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EXTENT OF NUTRACEUTICAL MICRONUTRIENT CONTENT IN FINGER MILLET AND BARNYARD MILLET GERMPLASM COLLECTED FROM UTTARAKHAND

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ABSTRACT

The present investigation aimed at evaluation of finger millet and barnyard millet germplasm for nutraceutical micronutrient content, was conducted with 71 and 72 germplasm accessions of finger millet and barnyard millet, respectively which were collected from Uttarakhand. The fresh harvested seed material was subjected to chemical analysis to estimate Iron and Calcium in finger millet and Iron and Zinc in barnyard millet. Wide range of variation was observed for Iron and Calcium in finger millet accessions and Iron and Zinc in barnyard millet accessions. Finger millet accessions *viz.,* GP-2018-1240, GP-2016-191, GP-2017-888, GP-2016-129, GP-2017-889 and GP-2017-461, GP-2018-1249, GP-2018-1237, GP-2017-602, GP-2018-1240 were reflected significantly superior and top performance for Iron and Calcium, respectively. Similarly, Barnyard millet accessions namely GP-2017-932, GP-2018-1357, GP-2018-1231, GP-2016-44, GP-2018-1229 and GP-2017-844, GP-2017-840, GP-2018-1227, GP-2017-893, GP-2017-852 were exhibited significant superiority over best check for Iron and Zinc, respectively.

Key words : *Finger millet, barnyard millet, Eleusine coracana, Echinochloa frumentacea germplasm, micronutrient*

Millets, are the oldest food grains of Poaceae family and are originated in Eastern Asian regions. Millets belongs to the group of small-seeded species of cereal crops or grains which are annual plants. They are major sources of food and feed in developing countries, especially in arid and semi-arid tropical regions of Africa as well as Asia. Across the globe, minor millets such as finger millet (*Eleusine coracana*), kodo millet (*Paspalumss corbiculatum*), small millet (*Panicum sumatrense*), foxtail millet (*Setaria italica*), proso millet (*Panicum miliaceum*) and barnyard millet (*Echinochloa frumentacea*) are extensively cultivated. Milletshave many advantages: 1) Can be utilized under sustainable agriculture because it can withstand under stress conditions and combating malnutrition. 2) Nutritional security: rich in micronutrients (Ca, Fe Zn and I), bioactive compounds and have better amino acid profile. 3) safety from diseases: gluten free so used as substitute of wheat in cardiac diseases, have low glycaemic index so good for diabetic persons and helps to overcome cardiovascular diseases, anaemia and Ca deficiency. 4) Economic security: climate resilient crop, sustainable income source for farmers, low investment required for production and for economic gains value addition can also be done (1). Mineral elements such as Fe, Zn, and Ca has similar importance for human health and nutrition like carbohydrates, fats and vitamins. So, it is very important to identify nutrient rich germplasm from large population so that it can be further used in breeding programmes for development of a promising variety (2). These crops are used as substitute for rice (*Oryza sativa* L.) when paddy fails to grow, it is highly nutritious, rich in proteins, lipids, and vitamins B_1 and B_2 compared to other cereals such as rice and wheat grains. (3) reported wide range of genetic variability viz., 135.0-312.0?mg/100g for Calcium, 2.0–21.6?mg/100g for Iron and 31.0–139.0?mg/100g for Mg in finger millet germplasm. Similarly, High iron (13.34-16 mg/100g) and zinc content (3.28-4.96 mg/100g) were reported by (4) inbarnyard millet accessions. (4) also noticed high PCV and GCV values and high heritability in F2 population of three crosses for number of tillers, iron and zinc content thereby indicating the predominance of additive gene effects in their expression and would respond to selection effectively as they are least influenced by environment. Keeping in view the above facts the present investigation was conducted to determine micronutrient content, *i.e.* Iron (Fe) and Calcium (Ca) in finger millet and Iron (Fe) and Zinc (Zn) in barnyard millet.

MATERIALS AND METHODS

The experimental material was comprised of 71 finger millet and 72 barnyard millet germplasm accessions with six and five check varieties, respectively. The fresh harvested seed material was used for estimating the micronutrient content. this experiment. The micronutrient (Fe, Zn and Ca) were estimated in acid digested grains of millets following (5) method.

One-gram dried sample of millet grain of each genotype was taken into 150 ml conical flask and 10 ml of nitric acid and perchloric acid in the ratio of 9:4 was added to it. Each conical flask was kept overnight with the mouth of flask covered.Thereafter conical flask filled with digestion solution was heated for 30 minutes on a hot plate at 40º C till completion of digestion. First brown fumes of nitric acid evolved and towards the end of digestion white fumes of perchloric acid evolved. The sample digested until a semi-solid viscous material of light brownish colour is reduced to traces of white residue in the bottom. It usually takes 1-2 hrs for completion of digestion. If the sample was charred another 10 ml of nitric acid was added and

Table-1 : Mean performance of finger millet accessions with respect to micronutrient content.

S.No.	Genotype	Fe (mg/g)	Ca (mg/g)	S.No.	Genotype	Fe (mg/g)	Ca (mg/g)
1	GP-2017-333	3.04	0.82	41	GP-2016-119	3.13	0.81
2	GP-2017-461	7.8	3.15	42	GP-2018-1028	2.7	0.66
3	GP-2017-502	2.62	0.67	43	GP-2016-148	5.19	0.87
4	GP-2017-519	3.39	1.11	44	GP-2016-198	7.77	1.06
5	GP-2017-532	2.72	0.67	45	GP-2017-438	3.54	1.02
6	GP-2017-577	3.57	1.19	46	GP-2016-191	12.95	1.28
7	GP-2017-579	4.6	1.45	47	GP-2018-1041	6.43	0.69
8	GP-2017-592	2.69	1.02	48	GP-2016-197	3.78	0.59
9	GP-2017-602	4.64	2.15	49	GP-2016-128	4.02	0.81
10	GP-2017-636	2.31	0.96	50	GP-2016-120	5.19	0.74
11	GP-2017-644	3.33	1.35	51	GP-2018-1175	4	1.45
12	GP-2017-652	3.97	1.4	52	GP-2017-3	2.92	0.78
13	GP-2017-666	2.57	1.25	53	GP-2018-1212	4.93	0.72
14	GP-2017-687	2.99	1.96	54	GP-2016-131	3.35	0.72
15	GP-2017-689	2.93	1.4	55	GP-2017-384	2.66	0.55
16	GP-2017-703	6.28	1.61	56	GP-2018-1177	3.37	0.97
17	GP-2017-752	2.29	0.91	57	GP-2018-1172	2.43	1.12
18	GP-2017-802	3.09	1.46	58	GP-2016-116	2.58	0.86
19	GP-2017-827	4.51	1.66	59	GP-2016-192	3.22	1.1
20	GP-2017-829	2.61	1.22	60	GP-2017-410	3.67	0.91
21	GP-2017-832	3.44	1.2	61	GP-2016-129	9.65	1.24
22	GP-2017-834	2.8	0.68	62	GP-2017-396	3.07	0.75
23	GP-2017-835	3.57	1.84	63	GP-2016-236	2.78	0.68
24	GP-2017-836	6.13	2.12	64	GP-2016-194	2.8	0.6
25	GP-2017-886	4.14	1.92	65	GP-2016-132	3.06	0.59
26	GP-2017-888	10.51	1.22	66	GP-2017-402	2.61	0.49
27	GP-2017-889	8.5	2.1	67	GP-2016-126	2.55	0.4
28	GP-2017-892	3.22	1.12	68	GP-2017-390	2.14	0.51
29	GP-2017-923	3.72	1.2	69	GP-2017-413	2.83	0.74
30	GP-2017-958	3.35	1.19	70	GP-2017-393	2.64	0.47
31	GP-2018-1234	2.28	0.97	71	GP-2018-1032	-	0.62
32	GP-2018-1237	4.73	2.17	72	VL 149	4.07	0.99
33	GP-2018-1239	2.16	1.2	73	VL 315	1.58	0.35
34	GP-2018-1240	17.31	2.15	74	VL 324	2.13	1.39
35	GP-2018-1241	2.26	1.63	75	VL 347	3.39	1
36	GP-2018-1242	2.49	0.8	76	VL 348	3.76	0.88
37	GP-2018-1245	1.99	1.66	77	VL 352	4.27	0.66
38	GP-2018-1249	8.04	2.24		General Mean	4.08	1.13
39	GP-2018-1253	3.36	1.38		CD @5%	1.184	0.252
40	GP-2016-21	2.93	0.85		CV %	3.75	3.64

digested again. The digested samples were filtered through Whatman No. 42 filter paper and final volume was made up to 50 ml with distilled water. A blank was treated similarly with each set of samples. The filtrate was used for estimation of micronutrient content through atomic absorption spectrophotometer (AAS). Final mineral concentration was calculated using the following formula :

Mineral content = Concentration of sample (ppm) x dilution factor.

RESULTS AND DISCUSSION

The estimation of micronutrient content was carried out through chemical method using dried seed of fresh harvest of the two consecutive years *i.e., Kharif* 2017 and

Table-2 : Mean performance of Barnyard millet accessions with respect to Micronutrient content.

S.No.	Genotype	Fe (mg/g)	Zn (mg/g)	S.No.	Genotype	Fe (mg/g)	Zn (mg/g)
1	GP-2017-753	1.79	1.29	41	GP-2016-29	1.2	0.88
2	GP-2017-831	1.48	1.03	42	GP-2016-30	1.22	0.72
3	GP-2017-838	-	0.92	43	GP-2016-32	1.38	0.83
4	GP-2017-839	1.85	1.1	44	GP-2016-33	1.55	0.87
5	GP-2017-840	1.81	1.45	45	GP-2016-34	1.82	0.89
6	GP-2017-841	1.36	0.96	46	GP-2016-35	0.84	0.89
7	GP-2017-842	2.63	1.36	47	GP-2016-37	1.46	0.85
8	GP-2017-844	2.4	1.54	48	GP-2016-39	2.49	1.08
9	GP-2017-845	1.94	1.25	49	GP-2016-40	1.32	0.8
10	GP-2017-847	1.92	1.27	50	GP-2016-41	1.09	0.71
11	GP-2017-848	2.37	1.18	51	GP-2016-43	2.23	1.14
12	GP-2017-849	1.77	1.16	52	GP-2016-44	3.15	0.75
13	GP-2017-850	2.65	1.34	53	GP-2016-45	1.03	0.56
14	GP-2017-851	2.39	1.17	54	GP-2017-395	2.45	1.15
15	GP-2017-852	2.53	1.37	55	GP-2017-423	2.28	1.01
16	GP-2017-893	2.04	1.39	56	GP-2017-432	0.84	0.81
17	GP-2017-932	8.17	1.17	57	GP-2017-457	1.6	1.15
18	GP-2018-1223	2.1	1.36	58	GP-2017-64	1.56	1.13
19	GP-2018-1224	-	1.13	59	GP-2017-66	1.49	0.87
20	GP-2018-1225	1.81	1.06	60	GP-2017-69	0.64	0.53
21	GP-2018-1226	1.75	1.19	61	GP-2018-1046	1.3	1.27
22	GP-2018-1227	2.15	1.42	62	GP-2018-1047	2.56	1.06
23	GP-2018-1228	1.63	1.06	63	GP-2018-1048	1.9	1.05
24	GP-2018-1229	3	1.3	64	GP-2018-1049	1.19	0.76
25	GP-2018-1231	3.17	1.16	65	GP-2018-1050	1.68	0.89
26	GP-2018-1233	1.84	1.13	66	GP-2018-1051	1.95	0.92
27	GP-2018-1357	3.35	0.88	67	GP-2018-1052	1.23	0.92
28	GP-2014-42	1.42	0.83	68	GP-2018-1053	1.64	1
29	GP-2016-113	1.23	1.03	69	GP-2018-1168	1.81	0.91
30	GP-2016-114	2.3	1.31	70	GP-2018-1175	1.95	0.81
31	GP-2016-230	2.25	0.94	71	GP-2018-1201	1.36	0.76
32	GP-2016-231	1.31	0.92	72	GP-2018-1871	0.95	0.7
33	GP-2016-233	0.88	0.84	73	PRJ 1	2.23	0.94
34	GP-2016-234	2.21	0.98	74	VL 172	1.23	1.07
35	GP-2016-235	1.19	1.21	75	VL 181	1.67	0.93
36	GP-2016-237	1.26	0.85	76	VL 207	2	1
37	GP-2016-238	1.31	0.85	77	VL 29	1.37	0.92
38	GP-2016-239	1.35	1.13		General Mean	1.85	1.02
39	GP-2016-240	1.45	0.97		CD @5%	0.42	0.06
40	GP-2016-241	1.17	0.83		CV %	4.11	4.68

2018 and analysis of variance was carried out for the micronutrient content in finger millet and barnyard millet separately for season and the pooled analysis of variance was also conducted as the variances were found to be homogeneous for both the years. The analysis of variance for both the individual seasons and also the pooled analysis for the micronutrient content traits, revealed highly significant differences among the germplasm accessions and suggested sufficient amount of genetic variability among evaluated germplasms for further analysis. The estimates of average micronutrient content for finger millet and barnyard millet is presented in Table-1 and 2, respectively and the results are summarized in following paragraphs.

Table-3 : Range and performance of Finger millet and Barnyard millet accessions with respect to Micronutrient content.

Crop /Micronutrient	Range	Best Check	No. of Superior accession	Top five accessions
Finger Millet				
Fe (mg/g)	1.58-17.31	VL 352 (4.27)	11	GP-2018-1240 (17.31), GP-2016-191 (12.95), GP-2017-888 (10.51), GP-2016-129 (9.65), GP-2017-889 (8.5)
Ca (mg/g)	0.35-3.15	VL 324 (1.39)	12	GP-2017-461 (3.15), GP-2018-1249 (2.24), GP-2018-1237 (2.17), GP-2017-602 (2.15), GP-2018-1240 (2.15)
Barnyard Millet				
Fe (mg/g)	0.64-8.17	PRJ 1(2.23)	06	GP-2017-932 (8.17), GP-2018-1357 (3.35), GP-2018-1231 (3.17), GP-2016-44 (3.15), GP-2018-1229 (3.00)
Zn (mg/g)	0.53-1.54	VL 172 (1.07)	24	GP-2017-844 (1.54), GP-2017-840 (1.45), GP-2018-1227 (1.42), GP-2017-893 (1.39), GP-2017-852 (1.37)

Mean performance of finger millet accessions for nutritional traits : The estimates of average micronutrient content for finger millet is presented in Table-1. Critical perusal of the Table-1 revealed that VL 352 (4.27 mg/g) emerged as best check for Iron content, whereas VL 324 (1.39 mg/g) was found to be best check for Calcium content. The finger millet accessions had shown wide range of variation from 1.58 mg/g(VL 315) to 17.31 mg/g (GP-2018-1240) with a general mean of 4.08mg/g for Iron content. Eighteen finger millet accessions exhibited significantly superior performance for Iron content, out of which GP-2018-1240 (17.31mg/g), GP-2016-191 (12.95mg/g), GP-2017-888 (10.51mg/g), GP-2016-129 (9.65mg/g), and GP-2017-889 (8.5mg/g) were the top five accessions having high Iron content in the seed. Similarly, wide variation for Calcium content was reflected by the finger millet accessions, ranging from 0.35 mg/g (VL-315) to 3.15 mg/g (GP-2017-461) with a general mean of 1.13 mg/g Calcium. Nineteen accessions were found significantly higher in Calcium content than the best check, out of which top five accessions wereGP-2017-461 (3.15mg/g), GP-2018-1249 (2.24mg/g), GP-2018-1237 (2.17mg/g), GP-2017-602 (2.15mg/g), GP-2018-1240 (2.15mg/g) in finger millet.(6) reported micronutrient Fe, in white, black and mixed species of Ethiopian finger millets with a range of variation from 156 ± 18 to 775 ± 42 ppm among the accessions.

Mean performance of Barnyard millet accessions for nutritional traits : The estimates of average micronutrient content for barnyard millet is presented in Table-2, which revealed that PRJ 1 (2.23 mg/g) identified as best check for Iron content, whereas VL-172 (1.07mg/g) was ranked as the best check for Zinc content. The wide range of variation was found among the barnyard millet accessions from 0.64mg/g (GP-2017-69) to 8.17mg/g (GP-2017-932) with a general mean of 1.85mg/g for Iron content. Eighteen barnyard millet accessions surpassed significantly the best check for Iron content, out of which GP-2017-932 (8.17mg/g), GP-2018-1357 (3.35mg/g), GP-2018-1231 (3.17mg/g), GP-2016-44 (3.15mg/g), GP-2018-1229 (3.00mg/g)were the top five accessions containing high Iron in the seed. Similarly, wide variation for Zinc content was observed among the barnyard millet accessions, ranging from 0.53mg/g (GP-2017-69) to 1.54mg/g (GP-2017-844) with a general mean of 1.02mg/gZinc. Thirty barnyard millet accessions were found significantly higher in Zinc content than the best check, out of which top five accessions were GP-2017-844 (1.54mg/g), GP-2017-840 (1.45mg/g), GP-2018-1227 (1.42mg/g), GP-2017-893 (1.39mg/g), GP-2017-852 (1.37mg/g) in barnyard millet.The range of iron was reported by (7) as 1.2-1.5mg/100g in barnyard millet.(4) also reported widerange of iron content and zinc content in accessions of barnyard millet.

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REFERENCES

1. Kumar A., Reddy B.V. and Ramaiah B. (2018). Biofortification for combating micronutrient malnutrition : Identification of commercial sorghum cultivars with high grain iron and zinc concentrations. *Indian Journal of Dryland Agricultural Research and Development*, *28(1):* 89-94.
2. Imtiaz M., Rashid A., Khan P., Memon M.Y. and Aslam M. (2010). The role of micronutrients in crop production and human health. *Pak. J. Bot., 42(4):* 2565-2578.

3. Badigannavar A. and Ganapathi T.R. (2018). Genetic variability for mineral nutrients in indigenous germplasm lines of finger millet (*Eleusinecoracana* Gaertn.). *Journal of cereal science*, *84:* 1-6.
4. Renganathan V.G., Vanniarajan C., Nirmalakumari A., Raveendran M., Thiyageshwari S. and Arunachalam P. (2017). Association analysis in germplasm and F_2 segregating population of barnyard millet (*Echinochloa frumentacea* Roxb. Link) for biometrical and nutritional traits. *International Journal of Current Microbiology and Applied Sciences*, *6(8):* 3394-3400.
5. Lindsay W.L. and Norvell W.A. (1978). Development of a DTPA soil test for zinc, iron, manganese, and copper. *Soil Science Society of America Journal, 42:* 421-428.
6. Birhanu W.T., Chaueby A.K., Teklemariam T.T., Dewu B.M., Oladipo M.O.A., Ahmed, Y.A. and Abubakr N. (2015). Analysis of essential elements in Ethiopian finger millets (*Eleusine coracana*) by instrumental neutron activation analysis (INAA). *International Journal of Basic and Applied Sciences*, *4(1):* 82.
7. Veena B., Chimmad B.V., Naik R.K. and Shantakumar G. (2005). Physico-chemical and nutritional studies in barnyard millet. *Karnataka J. Agril. Sci.*, *18(1):* 101-105.

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