determinations.
blanched pearl millet (9.31mg/100g), sorghum (4.61mg/100g), unprocessed mung bean (2.62mg/100g) and germinated mung bean (2.57mg/100g). Abdalla et al. (2010) reported higher iron and zinc content in pearl millet varieties.

**Available minerals:** Data regarding available calcium, iron and zinc content of grains are presented in Table 3.

Maximum amount of available calcium was found in germinated mung bean. Whereas, Availability of iron and zinc were found to be maximum in blanched pearl millet. Blanching and germination of grains improve the mineral bio availability. This might be due to processing of grains cause the significant reduction in anti-nutritional factors and lower amount of anti-nutrients and enhances the mineral bio availability. Similar results were reported by Grewal and Jood (2009). They reported that sprouting significantly increased the per cent availability of calcium (59 to 61), iron (52 to 56) and zinc (62 to 67).

**Antioxidant activity:** A significant difference for total phenolic content and DPPH radical scavenging activity was observed in different grains Table 4. Highest amount of total phenolic content (30.67mgGAE/g) and DPPH radical scavenging activity (70.24%) were observed in germinated mung bean. These results are in agreement with earlier literature reported on antioxidant activity of germinated mung bean (Anwar et al., 2007; Kim et al., 2012).

### REFERENCES

Abdalla, A.A., Ahmed, I.A. and El-Tinay, A.H. (2010). Influence of traditional processing on minerals HCl-extractability of pearl millet. *J. Agri. Biological Sci.* 6 (4): 530-534.

Anu, Sehgal, S.; Kwaatra, A. (2006). Nutritional evaluation of pearl millet based sponge cake. *J. Food Sci. Technol.* 43: 312-313.

Anwar, F., Latif, S., Przybylski, R., Sultana, B. and Ashraf, M. (2007). Chemical composition and antioxidant activity of seeds of different cultivars of mung bean. *J. Clin. Invest.* 117:2486-2495.

Chavan J K and Kachare D P. (1994). Effects of seed treatment on lipolytic deterioration of pearl millet flour during storage. *Journal of Food Science and Technology* 31: 80–1.

Furda, I. (1981). Simultaneous analysis of soluble and insoluble dietary fiber. In James W.P.T., and Theander O., *The Analysis of Dietary Fibre in Food.* (Eds.) Marcel Dekker, New York. 163-172.

Grewal, A. and Jood, S. (2009). Chemical composition and digestibility (*in vitro*) of green gram as affected by processing and cooking methods. *Brit. Food J.* 3: 235-242.

Hatano, T., Edomatsu, R., Hiramatsu, M., Mori, K., Fujita, Y., Yasuhara, T. and Okuda, T. (1989). Effect of the interaction of tanins with co-existing substance VI. Effect of tannins and related polyphenols on superoxide anion redical on 1,1-diphenyl-2-picrylhydrazyl radical. *Chem. Pharma. Bull.* 37: 2016-2021.

Khan, A.R., Slan, S., Ali, S., Bibi, S. and Khalil, I.A. (2007). Dietary fibre profile of food legumes. *Sarhad J. Agric.* 23: 320-327.
Kim, D. K., Jeong, S. C., Garinstech, S. and Chon, S. U. (2012). Total polyphenols, antioxidant and antiproliferative activities of different extract in mung bean seeds and sprouts. *Plant Foods Hum. Nutr.* **67**: 71-75.

Kim, H. and Zemel, M.B. (1986). In vitro estimation of potential bioavailability of calcium for sea mustard milk and spinach under stimulate normal and reduce gastric condition. *J. Food Sci.* **51**: 957-963.

Lindsey, W.L. and Norwell, M.A. (1969). A new DPTA-TEA Soil test for zinc and iron. *Agron. Abst.* **61**: 84-89.

Paul, T., Mozumder, N. H. M. R., Sayed, M. A. and Akhtaruzzaman, M. (2011). Proximate composition, mineral contents and determination of protease activity from green gram. *Bangladesh Res. Pubs. J.* **5**: 207-213.

Rao, B.S.N. and Parbhavati, T. (1978). An in vitro method of predicting the bioavailability of iron from food. *Am. J. Clin. Nutr.* **31**: 169.

Serrano, J. Goni, I. and Saura-Calixto, F. (2007). Food antioxidant capacity determined by chemical methods may underestimate the physiological antioxidant capacity. *Food Res Int.* **40**: 15–21.

Singleton, V. L. and Rossi, J.A. (1965). Calorimetry of total phenols with phosphomolybdic- phosphotungstic acid reagents. *Am. J. Enology Viticulture.* **16**: 144-158.