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STUDIES ON EFFECT OF ROASTING ON NUTRITIONAL AND ANTI-NUTRITIONAL COMPONENTS OF FOXTAIL MILLET (*SETARIA ITALICA*)

A. P. KHAPRE*[1], D. M. SHERE[1] AND H. W. DESHPANDE[2]
[1]Department of Food Science and Technology,
[3]Department of Food and Industrial Microbiology,
College of Food Technology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani - 431 402 (Maharshtra)
e-mail: khapreft@gmail.com

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***Corresponding author**

ABSTRACT
Foxtail millet was roasted in a shallow pan at 95 ± 5°C for 5-7 min. Application of roasting treatment significantly decreased the moisture (8.9 to 3.7 %) and slightly reduced the fiber (5.66 to 5.49 %), carbohydrate (70.5 to 70.3 %), protein (12.1 to 10.8 %), fat (1.93 to 1.86 %), potassium (128.8 to 122.5 mg/100g) and magnesium (72 to 55 mg/100g). Roasting increased the iron (2.92 to 3.1 mg/100g), calcium (41 to 42.1 mg/100g) and phosphorous (280.1 to 281.7 mg/100g). Roasting also significantly reduced the anti-nutrients like polyphenols (14.5 to 7.8 mg GAE/100g), tannins (221.1 to 92.4 mg CAE/100g) and phytic acid (306 to 180.5 mg/100g). Results of study revealed that the roasting of foxtail millet found to be beneficial in terms of nutritional characterics.

INTRODUCTION

Millets are one of the oldest foods known to humans and possibly the first cereal grain to be used for domestic purposes. Millets are small-seeded grasses grow well in dry zones as rain-fed crops, under marginal conditions of soil fertility and moisture. They are a staple food with superior nutritional qualities compared to other cereals. India is the largest producer of many kinds of millets called coarse cereals. Based on a five-year average, India ranks 1st place in per-capita consumption of millets (Changmei and Dorothy, 2014).

India is the largest producer of various kinds of millets, which are often referred as coarse cereals. However, realizing the nutrient richness of these grains they are now considered as 'nutria-cereals'. Though they occupy relatively a lower position among feed crops in Indian agriculture, they are quite important from the point of food security at regional and farm level (Stanly Joseph and Shanmugam, 2013).

Foxtail millet (*Setaria italica*) is the oldest cultivated millet crop and is often cultivated in harsh conditions because of their better adaptability to arid land than most other crops. It ranks second in importance among millets in the world after pearl millet (Ramesh *et al.,* 2015). This millet is superior to rice and wheat, and provide protein, mineral and vitamins to the poor where the need for such nutrients is in high demand. In addition to the nutritional benefits, foxtail millet possess certain phytochemicals with anti nutrient effects which may hinder efficient utilization, absorption or digestion of nutrients, and thus reduce their nutrient bioavailability and nutritional quality. Antinutrients are unevenly distributed in the grain. Depending on their localization, the proportions of these antinutrients in the diet can be reduced by dehulling and further processing.

Mbithi-Mwikya *et al*. (2000) highlighted the importance of roasting in millets' value addition. The processing and utilization of millet crops are largely confined to the home scales that render many of these valuable nutrients unavailable to human beings. In India, millet crops are consumed in traditional ways and in the form of various food products. But due to the lack of processing knowledge, widespread consumption of these crops is limited. Most of them produced are consumed locally in the form of traditional foods and majority of the nutrients remain unavailable to consumers because of presence of anti-nutrients. Different procedures have been proposed to eliminate or reduce anti-nutritional factors in millets. Home practices such as soaking, roasting, germination and cooking can effectively improve the nutritional value of grains. Roasting process render the grain digestible, without the loss of nutritious components. Roasting of cereals, pulses and oilseeds is a simpler and more commonly used household and village level technology which is reported to remove most antinutritional or toxic effects such as polyphenols, phytate, trypsin inhibitor, hemagglutinin, gioterogenic agents, cyanogenic glycosides, alkaloids and saponins and increase storage life (Huffman and Martin,

2004). Geervani *et al*. (2006) reported significantly higher NPU (Net Protein Utilization) from roasted millets and legumes mix as compared to dehulled, boiled, malted and baked mixes.

The present work was carried out with a view to evaluate the effect of roasting as a dry heat processing method on the nutritional characteristics of foxtail millet grains which is beneficial while formulating nutritionally enriched processed food products from millet.

MATERIALS AND METHODS

Roasting of foxtail millet

The foxtail millet sample was purchased from local stores assuring the best quality. Grains were cleaned to remove dirt and soil particles and washed with water for 2-3 times and soaked in water containing 10 % sodium hypochlorite for 15 minutes. Grains were rinsed with fresh water to remove the smell of sodium hypochlorite. Millet grains were roasted in a shallow pan at $95 \pm 5^{o}C$ temperature for 5-7 min. The pan was maintained at that temperature (by using laboratory scale digital thermometer) and vigorously stirred for the purpose of uniform roasting. After roasting the samples were brought to room temperature and processed further. Roasted grains were ground to fine powder using laboratory grinder and the flour was passed through a sieve of mesh size 40. The resultant flours were packed in air tight plastic containers until used for analysis (Marpalle *et al.,* 2014; Ayman, 2015).

Nutritional analysis

The raw and roasted foxtail millet samples were analyzed for moisture, ash, carbohydrate, protein, fat, fiber, calcium, iron, phosphorous, magnesium and potassium by the methods given by AOAC (1990) and Ranganna (1995).

Anti-nutritional factors analysis

Polyphenols content was determined by using modified Folin-Ciocalteu calorimetric method using gallic acid as standard (Makkar, 2000). Phytic acid was estmated by standard procedure of Wheeler and Ferrel (1971). Tannin content was determined by calorimetric method using Folin-Denis reagent (AOAC, 1990).

RESULTS AND DISCUSSION

Nutritional composition of raw foxtail millet

The data pertaining to nutritional composition of raw foxtail millet is given in Table 1.

The results regarding nutritional components of foxtail millet indicated that the moisture and ash content of grain was 8.9 per cent and 1.42 per cent respectively. Protein content was found to be 12.1 per cent. So, the foxtail millet is protein rich and significant from nutritional point of view. It was also observed that the carbohydrate content of grain was found to be 70.5 per cent. Fat content was found to be 1.93 per cent. The value of crude fiber found in millet grain was 5.66 per cent. Additionally millet is also a good source of valuable micro-nutrients (minerals) along with the major food components. The values observed for minerals viz. calcium, iron, phosphorous, potassium and magnesium content of foxtail millet was found to be 41 mg/100 g, 2.92 mg/100 g, 280.1 mg/100g, 128.8 mg/100 g and 72 mg/100 g respectively. Similar results were reported by Jemima and Indu (2012).

Nutritional composition of roasted foxtail millet

The roasted foxtail millet was subjected to chemical analysis and the data pertaining to the present investigation is tabulated in Table 1.

The moisture and ash content of grain was 3.7 per cent and 1.41 per cent respectively. Reduction in moisture of millet was due to use of roasting as a dry heat processing method. It was observed that the carbohydrate and protein content of grain was found to be 70.3 and 10.8 per cent respectively and their reduction during roasting is due to Maillard reaction. Fat content of foxtail millet was found to be 1.86 per cent. Crude fiber content of millet was found to be 5.49 per cent. The values observed for minerals viz. calcium, iron, phosphorous, potassium and magnesium content of foxtail millet was found to be 42.1 mg/100 g, 3.1 mg/100 g, 281.7 mg/100 g, 122.5 mg/100 g and 5 mg/100 g respectively. Similar results were reported by Jemima and Indu (2012).

Anti-nutritional factors of raw and roasted foxtail millet

The foxtail millet was subjected to roasting and then undergone chemical analysis and the data pertaining to the anti-nutritional factors content is tabulated in Table 1.

Anti-nutritional factors present in foxtail millet were significantly reduced by the roasting as polyphenols (14.5 to 7.8 mg GAE/ 100g), tannins (221.1 to 92.4 mg CAE/100g) and phytic acid (306 to 180.5 mg/100g). Similar results were reported by Shobana *et al.,* (2013) for reduction of anti-nutrients in finger millet by the roasting.Foxtail millet being staple food in different parts of India and abroad is promoted as an extremely healthy food. After the nutritional screening of roasted foxtail millet it was concluded that roasting treatment resulted in significant effect on the nutritional quality with effective anti-nutritional factors reduction. Hence, roasting should be followed prior to

Table 1: Nutritional composition of foxtail millet

Sr. No.	Nutritional Component	Value (Foxtail millet-Raw)	Value (Foxtail millet -Roasted)
1	Moisture (%)	8.9	3.7
2	Ash (%)	1.42	1.41
3	Fiber (%)	5.66	5.49
4	Carbohydrate (%)	70.5	70.3
5	Protein (%)	12.1	10.8
6	Fat (%)	1.93	1.86
7	Iron (Fe) (mg/100g)	2.92	3.1
8	Calcium (Ca) (mg/100g)	41	42.1
9	Phosphorous (P) (mg/100g)	280.1	281.7
10	Potassium (K) (mg/100g)	128.8	122.5
11	Magnesium (Mg) (mg/100g)	72	55

Table 2: Anti-nutritional factors content of foxtail millet

Sr. No.	Anti-nutritional factor	Value (Foxtail millet -Raw)	Value(Foxtail millet -Roasted)
1	Polyphenols (mg GAE/100g)	14.5	7.8
2	Tannins (mg CAE/100g)	221.1	92.4
3	Phytic acid (mg/100g)	306	180.5

utilization of raw foxtail millet for nutritional importance.

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