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Micronutrient and Phytic Acid Variability in Finger Millet (*Eleusine coracana* L.) Germplasm

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Abstract

Finger millet (*Eleusine coracana* L.) grains are known to be a rich source of minerals like iron, zinc, calcium and phosphorous, besides dietary fiber and other essential micronutrients. In spite of being a treasure trove of nutrients, presence of antinutritional factors such tannins, oxalates, polyphenols and phytates interferes with the absorption of minerals and makes them less bioavailable to the body. A greater understanding of phytic acid and mineral content in finger millet germplasm would form a powerful basis for further improvement in nutritional security. Hence, the present study was undertaken to analyse 14 finger millet germplasm along with ML-365 variety. Results revealed that minerals such as calcium, phosphorous, iron, magnesium and zinc ranged from 155.45-312.55, 186.15-371.60, 2.88-6.62, 123.41-198.45 and 0.72-5.76 mg /100g respectively in the selected finger millet germplasm. However, the phytic acid phosphorous and phytic acid content ranged from 167.26 to 251.63 and 593.76 to 893.27 mg/100g respectively.

Millets are of minor importance in the West, but staple in the diets of African and Asians. Finger millet is one among the minor millets, which has gained importance due to its drought resistance quality and high nutritional value. It is the richest source of calcium among the cereals with good source of iron, zinc and with substantial quantity of carbohydrate, protein, polyphenols, dietary fibre as well as functional fibre and starch pattern (Chethan and Malleshi, 2007). In spite of being a treasure trove of nutrients, presence of anti-nutritional factors such as tannins, polyphenols, oxalates and particularly phytates make the micronutrient to become less bioavailable to the body. In human studies, phytic acid has been reported to inhibit absorption of iron, zinc, calcium, magnesium and manganese (Phillippy, 2006). Hence, it is important to identify genotypes with low anti-nutritional factors or alternatively a more comprehensive approach to enhance the bioavailability of nutrients would be to genetically decrease phytic acid and other anti-nutritional factors. This warrants a thorough investigation to capture genetic variability in phytic acid and other anti-nutritional factors. Hence, the present study was undertaken to screen finger millet germplasm for their phytic acid and mineral content which would serve as a data base for further crop improvement to obtain nutritional benefits. In the present study 100 finger millet germplasm were evaluated for phytic acid and mineral content. However the results of 14 randomly selected finger millet germplasm along with ML-365 as check variety has been reported.

Finger millet germplasm and ML-365 variety were procured from mini core of finger millet germplasm, All India Co-ordinated Research Project on Small Millets, University of Agricultural Sciences, Bengaluru, India and were analysed for phytic acid and micronutrient content. Seeds were thoroughly cleaned to remove extraneous matter and deglumed with deionized water and dried. Each finger millet germplasm was ground in a coffee bean grinder to obtain fine powder and passed through a 60 mesh sieve, which was further used for the analysis of phytic acid and mineral content.

Minerals such as calcium, phosphorous, iron, magnesium and zinc were analysed by using inductively coupled plasma-optical emission spectrometry (ICP-OES) and results were expressed as percentage of the dry weight (mg/100g). Phytic acid phosphorous (PA-P) was estimated by the Wade reagent method (Gao *et al*., 2007) and the

TABLE II

Phytic acid phosphorous and phytic acid content in finger millet germplasm

Germplasm	PA-P (mg/100g)	PA (mg/100g)
69	201.56	715.53
469	245.82	872.66
1003	236.75	840.46
1074	184.92	656.48
1090	251.63	893.27
1219	215.69	765.69
4707	217.31	771.47
5192	220.85	784.01
1899	217.94	773.69
4415	202.16	718.04
5230	206.71	733.83
5199	192.58	683.66
1417	167.26	593.76
3864	245.24	870.60
ML-365	200.67	712.37
Mean	213.81	759.03
CD (0.05)	9.91	26.08
CV	2.05	2.05
F-value	*	*

*-Significant @0.05%, PA-P Phytic acid phosphorous and PA: Phytic acid

concentration of phytic acid was obtained by multiplying the phytic acid phosphorous with the conversion factor 3.55. PA-P was calculated through the regression equation (Absorbance =0.0338*Phytic acid phosphorous (µg) + 0.552, R^2 =0.9986) plotted with the sodium salt of phytic acid (1.12 to 11.2 µg/L) as standard. Results were expressed as a percentage of the dry weight (mg / 100g).

Research results revealed that the calcium, phosphorous, iron, magnesium and zinc in selected finger millet germplasm ranged from 155.45-312.55, 186.15-371.60, 2.88-6.62, 123.41-198.45 and 0.72-5.76 mg/100 g, respectively (Table I). The results are on par with the findings reported by Sreeramaiah *et al*. (2006) in a study on the iron and zinc content in the cereals and pulses consumed in India where in the mean iron, zinc and calcium content of finger millet varieties were 2.13 ± 0.05, 1.73 ± 0.04 and 325 ± 9.23 mg / 100 g respectively. Further, the phosphorus content of the research samples was also in tune with the findings of Shashi *et al*. (2007) which ranged from 234 -292 mg / 100 g in eight varieties of finger millet.

TABLE I

Micronutrient content in finger millet germplasm

Germplasm	Calcium (mg/100g)	Phosphorous (mg/100g)	Iron (mg/100g)	Magnesium (mg/100g)	Zinc (mg/100g)
69	238.80	235.75	3.70	161.95	1.74
469	278.20	371.60	4.95	198.45	3.40
1003	264.20	296.65	4.08	181.40	4.61
1074	209.00	253.30	5.20	160.00	3.48
1090	262.30	301.00	4.31	167.60	2.67
1219	171.95	202.35	4.98	163.70	2.51
1417	193.90	269.25	4.78	163.70	2.82
1899	312.55	200.95	2.88	172.75	3.50
3864	236.95	264.65	3.92	123.41	0.72
4415	155.45	207.30	4.32	124.35	2.80
4707	221.10	297.20	4.38	169.3	2.78
5192	228.45	289.75	3.55	155.35	3.18
5199	194.10	186.15	3.36	172.75	5.76
5230	215.05	280.00	6.62	146.05	4.24
ML-365	247.35	280.00	5.35	165.35	2.50
Mean	228.62	262.39	4.42	161.74	3.29
CD (0.05)	26.44	27.78	0.47	29.02	0.89
CV	6.92	6.33	6.79	10.73	16.61
F-value	*	*	*	*	*

*-Significant @0.05%

Phytic acid phosphorous and phytic acid content of the finger millet germplasm ranged from 167.26 to 251.63 and 593.76 to 893.27 mg/100 g respectively (Table II). Phytic acid phosphorous content was almost on par as reported by Wadikar *et al.* (2006) which ranged from 212-240 mg/100 g. The phytic acid content was highest in 1090 germplasm with 893.27 mg / 100g and lowest of 593.76 mg/100 g in 1417. However, the phytic acid content of the samples was found to be statistically different from ML-365 (712.37 mg / 100 g) variety. The results are on par with the results of Gunashree *et al.* (2014) *i.e.* 685 mg / 100 g, but, slightly lower than that reported by Makhoka *et al.* (2002) in which phytic acid content of finger millet ranged from 852-1419 mg /100 g. Phytic acid content among the selected germplasm showed a wide variability and similar findings have been reported by Lorenz *et al.* (1983) on 24 proso millet (0.17 to 0.47%) varieties studied.

Correlation between phytic acid and micronutrient is presented in Fig 1. Statistically, significant

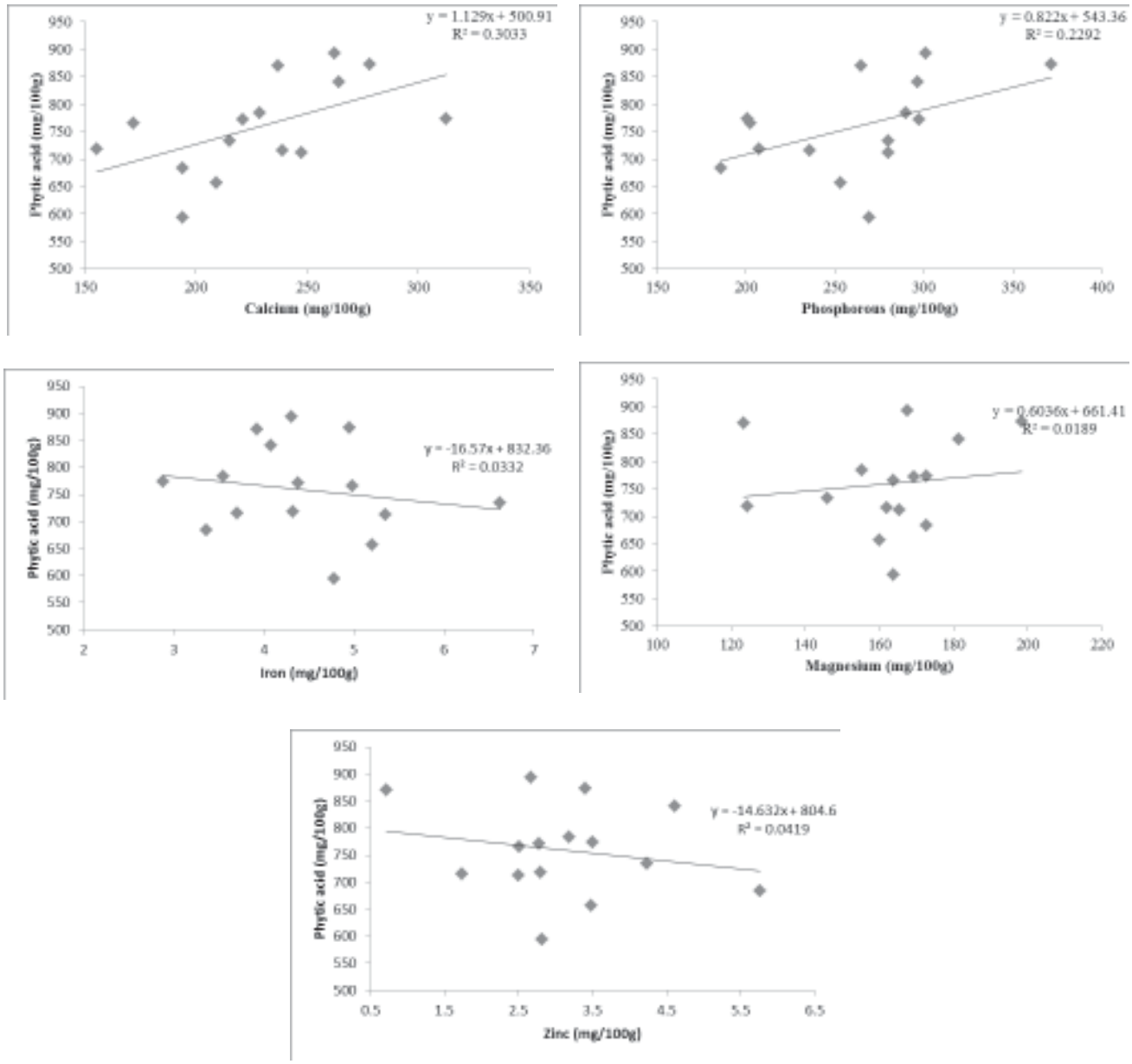

Fig 1. Relationship between the micronutrient and phytic acid content in finger millet germplasm

correlation was found between phytic acid and calcium (R^2 =0.3033) as well as phytic acid and phosphorous (R^2 =0.229) at Pd"0.05 level.

It can be concluded that there is diversity in phytic acid and mineral content among the selected finger millet germplasm and hence selecting germplasm with low phytic acid and high mineral content for crop improvement would help to gain maximum nutritional health benefits.

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