

Nutritional and Physical Evaluation of Selected Pearl Millet Cultivars†

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A comparative study was carried out on nutritional and physical qualities of nine cultivars (three in each group of hybrid, composite and land races) of pearl millet (*Pennisetum glaucum*) grown in I-C zone of Rajasthan. The estimated mean values for moisture, protein, fat, ash, fiber, carbohydrates and energy on g per cent basis were found to be ranging as 4.79 to 7.81, 8.59 to 10.71, 5.17 to 10.28, 1.24 to 2.06, 1.86 to 3.66, 69.20 to 74.76 and 396 to 421 Kcal respectively. Fat content was found to be maximum in RHB 121 (10.28 g) and minimum in Jaisalmeri Desi (5.17 g). Protein content was found to be higher in land races followed by composite and hybrid. The total soluble sugar, reducing sugars and non-reducing sugars were ranging from 1.77 to 2.08, 1.30 to 1.80 and 0.24 to 0.79 %. The per cent values for calcium, phosphorus and iron ranged between 396 to 421 Kcal, 29.47 to 60.15, 256.79 to 398.84 and 5.24 to 7.94 mg per cent respectively. The values for physical characteristics like seed weight, seed volume, seed density, hydration capacity, swelling capacity, seed germination per cent were ranging between 5.01 to 8.64 g/1000 seed, 0.017 to 0.043 m/seed, 0.780 to 0.860 g/mL, 0.0027 to 0.0037 g/seed, 0.0018 to 0.0033 mL /seed and 86.86 to 95.94 per cent respectively with significant variation between the variation at five per cent level of significance. Seed weight was noted high in all the hybrid cultivars as compare to land races and composite varieties. Amount of antinutritional factors like polyphenols and phytic acids was noted to be ranging from 261.11 to 653.47 mg per cent and 48.65 to 84.75 mg per cent respectively. The varieties in nutritional and physical qualities of pearl millet cultivars varied widely and found to be independent of the type of sub groups of their varieties *i.e.* hybrid, composite and land races.

Key Words: Pearl millet, Cultivars, Nutritional, Physical, Hybrid, Composite, Land races.

INTRODUCTION

Pearl millet (*Pennisetum glaucum*) with a popular name 'Bajra' ranks sixth in importance, follows wheat, rice, corn, barley and sorghum. However, in India it is fourth most important cereal crop after rice, wheat and sorghum. It has the greatest potential among all the millets. Pearl millet is an important coarse grain cereal generally grown as rain fed crop on marginal lands under low input management conditions. It provides nutritionally superior staple food for millions of people living in environment that all are characterized by persistent drought, unpredictable weather, limited and erratic rainfall and nutrient poor soil. As a cereal for human food pearl millet may contribute a great part of dietary nutrients for large segments of population and is often considered highly palatable and a good source of protein, minerals and energy.

Rajasthan is the largest state of India, having 158.6 lac hectare arable land. About 2/3 part of the state is under arid and semi-arid region. The water resource in state is only 1 % of the total water resource in the country and its demand is

increasing. In order to manage the developmental activities and speed up the need based research, whole of the Rajasthan is divided into ten agro-climatic zones. I-c zone covers the districts of Bikaner, Jaisalmer and three tehsils of Churu district *i.e.* Ratanghar, Sujanghar and Sardarsahar. In the state of Rajasthan pearl millet is cultivated on 42.8 lac ha with the production and productivity of 25.4 lac tonne and 470 kg. per hectare respectively. The share of zone I-c in area and production is 17.5 per cent (8.5 lac hectare) and 14.95 per cent (3.0 lac tonne), respectively¹.

Generally pearl millet varieties can be divided into three sub groups, local varieties, composite varieties and hybrid varieties². Local varieties are the mixture of different types and it is adopted to local environment. It is endemic to an area with its origin dating back to several hundred years. Composite varieties are those varieties whose seeds are composed by mixing different varieties taken from various parts of seed lot. Hybrid varieties are the first generation or offspring from a cross of different varieties or strains³. As compare to hybrid and composite varieties local varieties can be considered as

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TABLE-1
NUTRITIONAL COMPOSITION OF DIFFERENT PEARL MILLET CULTIVARS (per 100 g)

Pearl Millet Cultivars	Moisture (g)	Protein (g)	Fat (g)	Ash (g)	Fiber (g)	Total carbohydrates	Total soluble sugars (g)	Reducing sugars (g)	Non reducing sugars (g)	Energy (Kcal)
Hybrid										
RHB 121	5.84	9.19	10.28	1.90	1.95	70.84	2.07	1.58	0.49	413
HHB 67	4.97	9.60	7.38	1.85	2.56	73.64	2.02	1.78	0.24	399
HHB 94	5.06	8.59	8.37	1.70	3.35	72.92	2.08	1.30	0.79	401
Composite										
Raj 171	7.30	10.28	7.54	2.04	2.02	70.82	2.07	1.80	0.27	393
CZP 9802	4.79	10.06	8.20	1.72	1.85	73.38	2.04	1.44	0.60	408
Pusa 334	5.49	8.75	6.55	1.87	3.66	73.69	2.08	1.66	0.42	389
Land Races										
Chadi	7.81	10.71	7.04	2.06	3.18	69.20	1.82	1.39	0.39	383
Jaisalmeri Desi	5.87	10.50	5.17	1.35	3.08	74.07	2.02	1.59	0.58	385
Bikaneri	5.31	9.40	6.84	1.24	2.44	74.76	1.77	1.58	0.34	398
CD at 5 %	0.22	0.54	0.48	0.10	0.13	0.822	-	0.029	0.025	2.48

*on dry basis

similar to organic varieties, as in Rajasthan, due to erratic rainfall, frequent drought and poor economic condition of farmers they just sow the seeds of pearl millet and harvest it at the time of harvesting without using inputs like, inorganic manure, insecticides, pesticides and even irrigation. However scientific information about nutrient and physico-chemical aspects of different varieties of pearl millet is not available in the literature, hence present study may unfold the existing facts.

EXPERIMENTAL

The present investigation was therefore undertaken to analyze the nutritional and physical qualities of different pearl millet cultivars grown in I-c zone of Rajasthan. Common available pearl millet cultivars were divided into three sub groups *i.e.* hybrid, composite and land races cultivars⁴. Among these groups, three cultivars of each class were selected as per the convenience and availability in I-c zone of Rajasthan. These included:-RHB-121, HHB-67, HHB-94 of hybrid cultivars, Raj 171, CZP-9802, Pusa-334 of composite cultivars and Chadi, Jaisalmeri Desi and Bikaneri of land races of pearl millet cultivars were procured from Agricultural Research Station Bikaner and Krishi Vigyan Kandra's located in I-c zone of Rajasthan in a single lot.

All the selected pearl millet cultivars were evaluated for physical properties such as seed weight, seed density, seed volume, hydration capacity, swelling capacity, germination per cent by the standard method of⁵. Proximate composition *i.e.* moisture, protein, fat, crude fiber and ash was estimated by using the standard procedures of while their colour was noted visually⁶. Carbohydrates, total soluble sugars and energy were also estimated on the biases of standard methods proposed by AOAC y reducing sugars was determined by the method of dinitrosalicylic acid method⁷. The amount of non-reducing sugars was calculated as the differences between the amount of total soluble sugars and reducing sugars. All minerals, macro (calcium, phosphorus) and micro (iron) estimation from ash of different selected pearl millet varieties. Calcium and phosphorus content were estimated by Talpatra *et al.*⁸. Iron content was estimated by atomic absorption spectrophotometer (model-139, ECI: Electronic Corporation of India). Phytic acid was determined by the method of Davies and Reid⁹. Total

polyphenols were extracted by the method of Singh and Jambunathan¹⁰.

RESULTS AND DISCUSSION

Proximate composition: Moisture of the pearl millet cultivars analyzed during present study was found to be significantly different from one another at 5 % level of significance. Table-1 depicts that the moisture content remained between 4.79 to 7.81 %, which is far below the safe limit (13 %) for storage¹¹. Variety CZP 9802 contained the minimum whereas Raj 171 contained the maximum moisture. Akubor and Obiegbuna¹² and Elkhalfa and Singh¹³ also have reported almost similar for moisture content in different varieties of pearl millet. Protein content in different varieties ranged from 8.59 to 10.71 percent. Variety HHB 94 and Pusa 334 had minimum, whereas variety Chadi contained maximum amount of protein. In general, land races had higher protein content followed by composite and hybrid varieties of pearl millet. The crude fat content in the varieties ranged from 5.17 (Jaisalmeri Desi) to 10.28 percent (RHB 121).

It had been observed that all the cultivars had significant difference in their fat content at 5 % level of significance. The ash content of the pearl millet cultivars was significantly varying from one another at five percent level of significance except for Raj 171 (2.04 %) and Chadi (2.06 %), which were at par in the ash contents. The values of ash are in the agreement with earlier reports^{14,15}. The crude fiber content of the nine selected pearl millet cultivars was falling between 1.85 % to 3.66 %. It was observed that Pusa 334 had maximum fiber content where as CZP 9802 contained minimum fiber value (Table-1). Fiber content in hybrid cultivars differed significantly with each other at 5 % level of significance. More or less similar values of crude fiber content have been reported by Abdalla *et al.*¹⁶ and Sehgal *et al.*¹⁵. The carbohydrate content (by difference) in different varieties ranged from 69.20% to 74.79 % with statistically significant (5 %) difference. The minimum and maximum contents were exhibited by varieties Chadi and Bikaneri respectively. The difference in carbohydrate content among various varieties are attributed to the difference in content of other constituents namely moisture, protein, fat, fiber and ash in the grains. The content of reducing sugars in

TABLE-2
MINERAL CONTENT IN PEARL MILLET CULTIVARS (per 100 g)

Minerals	Hybrid		Composite			Land races			CD (5%)	
	RHB 121	HHB 67	HHB 94	Raj 171	CZP 9802	Pusa 334	Chadi	Jaisalmeri Desi		Bikaneri
Calcium (mg)	43.49	36.31	57.65	60.15	44.378	29.47	32.91	34.47	36.47	1.99
Phosphorus (mg)	291.60	346.31	358.59	358.29	365.50	520.31	398.84	361.02	256.79	13.99
Iron (mg)	5.27	6.34	5.24	6.32	6.44	7.32	6.16	7.56	7.94	0.062

TABLE-3
ANTINUTRITIONAL FACTORS IN PEARL MILLET CULTIVARS (mg/100 g)

Antinutritional factor	Hybrid		Composite			Land races			CD (5%)	
	RHB 121	HHB 67	HHB 94	Raj 171	CZP 9802	Pusa 334	Chadi	Jaisalmeri Desi		Bikaneri
Poly-phenols	364.87	483.01	322.79	342.28	675.33	649.98	261.11	653.47	312.87	17.19803
Phytic acid	61.02	54.75	71.75	48.65	84.00	56.25	72.50	84.75	66.50	3.322246

pearl millet cultivars (Table-1) varied in narrow range (1.80 to 1.30 %). The content of non reducing sugar was also seen in a close range (0.24 to 0.79). The total sugar content in different cultivars varied from 2.08 to 1.77 %. Differences in energy value among different varieties are attributed to the variation in the contents of carbohydrates, fat and protein. Calculated energy value of nine pearl millet cultivars ranged from 383 kcal/100 g to 413 kcal/100 g. Statistically significant variation was noted within hybrid and composite cultivars for their energy contents. Variability in the nutrient and physical variation could be attributed to different agro-climatic conditions as well as due to the varied uptake of nutrients, as all the cultivars were collected from the different parts of I-c zone of Rajasthan.

Mineral content: Calcium, phosphorus and iron content of different pearl millet cultivars are given in Table-2. The calcium content of the pearl millet cultivars fell between the value of 29.47 mg/100 g and to 60.15 mg/100 g as noted for Pusa 334 and Raj 171 respectively. The significant variations in the calcium content were observed among hybrid, composite and land races at five per cent level of significances. Varieties RHB 121 and Bikaneri contained significantly lower phosphorus than others. On the other hand Pusa 334 contained higher content of phosphorus than all the other varieties.

During present study, the iron content ranged between 5.27 mg/100 mg to 7.94 mg/100 g being minimum for RHB 121 and maximum for Bikaneri respectively. The variation in the iron values was noted to be significant among all the pearl millet cultivars. The ranges of values for mineral content observed in the present investigation are in conformation to earlier reports¹⁶⁻¹⁸.

Antinutritional factors: The content of phytic acid in pearl millet varieties ranged from 84.75 to 48.65 mg/100 g. The maximum phytic acid content of was obtained for Jaisalmeri Desi and the value was found to be minimum for 84.75 mg/100 g cultivar of pearl millet. However, Aggarwal¹⁹, Kumar and Chauhan²⁰ and Abdalla *et al.*¹⁶ have reported higher values for phytic acid content of pearl millet under their study (Table-3).

The polyphenols content of the nine pearl millet cultivars fell between 261.11 mg/100 g to 675.33 mg/100 g. When all pearl millet cultivars were compared for their polyphenols contents, higher per cent value was found in case of CZP 9802

(675.33 mg per cent) and it was lowest in case of Chadi (261.11 mg per cent). Pearl millet cultivars differed significantly with respect to polyphenol content at five per cent significance level. All these values are, however, in conformity with data reported by Khetarpaul and Chauhan²¹ and Aggarwal¹⁹.

Physical characteristics: Physical characteristics of all the test cultivars are presented in Table-4. One thousand seed weight of different varieties of pearl millet ranged from 8.64 g to 5.01 g. As compared to land races and composite cultivars, seed weight was found higher in hybrid cultivars. Variation in seed weight of different cultivars may be attributed to the size of the seed since hybrid cultivars had greater seed size as compared to other cultivars of composite and land races. All the cultivars differed from one another at 5 % level of significance in their seed weights. The seed volume in different selected pearl millet cultivars ranged between 0.047 to 0.010 mL/seed for HHB 67 and Jaisalmeri Desi respectively. Seed volume was found to be maximum in hybrid cultivars *i.e.* RHB 121(0.043 mL/seed). The seed density of different pearl millet cultivars was seen with in close range (0.860 g/100 mL to 0.780 g/mL). Hydration capacity of pearl millet cultivars ranged between 0.00370 g/seed (Raj 171) to 0.00207 g/seed (CZP 9802).

The swelling capacity was found significantly higher in Raj 171 (0.0046 mL/seed) and it was lower in case of Bikaneri (0.0018 mL/seed). Swelling capacity of all varieties was varying significantly (5 %) except RHB 121 and Pusa. The germination per cent was observed to be maximum in Bikaneri (95.94 %) and minimum in RHB 121 (81.71 %). The colour of different pearl millet varieties varied from gray to yellowish, it was clear from the physical observation of grains the hybrid varieties varied deep grey colour whereas pearl millet belonging to composite and land race varieties had yellowish grey and yellow colour respectively (Table-4).

Conclusion

The results of the study clearly shows that there was a significant difference in nutritional and physical characteristics among various pearl millet varieties tested. In general when the varieties were compared between the sub class, *i.e.* hybrid composite and land races, there was no uniformity in the content of different nutritional and physical characteristics.

TABLE-4
PHYSICAL CHARACTERISTICS OF PEARL MILLET CULTIVARS

Pearl millet cultivars	Seed weight (g/1000 seeds)	Seed volume (mL /seed)	Seed density (g/mL)	Hydration capacity (g/seeds)	Swelling capacity (mL /seed)	Germination (%)	Colour
Hybrid							
RHB 121	8.40	0.043	0.860	0.00350	0.0024	81.70	Gray
HHB 67	8.64	0.047	0.820	0.00290	0.0033	86.86	Gray
HHB 94	7.71	0.040	0.800	0.00320	0.0023	93.68	Gray
Composite							
Raj 171	7.68	0.043	0.800	0.00370	0.0046	93.56	Gray Yellow
CZP 9802	6.58	0.020	0.820	0.00207	0.0019	91.10	Gray Yellow
Pusa 334	5.24	0.023	0.840	0.00250	0.0024	90.98	Gray Yellow
Land races							
Chadi	5.54	0.017	0.800	0.00210	0.0025	90.27	Yellowish
Jaisalmeri Desi	5.01	0.010	0.780	0.00260	0.0027	92.63	Yellowish
Bikaneri	5.46	0.017	0.820	0.00210	0.0018	95.94	Yellowish
CD. (5%)	0.400011	0.004043	0.0035752	0.000214	0.000181	0.861052	-

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