RESEARCH PAPER

ADVANCE RESEARCH JOURNAL OF
CROP IMPROVEMENT
Volume 7 | Issue 1 | June, 2016 | 76-79
e ISSN-2231-640X

DOI :
10.15740/HAS/ARJCI/7.1/76-79
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An evaluation of nutritional properties in barnyard millet [*Echinochloa frumentacea* (Roxb.) Link] germplasm

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ABSTRACT : An estimation was carried out with 65 indigenous and exotic barnyard millet germplasm to study the nutritional properties such as protein, carbohydrate and fibre content. The study revealed that, highest amount of protein was observed in ACM 161 (13.20 g/100 g), highest carbohydrate content was in ACM161 (76.20 g/100 g), crude fibre was highest in ACM 161 (10.80 g/100 g) with a grain yield of 47.8g/plant. In any crop the yield will be inversely proportional to the quality parameters. On the contrary in the present study, it was observed that ACM 161, ACM 110, ACM 145 and ACM 313 had high yielding as well as good in nutritional content.

KEY **W**ORDS : Barnyard millet, Carbohydrate, Protein, Fibre estimation

How to cite this paper : Prakash, R., Vanniarajan, C., Kanchana, S., Prabhaharan, J. and Chandrakumar, K. (2016). An evaluation of nutritional properties in barnyard millet [*Echinochloa frumentacea* (Roxb.) Link] germplasm. *Adv. Res. J. Crop Improv.,* **7** (1) : 76-79, **DOI : 10.15740/HAS/ARJCI/7.1/76-79**.

Paper **H**istory : **Received :** 02.02.2016; **Revised :** 09.04.2016; **Accepted :** 07.05.2016

The grains of barnyard millet contain 11.2 per cent protein, 9.8 per cent crude fibre, 65.5 per cent carbohydrate and 4.7 per cent ash (Joshi, 2013) and are consumed just like rice. Out of the total protein, it also consists of 16.6 per cent of amino acid leucine, which is twice the quantity of rice (CZFCDB, 2012). Barnyard millet is having a low glycemic index and it is used for preparation of low GI biscuits and *Burfi*, a sweet product and it is an ideal food for people suffering from diabetes. Barnyard millet being a promising source of micronutrients and protein besides energy, can make a contribution to alleviating micronutrient and protein malnutrition, also called 'hidden-hunger', affecting more than half of the world's population, especially women and pre-school children in most countries of Africa and south-east Asia. The high proportion of carbohydrates in form of non-starchy polysccharides and dietry fibres in grains helps in reducing cholesterol and slow release of glucose to the blood stream during digestion and hence suitable for the diabetic patients. So far, very limited work has been done for the genetic improvement of barnyard millet crop and continued to be a neglected and underutilized

crop. Hence, the present research work was undertaken to study the nutritional properties of barnyard millet germplasm.

RESEARCH PROCEDURE

Sixty five genotypes grain samples were taken and it was subjected to various nutritional analyses like carbohydrate, protein and crude fibre. These nutritional quality analyses were carried out at Department of Food Science and Nutrition, Home Science College and Research Institute, Madurai and Department of Soil and Environment, Agricultural College and Research Institute, Madurai.

Protein estimation :

About 0.5 g of the sample was ground with a suitable solvent system, supernatant was collected for protein estimation. To 0.1 ml of the sample extract, 1 ml of water was added in all the tubes. Five ml of solution C (2% sodium carbonate in 0.1N NaOH + copper sulphate in 1% sodium potassium tartarate) was added and mixed well and incubated at room temperature for 10 min. About 0.5 ml of FCR was added, mixed well immediately and kept at room temperature in dark for 30 min. Protein reacts with the Folin-Ciocalteau reagent (FCR) to give a blue coloured complex. The absorbance was read at 660 nm. The amount of protein in the sample was calculated using a standard curve prepared and the results are expressed as mg/g or mg/100 g sample or percentage.

Carbohydrate estimation :

The carbohydrate content present in the seed samples were estimated by Anthrone method (Hedge and Hofreiter, 1962). The carbohydrate content was measured by hydrolyzing the polysaccharides in to simple sugars by acid hydrolysis and estimating the resultant monosaccharide. Hundred mg of the sample was weighed and transferred to a boiling tube. The sample was hydrolysed in boiling water bath for three hours with 5 ml of 2.5 N HCl and cooled to room temperature. It was neutralized with solid sodium carbonate until effervescence stopped. The volume was made upto to 100 ml. The samples were prepared by taking 0.2, 0.4, 0.6, 0.8 and 1.0 ml of the working standard. '0' served as the blank. The volume was made upto 1.0 ml with distilled water in all the tubes including the sample tube. Then 4 ml of anthrone reagent was added. The tubes were heated in boiling water bath for 8 min and cooled rapidly. The readings were taken from green to dark green colour at 630 nm. Standard graph was drawn by blotting the concentration of the standard on X axis and absorbance on Y axis. From the graph, the amount of carbohydrate present in the sample was calculated.

Crude fibre estimation :

The crude fibre content was determined by the method described by Sadasivam and Manickam (1996). The dried sample was taken in the beaker and 200 ml of 1.25 per cent sulphuric acid was added and boiled for 30 min. The contents were filtered through muslin cloth and washed with distilled water until washings were no longer acidic. The residue was transferred to the same beaker and boiled with 1.25 per cent sodium hydroxide for 30 min and filtered through muslin cloth, washed with 50 ml of distilled water and 25 ml of alcohol. The residue transferred into a pre weighed silica crucible, dried for 2-4 hrs at 130^0C, cooled and weighed. The loss in weight due to the fibre content was expressed in percentage.

RESEARCH ANALYSIS AND REASONING

Millets are good source of energy, protein, vitamin, minerals and essential amino acids. In this direction, nutrient compositions of barnyard millet were analyzed for sixty five genotypes and the results are presented in Table 1. The protein content of the genotypes ranged from 6.80 g/100 g to 13.20 g/100g. The maximum amount of protein is noticed in ACM 161 (13.20 g/100g) followed by ACM 110 (12.30 g/100g), ACM 145 (12.20 g/100g) and ACM 313 (12.10 g/100g) and the minimum was observed in IEc. 675 (6.80g/100g). Eleven genotypes were found to excel significantly higher protein content (more than 9.84 g/100g). Carbohydrate content in the genotypes ranged from 60.40g/100g to 76.20 g/100g. The maximum amount of carbohydrate was observed in ACM161 (76.20 g/100g) followed by ACM 110 (75.40g/100 g), ACM 313 (75.20 g/100g) and ACM 145 (75.00 g/100g) and the minimum content was recorded by IEc. 786 (60.40g/100g). A total of 25 genotypes were found to have more carbohydrate (more than 68.11 g/100g). The maximum amount of crude fibre was found in ACM 161 (10.80 g/100g) followed by ACM 145 and ACM 110 (10.40 g/100g) and minimum in IEc.701 (7.00 g/100g). Out of 65 genotypes twenty were recorded more fibre content (more than 9.31 g/100g).

The study revealed that, highest amount of protein was observed in ACM 161 (13.20 g/100 g), highest carbohydrate content was in ACM161 (76.20 g/100 g), crude fibre was highest in ACM 161 (10.80 g/100 g) with a grain yield of 47.8g/plant. The values observed for protein content in the different genotypes is also comparable with those reported for common cereals (Gopalan *et al*., 2002). High protein content in barnyard millet was also reported by Jun Young Kim *et al*. (2011). Millets in general are reported to contain lower

Table 1 : Mean performance of 65 barnyard millet genotypes for nutritional traits

Sr.No.	Genotype	Protein	Carbohydrate	Fibre	Sr. No.	Genotype	Protein	Carbohydrate	Fibre
1.	IEc. 53	7.9	63.5	7.8	36.	IEc. 648	8.3	69.1*	9.9*
2.	IEc. 80	8.2	68.4*	7.5	37.	IEc. 650	9.7	63.5	8.5
3.	IEc. 131	8.5	60.5	7.4	38.	IEc. 651	7.5	68.4*	9.2
4.	IEc. 365	7.7	67.7	8.2	39.	IEc. 661	8.7	60.5	7.8
5.	IEc. 137	6.9	66.5	8.7	40.	IEc. 672	9.3	67.7	7.5
6.	IEc. 178	8.5	65.3	9.4*	41.	IEc. 675	6.8	66.5	7.4
7.	IEc. 179	9.3	64.5	9.0	42.	IEc. 688	9.4	65.3	8.2
8.	IEc. 183	8.3	65.0	7.8	43.	IEc. 690	8.3	64.5	7.6
9.	IEc. 217	9.7	60.8	7.6	44.	IEc. 701	7.8	65.0	7.0
10.	IEc. 229	7.5	64.3	7.3	45.	IEc. 706	7.9	60.8	9.8*
11.	IEc. 239	10.6	68.9*	9.8*	46.	IEc. 747	8.4	64.3	9.9*
12.	IEc. 240	11.8*	71.7*	9.9*	47.	IEc. 751	8.5	68.9*	9.2
13.	IEc. 265	6.9	67.8	8.5	48.	IEc. 786	9.3	60.4	7.8
14.	IEc. 269	9.4	66.5	9.2	49.	IEc. 52	8.3	67.7	7.5
15.	IEc. 285	8.3	70.1*	7.8	50.	IEc. 264	7.8	66.5	7.4
16.	IEc. 321	7.8	68.4*	7.5	51.	IEc. 402	7.9	65.3	8.2
17.	IEc. 338	7.9	65.4	7.4	52.	IEc. 455	8.5	64.5	7.6
18.	IEc. 348	8.4	62.6	8.2	53.	ACM 313	12.1*	75.2*	7.4
19.	IEc. 350	8.5	67.8	7.6	54.	ACM 331	11.4*	68.9*	8.9
20.	IEc. 360	9.3	69.1*	7.3	55.	ACM 35	10.9*	70.4*	9.1
21.	IEc. 364	7.9	63.5	9.8*	56.	ACM 296	10.3	71.3*	9.5*
22.	IEc. 370	8.2	68.4*	9.9*	57.	ACM 161	13.2*	76.2*	10.8*
23.	IEc. 374	8.5	60.5	8.5	58.	ACM 82	11.8*	74.8*	10.2*
24.	IEc. 381	7.7	67.7	9.2	59.	ACM 22	10.4	70.4*	9.7*
25.	IEc. 346	6.9	66.5	7.8	60.	ACM 145	12.2*	75.0*	10.4*
26.	IEc. 353	8.5	65.3	7.5	61.	ACM 146	10.6	72.6*	9.8*
27.	IEc. 556	9.3	64.5	7.4	62.	ACM 110	12.3*	75.4*	10.4*
28.	IEc. 568	8.3	65.0	8.2	63.	Co (Kv) 2 (M)	11.0*	71.3*	9.8*
29.	IEc. 573	9.7	60.8	8.7	64.	Co 1	11.0*	75.0*	10.0*
30.	IEc. 607	7.5	64.3	9.4*	65.	Co (Kv) 2	11.98*	74.8*	9.8*
31.	IEc. 613	8.7	68.9*	9.0	Grand mean		9.1	67.20	8.6
32.	IEc. 616	9.3	62.5	7.8	S.E.±		0.38	0.46	0.36
33.	IEc. 619	6.9	67.8	7.6	C.D. (P=0.05)		0.74	0.91	0.71
34.	IEc. 624	9.4	66.5	7.3					
35.	IEc. 647	9.3	70.1*	9.8*					

* indicate significance of value at P=0.05

carbohydrate content than the staple cereals (Gopalan *et al.*, 2002). The chemical analysis for total crude fibre revealed a higher value of 9.82 mg/ g and a similar range of values were reported by Veena *et al*. (2005).

In any crop the yield will be inversely proportional to the quality parameters. On the contrary in the present study, it was observed that ACM 161, ACM 110, ACM 145 and ACM 313 had high yielding as well as good in nutritional content. A similar finding of high yield coupled with good quality in barnyard millet was reported by Ganesamoorthi (2012).

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