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Antioxidant property of finger millet (*Eleusine coracana* L.)

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Abstract
The search for novel high quality but cheap source of antioxidant property along with micronutrient rich source has been attaining popularity in developing countries for meeting the challenges micronutrient deficiency on one side and prevention and control of non communicable diseases through diet on the other side. Finger millet is one of the grains gaining popularity in this aspect. Hence, the present study was undertaken to find the antioxidant property of finger millet in terms of their tannin and polyphenols content. Finger millet germplasm along with KOPN-330, MR-6 and RAU-8 varieties were selected for the study. Further molar ratio of phytic acid to iron was assessed in selected lines along with varieties. Results showed the mean values for polyphenol as 156.34 mg GAE/100 g and tannin as 99.26 mg TAE/100 g. The molar ratio for phytic acid to iron in selected samples was in the range of 16.18 to 20.01 indicating the lower absorption of iron from finger millet where molar ratio of phytic acid to iron is preferred to be less than 10:1 for higher iron absorption.

Keywords: finger millet, tannin, polyphenols, phytic acid and molar ratio

Introduction
The main characteristic of an antioxidant is its ability to trap free radicals. Highly reactive free radicals and oxygen species are present in biological systems from a wide variety of sources. These free radicals may oxidize nucleic acids, proteins, lipids or DNA and can initiate degenerative diseases. Antioxidant compounds like phenolic acids, polyphenols and flavonoids scavenge free radicals such as peroxide, hydro peroxide and thus inhibit the oxidative mechanisms that lead to degenerative diseases. Scientific evidence suggests that antioxidants reduce the risk for chronic diseases including cancer and heart disease (Miller *et al.*, 1986).
Finger millet (*Eleusine coracana* L.) is one of the promising millets with treasure of nutrients which could be suitably used as nutrient rich food source. It occupies the largest area under cultivation among the small millets in India (Chandra *et al.*, 2016), which needs to be popularize by finding other nutritional property like antioxidant quality. Phytic acid is one of the predominant antinutritional factors, which interacts with food constituents such as essential minerals and make them unavailable to the body (Idris *et al.*, 2006), hence it is essential to evaluate phytic acid and iron molar ratio in finger millet to find its availability in the body.

Materials and Methods
Finger millet germplasm along with KOPN-330, MR-6 and RAU-8 varieties were procured from All India Co-ordinated Research Project on Small Millets (AICRPSM), Gandhi Krishi Vignana Kendra, Bengaluru. Seeds were thoroughly cleaned to remove extraneous matter, deglumed and dried in oven at 45 ± 5˚ C and were ground in a coffee bean grinder to obtain fine powder and passed through a 60 mesh sieve, further subjected for tannin and polyphenol estimation. Total polyphenol was analysed by Folin Ciocalteu Reagent (Singleton *et al*., 1999) and tannin by FDR method. Further two lines of high tannin and polyphenols were evaluated for phytic acid to iron molar ratio. Phytic acid phosphorous (PA-P) was estimated by the Wade reagent method. Phytic acid was obtained by multiplying the phytic acid phosphorous with the conversion factor 3.55, where phytic acid phosphorous (PA-P) was estimated by modified Wade reagent method (Gao *et al*., 2007). Iron was measured by using ICP (Inductively Coupled Plasma-Optical emission Spectrometry). All tests were carried out in triplicate and total phenol content was expressed as mg of gallic acid equivalents (GAE) per 100 g of extract**.** Molar ratio was calculated by using the formula (Elisa and Adelaide, 2010).
The molar ratios between phytic acid and iron were calculated by dividing the mole of phytate with mole of iron content using the following formula.

$$\text{PA: Iron} = \frac{\text{PA/MW(PA)}}{\text{Iron/MW(Fe)}}$$

Where, PA = Phytic acid analysed; MW $_{(PA)}$ = Phytic acid molecular weight (660.06 Da); Iron = iron content (Fe); MW $_{(Fe)}$ = Molecular weight of iron (Fe = 55.845 Da).

Results and Discussion

Significant difference (P<0.5) in the selected finger millet germplasm along with the released varieties were analysed for their polyphenol content as indicated in table 1. The polyphenol content of the finger millet germplasm under study ranged from 99.22 to 195.70 mg GAE/100 g with the mean of 92.22 mg GAE /100g, where in varieties ranged from 170.66 to 190.30 mg GAE /100g. Statistically significant difference was found to exist among the selected germplasm and varieties as indicated by 'F' value. The findings of the present study with respect to polyphenol content are slightly lower than that reported by Shahidi and Chandrasekara (2013), where it ranged from 265 to 373.15 mg GAE/100 g and higher than the reported by Chandra *et al.* (2016). However, varietal variations in respect to the polyphenol content of finger millets have been reported (Chethan and Malleshi, 2007) as in the present study. The present findings are in tune with the findings of Almakshi *et al.* (2017).

It was observed that there is a significant difference (P< 0.5) in the selected finger millet germplasm and varieties for their tannin content as indicated in table 2. The tannin content of the finger millet germplasm under study ranged from 57.43 to 143.90 mg TAE/100 g with the mean value of 92.78 mg TAE /100g. Among the varieties KOPN-330 variety had the highest tannin content of 140.48 TAE and PR-202 had the lowest tannin content of 90.35 mg. Statistically, significant difference was found to exist among the selected germplasm and varieties as indicated by 'F' value for tannin. Findings of the present study are in tune with the results reported by Mazumadar *et al.* (2006), where in the tannin content ranged from 70 to 220 TAE/100 g in finger millet varieties analysed. Solomon *et al*. (2014) revealed the presence of substantial variability for tannin content in six genotypes of finger millet. The results of the present study are relatively lower than those reported by Wadikar *et al.* (2006) on three Indian hilly region finger millets. The difference in tannin content between the reported values and the present study may be due to difference in agro climatic condition and varieties. However, present findings are in tune with that reported by Chavan *et al.* (2001). The molar ratio for phytic acid to iron in two lines of high taanin and polyphenols along with finger millet varieties was in the range of 16.18 to 20.01 (table 3) indicating the lower absorption of iron from finger millet where molar ratio of phytic acid to iron is preferred to be less than 10:1 for higher iron absorption (Makokha *et al*., 2002).

Statistical analysis

The data was subjected to analysis of variance (ANOVA) for testing the significance of variation in germplasm and varieties for tannin and polyphenol traits using MSTAT. Mean values were calculated and compared at 95% level of significance.

Table 1: Total polyphenol content of finger millet germplasm and varieties

Germplasm	**Polyphenol (mg GAE /100g)**
GE 12	153.92
GE 70	139.19
GE 91	144.15
GE 314	176.35
GE 597	195.70
GE 1012	144.15
GE 1172	130.37
GE 2866	121.94
GE 3094	181.38
GE 3164	92.22
GE 3179	186.10
GE 3686	130.37
GE 4597	178.60
GE 4685	134.70
GE 4976	152.56
GE 5052	158.53
Range	92.22-195.70
Mean	151.26
Varieties	**Polyphenol (mg GAE /100g)**
KOPN-330	170.66
MR-6	189.20
RAU-8	190.30
Range	170.66-190.30
Mean	183.39
Mean	156.34
SEm±	2.97
CD	8.43
F value	*

* Significant at p< 0.05; The values are expressed as mean of three replicates

Table 2: Tannin content of finger millet germplasm and varieties

Germplasm	Tannin (mg TAE /100g)
GE 12	86.57
GE 70	57.43
GE 91	90.95
GE 314	109.77
GE 597	118.57
GE 1012	89.95
GE 1172	75.66
GE 2866	93.54
GE 3094	101.26
GE 3164	78.02
GE 3179	143.90
GE 3686	76.01
GE 4597	91.96
GE 4685	66.77
GE 4976	92.42
GE 5052	111.75
Range	57.43-143.90
Mean	92.78
Varieties	Tannin (mg TAE /100g)
KOPN-330	140.48
MR-6	155.44
RAU-8	105.59
Range	105.59-155.44
Mean	133.83
Mean	99.26
F value	*
SEm±	3.12
CD	8.89

* Significant at P<0.05 level. The values are expressed as mean of three replicates

Table 3: Phytic acid to iron molar ratio in selected high polyphenol and tannin germplasm and varieties

Germplasm	PA:Fe
GE 597	16.18
GE 3179	20.01
KOPN-330	16.77
MR-6	18.12
RAU-8	17.23

Note: PA:Fe- Phytic acid to iron molar ratio

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