

CHARACTERIZATION OF COLOURED SKINNED POTATO GENOTYPES FOR MINERAL CONTENT

Dalamu*, Shambhu Kumar and Jagdev Sharma

ICAR- Central Potato Research Institute, Shimla-171001, HP

E-mail: dalamu04@gmail.com (*Corresponding author)

Abstract: Eleven coloured skinned potato varieties and advanced hybrids were evaluated for mineral content in whole potato and tuber flesh. Mineral composition depicted varietal and tissue dependence. Though potatoes are generally peeled before consumption but potato peels contains significant minerals. Significant positive correlations were observed between Fe-Zn, Cu- Zn, Ca-Zn, Cu-Fe, Ca-Fe and Ca-Mn contents while Mg-Mn and Ca-Mg contents were negatively correlated. 14KP-14-3, PT/14-16-1, PS/11-47 and 14KP-14-1 are potential nutrient rich genotypes that can serve as either genetic stocks or may release as varieties.

Keywords: Potato, minerals, whole potato, flesh.

Introduction

Hidden hunger affects more than 2 billion individuals in the developed and developing nations (FAO, 2013). The socio-economic constraints involved in success of conventional fortification, dietary diversification and supplementation has led to rethink of interventions into the nutritional biodiversity of crop germplasm *per se* for biofortification. Potato (*Solanum tuberosum* L.) holds the position of third most important food crop globally. The ability of the crop to yield high and nutritious food per unit area, time and water has interested the agricultural researchers and policy makers. China, the world's largest potato producer and consumer targets its half of the increased food production demand in next 20 years to be met from this crop (<https://cipotato.org/crops/potato>).

Potatoes are the excellent, low fat source of carbohydrates, proteins, ascorbic acid, minerals like potassium, phosphorus and magnesium, vitamins like B1, B3 and B6 and bioactive compounds. Bioavailability of minerals depends on its absorption percent. The absorption percent of potato iron and zinc is 10 and 25 percent respectively. Presence of promoter and inhibitors affects mineral bioavailability. Potato has low phytates and oxalates content and high ascorbate, b-carotene, cysteine rich polypeptides, organic acids render it ideal for mineral biofortification.

Worldwide researchers have reported significant genotypic-by-environment (GxE) interaction for iron and zinc content but this does not affect the relative ranking of genotypes with moderately high heritability of both the traits. Genetic associations between iron and zinc are significantly positive with negative association with tuber dry matter. Increasing micronutrient concentration has no negative impact on resistances also.

India, being is the second largest potato producer and increased per capita consumption of fresh potatoes at an Annual Compound Growth Rate of 2.34 (1991 to 2010; CPRI, Vision 2050) and demand of 125 million tonnes by 2050, there is need of high yielding biofortified potato varieties to harvest the dual benefit of food and nutritional security. The nutritional analysis of released varieties depicted narrow variations as till now the main breeding focus was for yield, resistance and processing attributes. The germplasm accessions including advanced hybrids with high ascorbic acid, iron and/or zinc is to be identified that may serve as potential parental lines for introgression of nutrient genes in adapted genetic background or to be released as nutrient rich potatoes.

Material and Methods

Eleven coloured skinned potato varieties and advanced hybrids (Table 1) viz., Kufri Kesar, PS/11-47, PS/11-86, PT/14-16-1, 14KP-39-1, 14KP-14-1, 14KP-14-2, 14KP-21, P-12, 14KP-39-3 and 14KP-14-3 were grown during Rabi season of 2017-2018 at the experimental farm of the ICAR- Central Potato Research Station, Patna. Recommended dosage of fertilizers and inter cultural operations were followed. Dehaulming was done at 90 days after planting followed by harvesting after 15-20- days. Freshly harvested unblemished 10 tubers were used for analysis. Samples were oven dried at 80°C for 72 hours, grinded and acid digest in di-acid mixture (HNO₃: HClO₄ = 2:1). Triplicate samples were used in atomic absorption spectrometer for estimation of micro and macronutrients. Statistical analyses were performed by using Complete Randomized Design (CRD) in TNAU STAT software (Manivannan, 2014).

Table 1. Coloured skinned potato genotypes and their parentage

Genotype	Parentage	Genotype	Parentage
Kufri Kesar	CP 2376 × JP 100	14KP-14-2	CP 2366 × CP 3770
PS/11-47	Kufri Arun × CP 3192	14KP-21	2005 P 75 × CP 3770

PS/11-86	PS 8/97-1 × PRT- 19	P-12	Kufri Arun × Desiree
PT/14-16-1	PS 5/51-1 × D 150	14KP-39-3	Kufri Pushkar × CP 2340
14KP-39-1	Kufri Pushkar × CP 2340	14KP-14-3	CP 2366 × CP 2340
14KP-14-1	CP 2366 × CP 2340		

Results and Discussion

Variations in micro nutrient content

Among the micro nutrients of dietary importance in tuber flesh (without peel), the mean zinc content of the eleven genotypes was 21.83 ppm or mg/kg dry weight basis (Table 2). This average zinc content was higher than those reported in tuber flesh of Indian potato varieties (17.64 ppm, Sharma *et al.*, 2017). The highest zinc content in tuber flesh was in PS/11-47 and 14KP-14-3 (26.20 ppm each) which was statistically equivalent to second highest containing genotype PT/14-16-1 (25.81 ppm). The maximum zinc content in tuber flesh was reported up to 22.85 ppm in Indian potato varieties (Sharma *et al.*, 2017). Least performing genotypes were PS/11-86 and P-12 (18.70 ppm) that were statistically similar to 14KP-39-1 (20.42 ppm), 14KP-14-2 (18.90 ppm) and 14KP-21 (19.20 ppm). However, mean zinc content in whole potato (tuber flesh with peel) was 23.96 ppm higher than those of mean content in potato flesh (21.83 ppm) depicting that potato peels do affect the zinc content of potato tuber (Fig. 1).

Average iron content in tuber flesh of eleven accessions was 45.65 ppm (Table 2) much higher compared to 28.49 ppm in Indian potato varieties (Sharma *et al.*, 2017). Best performing genotypes 14KP-14-3 (58.29 ppm) and 14KP-14-1 (57.35 ppm) had higher tuber flesh iron content than those reported in Indian potato varieties (49.51 ppm, Sharma *et al.*, 2017). 14KP-39-1 has lowest iron content (37.85 ppm) two times to that that lowest iron containing cultivated potato variety (19.96 ppm, Sharma *et al.*, 2017). Mean iron content of whole potato (51.22 pm) was higher than those in tuber flesh only (Fig. 1) again signifying the nutritional value of potato peel.

Highest copper containing genotypes were 14KP-14-1 (9.50 ppm), 14KP-39-3 & 14KP-14-3 (9.30 ppm each) and 14KP-39-1 (9.10 ppm) with lowest content up to 5.90 ppm (Kufri Kesar) (Table 2). However, these highest copper containing genotypes have much lower copper content than those in Indian potato varieties (21 ppm). The average copper content in tuber flesh was 7.76 ppm as compared to 12.59 ppm in Indian potato varieties. The mean copper

content of whole potato (8.93 ppm) was higher than those of tuber flesh (Fig. 1).

Manganese content in tuber flesh was highest in PS/11-47 (21.60 ppm) (Table 2) which was much lesser than the highest containing red skinned potato variety Kufri Lalit (30 ppm, Sharma *et al.*, 2017). The average manganese content of tuber flesh (12.61 ppm) was also lower than the average content of Indian potato varieties (21.13 ppm; Sharma *et al.*, 2017) and also to that of manganese content of whole potato (14.53 ppm, Fig. 1)

Variations in macro nutrient content

Macro nutrient, *viz.*, calcium in tuber flesh ranged from 320.50 ppm (14KP-39-1) to 486.50 ppm (14KP-14-1) (Table 2). The average calcium content of tuber flesh was 409 ppm which was quite low than that in Andean potato cultivars (1092.93 ppm; Andre *et al.*, 2007). The calcium content of whole potato (509.42 ppm) was higher than in potato flesh only (Fig. 1). Magnesium ranged between 900.40 ppm (PS/11-47) to 1084.90 ppm (PT/14-16-1) in tuber flesh (Table 2) with average content of 989.58 ppm lower than that in whole tuber (1095.45 ppm) (Fig. 1).

Table 2. Micro and macronutrient composition of coloured skinned potato genotypes

Genotypes	Micronutrient				Macronutrient	
	Zn (ppm)	Fe (ppm)	Cu (ppm)	Mn (ppm)	Ca (ppm)	Mg (ppm)
K. Kesar	21.00 ^{bc}	39.46 ^{cd}	5.90 ^c	14.50 ^b	470.10 ^{ab}	967.10 ^e
PS/11-47	26.20 ^a	43.85 ^{bcd}	7.30 ^{bc}	21.60 ^a	448.60 ^{ab}	900.40 ^f
PT/14-16-1	25.81 ^a	47.20 ^b	8.50 ^{ab}	11.30 ^{bc}	427.70 ^{bcd}	1084.90 ^a
14KP-39-1	20.42 ^c	37.85 ^d	9.10 ^a	11.10 ^c	320.50 ^f	1055.80 ^{ab}
14KP-14-1	23.95 ^{ab}	57.35 ^a	9.50 ^a	11.70 ^{bc}	486.50 ^a	948.30 ^{ef}
PS/11-86	18.70 ^c	41.77 ^{bcd}	6.80 ^c	12.70 ^{bc}	360.70 ^{ef}	992.60 ^{cde}
14KP-14-2	18.90 ^c	42.70 ^{bcd}	6.80 ^c	13.10 ^{bc}	433.30 ^{abc}	937.60 ^{ef}
14KP-21	19.20 ^c	46.39 ^{bc}	6.80 ^c	10.30 ^c	337.20 ^{ef}	953.30 ^{ef}
P-12	18.70 ^c	46.05 ^{bc}	6.10 ^c	10.60 ^c	374.10 ^{def}	1045.70 ^{abc}
14KP-39-3	21.10 ^{bc}	41.20 ^{bcd}	9.30 ^a	11.20 ^{bc}	380.20 ^{cde}	1026.20 ^{bcd}
14KP-14-3	26.20 ^a	58.29 ^a	9.30 ^a	10.60 ^c	459.60 ^{ab}	973.50 ^{de}
Mean	21.83	45.65	7.76	12.61	408.95	989.58
Range	18.70-26.2	37.85-58.29	5.90-9.50	10.30-21.60	320.50-486.50	900.40-1084.90
SE(±)	0.94	2.01	0.42	0.98	17.10	17.16
CV %	14.25	14.63	17.90	25.68	13.87	5.75

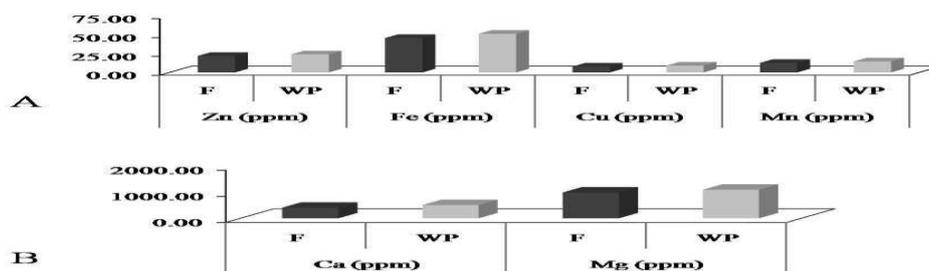


Fig. 1: Comparison of mean micronutrient (A) and macronutrient (B) content in flesh and whole potato (including flesh) of 11 potato genotypes

Correlations among different mineral nutrients

Correlations among Fe, Zn, Cu, Ca, Mn (Fe-Zn, Cu- Zn, Ca-Zn, Cu-Fe, Ca-Fe and Ca-Mn) contents in potato flesh tuber indicate significant positive correlation at 5% level of probability with each other (Table 3). The value of correlation of coefficient (r) was 0.55, 0.54, 0.62, 0.44,

0.52 and 0.37, respectively. On the other hand significant negative relationship was observed among Mg-Mn and Ca-Mg contents at 5% level of probability with each other. The value of correlation of coefficient (r) was -0.59 and -0.45, respectively.

Correlation analysis was presented in Table 3.

Table 3: Correlation coefficients among micro and macro nutrients

	Zinc	Iron	Copper	Manganese	Calcium	Magnesium
Zinc	1.00					
Iron	0.55*	1.00				
Copper	0.54*	0.44*	1.00			
Manganese	0.35	-0.24	-0.27	1.00		
Calcium	0.62*	0.52*	0.10	0.37*	1.00	
Magnesium	-0.11	-0.20	0.24	-0.59*	-0.45*	1.00

* Significant at p<0.05

References

[1] Andre CM, Ghislain M, Bertin P, Oufir M, del Rosario Herrera M, Hoffmann L, Hausman JF, Larondelle Y and Evers D (2007). Andean potato cultivars (*Solanum tuberosum* L.) as a source of antioxidant and mineral micronutrients. J. Agric. Food Chem. 55: 366-378.

[2] Manivannan, N. (2014). TNAUSTAT Statistical package. Retrieved from <https://sites.google.com/site/tnaustat>.

[3] Sharma J, Dalamu, Sharma V, Dua VK, Gupta VK and Kumar D (2017). Variations in micronutrient content in tubers of Indian potato varieties. Potato J 44 (2): 101-109.