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Effect of preliminary processing on antiradical properties of little millet landraces

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ABSTRACT

Millet is most important cereal after rice, sorghum and wheat and is a staple food in many parts of Africa and India. The present study was conducted to know the effect of preliminary processing like decortication on antioxidant contents of 10 little millet landraces grown in the year 2007-09 and collected from the farmers. The values for α-tocopherol ranged between 1.75 to 5.43 mg/100 g. After milling there was reduction in α-tocopherol content. It was also observed that bran contained higher amount of α-tocopherol compared to decorticated grain. Phytic acid content of different little millet samples varied from 1.44 to 1.53 g/100 g. The highest phytic acid was noticed in millets collected from Jekinkatti-82 (1.53 g/100 g) followed by Ganjigatti-55 (1.53 g/100 g) and least in Chikkayagatti-01 (1.44 g/100 g). It is observed that there was reduction in phytic acid content after milling. This reduction was statistically not significant. Milling significantly reduced the polyphenol content of different samples and reduction was statistically significant. The highest polyphenol content in decorticated grain was in millets collected from Jekinkatti-33 (90.73 mg/100 g) followed by Jekinkatti-82 (69.87 mg/100 g) and least in Chadaval-53 (49.47 mg/100 g). Bran contained highest polyphenol content as polyphenols are concentrated in bran.

Keyword: Millet; antioxidant; α-tocopherol; polyphenol; phytic acid; decorticated grain

INTRODUCTION

Little millet (*Panicum sumatrense*) 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. Little millet is comparable with other cereals such as rice and wheat as a source of protein, fat, carbohydrates and crude fibre apart from minerals and vitamins. Kodo millet (*Paspalum scrobiculatum*) and little millet (*Panicum miliare*) have 37-38 per cent of dietary fibre which is the highest among the cereals; the fat has higher PUFA (Hadimani and Malleshi 1993); the mineral content is also higher than decorticated grain or wheat. It also contains phytochemicals such as phenolic acids, flavonoids, tannins and phytate. Phenolic acids are known to act

as antioxidants by donating hydrogen or electrons. In addition their stable radical intermediates prevent the oxidation of various food ingredients particularly fatty acids and oils (Maillard et al 1996). The wide range of protective components in whole grains potential mechanism for protection and linkage to the reduced risk of cardiovascular diseases, cancer, diabetes and obesity have been described by many scientists. Hence the present investigations were carried out to evaluate the effect of preliminary processing on antiradical properties of little millet landraces.

MATERIAL and METHODS

Millets selected for the study were processed primarily by milling mainly to know the effect of processing on antiradical properties in little millet landraces.

Analysis of antioxidant contents in processed millets: Whole grain millets, milled fractions of millets viz bran and decorticated grain were analyzed for α-tocopherol, phenols and phytic acid contents .

Preparation of samples: Whole grain millets, bran and decorticated grains were powdered in a pestle and mortar to a fine powder. Powdered samples were defatted before the analysis.

Estimation of α-tocopherol: Tissue extract, standard and water 1.5 ml each were taken with pipettes and put in 3 centrifuge tubes which were then capped. Ethanol (1.5 ml) and water (1.5 ml) were added to test sample and blank respectively and centrifuged; 1.5 ml of xylene was added to all the three tubes and centrifuged. To each tube 1.5 ml of 2,2-dipyridyl reagent was added, stoppered and absorbance was recorded at 460 nm. Further 0.33 ml of ferric chloride solution was added to blank, test sample and standard, mixed well and after exactly 15 minutes absorbance was recorded at 520 nm.

Estimation of total phenols: Phenols were estimated by the Folin-Ciocalteau method (Malick and Singh 1980). Sample (0.5 mg) was ground with a pestle and mortar in 10 time volume of 80 per cent ethanol. The homogenate was centrifuged at 10,000 rpm for 20 min. The residue was re-extracted with five times the volume of 80 per cent ethanol, centrifuged and the supernatants were pooled. Supernatant was evaporated to dryness. Residue was dissolved in a known volume of distilled water (5 ml). Different aliquots were pipetted out (0.2-2 ml) into test tubes. The volume was made to 3 ml in each tube with water. To it Folin-Ciocalteau reagent about 0.5 ml was added. After 3 min, 2 ml of 20 per cent Na_2CO_3 solution was added to each tube, mixed thoroughly and the tubes were kept in boiling water for exactly one minute. These were further cooled and the absorbance was measured at 650 nm against a reagent blank.

Estimation of phytic acid : Phytic acid content was estimated by the method as described by Wheeler and Ferral (1971). A weighed quantity of finely ground sample was extracted in 50 ml (3%) per cent TCA for 30 min with mechanical shaking. The suspension was centrifuged and a 10 ml aliquot of the supernatant was transferred to a 40 ml conical centrifuge tube. $FeCl_3$ (4 ml) solution was added to the aliquot by blowing rapidly from the pipette. The contents were heated in a boiling water-bath for 45 min, centrifuged for 10-15 minute, carefully decanted the clear supernatant and washed the precipitate twice by dispersing well in 25 ml (3%) TCA. It was further heated in boiling water for 5-10 minutes and centrifuged; repeatedly washed with water and 3 ml 1.5N NaOH was added to it with constant stirring.

RESULTS and DISCUSSION

By any nutritional parameter millets are miles ahead of rice and wheat. These are rich in protein, fibre and micronutrients. Diet plays a crucial role in prevention of chronic degenerative diseases. Plant derived antioxidants such as phenolic compounds are reported to have multiple biological effects. They retard oxidative degradation of biomolecules like lipids, DNA and proteins. Food components rich in phenolic compounds have been shown to impart antimutagenic, antiglycemic and antioxidative properties. This has been exploited for the development of healthy food formulations. Little millet contains phytochemicals, phenolic acids, flavonoids, tannins and phytates. The vast array of biologically active compounds in millets including tannins, phenols and phytates may indicate their potential as therapeutic values.

α-Tocopherol content of little millet landraces at various stages of processing: Table 1 depicts α-tocopherol (mg/100 g) content of different millets at various stages of processing of decorticated grain and bran. The values for α-tocopherol ranged between 1.75 to 5.43 mg/100 g. After milling there was reduction in α-tocopherol content. The sample Mantrodi-77 millet had highest α-tocopherol content (5.43 mg/100 g) followed by Ganjigatti-55 (4.90 mg/100 g) and least in Chadaval-53 (1.75 mg/100 g). Bran contained higher amount of α- tocopherol compared to decorticated grain. Per cent retention of α-tocopherol varied among the millets. It ranged between 17.07 to 62.85 per cent. The highest retention was observed in Chadaval-53 millet followed by Jekinkatti-82 millet and least in Kamplikoppa-60 millet sample.

Youngmin et al (2006) also reported that black decorticated grain contained higher amount of vitamin E (1.2 mg/100 g) whereas proso millet contained least or negligible amounts of vitamin E (0.01 mg/100 g). α-tocopherol was high in landraces obtained from Haveri and

Table 1. α-Tocopherol (mg/100 g) content of different types of little millets at various stages of processing

Millet	Whole grain	Decorticated grain	Bran	% retention in decorticated grain
Chikkayagti-01	2.42	1.47	4.42	60
Chikkayagti-07	3.66	1.60	4.80	43.71
Jekinkatti-33	2.48	1.21	3.62	48.79
Chadaval-35	4.26	0.87	2.62	20.42
Chadaval-53	1.75	1.10	3.31	62.85
Ganjigatti-55	4.90	1.18	3.54	24.08
Kamplikoppa-60	4.86	0.83	2.49	17.07
Chadaval-66	3.80	1.10	3.30	28.94
Mantrodi-77	5.44	1.10	3.30	20.22
Jekinkatti-82	2.51	1.53	4.58	60.95
Mean	3.61	0.12	3.60	
SEM±	0.10	0.13	0.13	
$CD_{0.05}$	0.30	0.38	0.38	

Values are means of three replications

Dharwad districts. In the present study these were collected from Mantrodi and Ganjigatti.

Phytic acid content of little millet landraces at various stages of processing: Data on phytic acid content of milled fractions of different samples are presented in Table 2. Phytic acid content of different little millet samples varied from 1.44 to 1.53 g/100 g. The highest was noticed in millets collected from Jekinkatti-82 (1.53 g/100 g) followed by Ganjigatti-55 (1.53 g/100 g) and least in Chikkayagatti-01 (1.44 g/100 g). There was reduction in phytic acid content after milling. This reduction was statistically not significant. The phytic acid content of decorticated grain varied from 2.47 to 2.78 g/100 g. The per cent retention was high in millets collected from Chadaval-66 millet followed by Mantrodi-77 and least in Chadaval-35.

Phytic acid is widely found in cereals, legumes, nuts and oil seeds constituting 1 to 5 per cent. Decortication reduced the phytic acid content in decorticated grain. Phytic acid content did not vary significantly among the landraces

and also when classified based on locality, colour and size. Sridevi and Yenagi (2007) conducted a study to evaluate antioxidant properties of locally available regional whole grain cereals such as bread wheat, durum wheat, dicoccum wheat, common sorghum, pop sorghum, Kadabinajola, brown finger millet, white finger millet, pearl millet, foxtail millet and little millet and their processed foods (milled fractions, cooked and enriched foods). The highest phytic acid content was observed in brown ragi and lowest in little millet.

Polyphenol content of little millet landraces at various stages of processing: Data on polyphenol content of different little millet samples at various stages of processing are presented in Table 3. Milling significantly reduced the polyphenol content of different samples and the reduction was statistically significant. The highest polyphenol content in decorticated grain was in millets collected from Jekinkatti-33 (90.73 mg/100 g) followed by Jekinkatti-82 (69.87 mg/100 g) and least in Chadaval-53 (49.47 mg/100 g). Bran contained highest polyphenol content because polyphenols are concentrated in bran. Polyphenol content in bran was highest in millets collected from Chadaval-35 (336.10 mg/100g) followed by Mantrodi-77 (248.00 mg/100 g) and lowest in Chikkayagatti-07 (133.66 mg/100 g). The variation of polyphenol content in decorticated grain and bran was statistically significant. The per cent retention of polyphenol was found to be highest in millets collected from Jekinkatti-33 followed by Jekinkatti-82 and least in Chadaval-53.

Polyphenol did not vary significantly in the whole grains but decortication reduced the content of polyphenol in decorticated grain and variation was statistically significant. The landraces obtained from Dharwad region (Ganjigatti) were having highest content 145.90 mg/100 g compared to other two localities but colour and size did not show any significant influence. Anoma and Fereidoon (2011) analyzed seven millet grain samples for total phenolic contents. Kodo millet showed highest total phenolic content in free (16.2±0.5 ìmol FAE/g), esterified (2.02±0.1 ìmol FAE/g) and insoluble bound fractions (81.6±0.2 ìmol FAE/g) whereas pearl millet contained highest total phenolic content in esterified fractions. Youngmin et al (2006) reported that polyphenol content was more in red coloured sorghum (783 mg/100 g) followed by black coloured decorticated grain (313 mg/100 g) and least in white coloured decorticated grain (18 mg/100 g).

In the present investigations millets were primarily processed by ordinary milling and milled fractions were assessed for the antioxidant content. Milling of millet grains into decorticated grain reduced the antioxidant content (Table 1,2 and 3). Reduction in antioxidant content in decorticated grain and whole grain millet may be attributed to the removal of bran

Table 2. Phytic acid (mg/100g) content of milled fractions of little millet landraces

Millet	Whole grain	Decorticated grain	Bran	% retention in decorticated grain
Chikkayagatti-01	2.67	1.44	2.78	53.93
Chikkayagatti-07	2.69	1.48	2.60	55.93
Jekinkatti-33	2.72	1.47	2.82	54.04
Chadaval-35	2.73	1.47	2.75	53.84
Chadaval-53	2.68	1.46	2.74	54.47
Ganjigatti-55	2.65	1.53	2.73	57.73
Kamplikoppa-60	2.78	1.51	2.72	54.31
Chadaval-66	2.47	1.48	2.81	59.91
Mantrodi-77	2.65	1.52	2.73	57.35
Jekinkatti-82	2.70	1.53	2.74	56.66
Mean	2.68	1.49	2.74	
$CD_{0.05}$	NS	NS	NS	

Values are mean of three replications

Table 3. Polyphenol (mg/100g) content of milled fractions of little millet landraces

Millet	Whole grain	Decorticated grain	Bran	% retention in decorticated grain
Chikkayagatti-01	136.53	67.90	235.40	49.73
Chikkayagatti-07	113.87	54.07	133.66	47.48
Jekinkatti-33	115.55	90.73	182.70	78.52
Chadaval-35	138.11	59.93	336.10	43.39
Chadaval-53	130.08	49.47	184.96	38.03
Ganjigatti-55	145.90	61.51	190.76	42.15
Kamplikoppa-60	133.03	55.67	176.34	41.84
Chadaval-66	144.74	58.52	187.30	40.43
Mantrodi-77	145.35	58.89	248.00	40.51
Jekinkatti-82	136.91	69.87	194.35	51.03
Mean	134.01	62.66	206.95	
SEM±	8.47	0.34	1.49	
$CD_{0.05}$	NS	1.00	4.41	

Values are mean of three replications

which is a potent source of antioxidants. A significant reduction in polyphenol content on milling was observed. However there was no consistent relationship between the degree of milling with reduction in polyphenol. It may be due to distribution of polyphenol in endosperm of the grain. Milling of millets into decorticated grain did not affect the phytic acid content (Table 2) as the distribution of phytic acid as a storage form of phosphorous in seed is distributed more in the aleurone layer, endosperm and in the germ portion.

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