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COMPARISON OF PHYSICO-CHEMICAL AND FUNCTIONAL PROPERTIES OF LITTLE MILLET GENOTYPES

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ABSTRACT

Millets are one of the oldest foods known to humans and cultivated since time immemorial. Little millet (*Panicum miliare*) is nutritious, healthy and versatile and hence would be a worthy addition to one's diet. The physical, chemical and functional properties of local genotype and improved variety Sukshema were studied. Variation in physical characteristics of little millet genotypes revealed that dehulled Sukshema grain was significantly longer (1.81mm) with higher weight (2.32g/1000 grains), swelling capacity (0.20ml/1000 grains) and swelling index (10.41). Local little millet had higher moisture (11.43%) and fat (4.97%), while Sukshema possessed higher protein (8.96%), carbohydrate (70.47%), starch (59.19%) and zinc (2.03mg/100g). Functional properties indicated that the water (0.88g/g) and oil (0.66g/g) absorption capacity and swelling power (7.73g/g) were higher and least gelation capacity was lower (9.07%) in Sukshema.

KEY WORDS:
Little millet, Physico-Chemical, Functional Properties.

INTRODUCTION

Millets are a group of cereal crops, cultivated around the world in a wide range of soils and climate, for food and fodder. The group includes millets such as little millet (*Panicum miliare*), foxtail millet (*Setaria italica*), proso millet (*Panicum miliaceum*), kodo millet (*Paspalum scrobiculatum*), barnyard millet (*Echinochloa frumentacea*) and finger (*Elusine coracana*) millet. These crops are of special importance in semiarid regions because of their short growing seasons and tolerance to adverse climatic conditions and drought hardy. They require lower inputs in terms of fertilizers, pesticides and insecticides,

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hence eco-friendly. Traditionally millets were considered as poor man's food and were consumed by primitive tribes. In India, the area under production of minor millets is 2.4 m ha. with a production of 2.7 m tones of which minor millets excluding finger millet is cultivated in an area of 1.0 m ha. with a production of 0.53 m tonnes and productivity of 530 kg/ha. (Anon., 2008). Government policies which do not promote cultivation and consumption, together with difficulty in processing of these grains and shift to cultivation of cash crops have contributed to the neglect of millets under the modern agricultural production systems.

Interestingly, it is being now realized that the millets have importance as health foods, largely due to their nutraceutical components. Millets are being recognized as potential future crops because of relatively high dietary fibre, antioxidants, micronutrients, sulphur containing amino acids and essential fatty acids besides macro nutrients.

Little millet, one of the minor millet exhibit diversified use as food, feed and fodder. The grain compares well with other cereals. It has been utilized for production of various value added products apart from the traditional food preparations. Utilization of this grain for various value added and therapeutic products can increase the demand for this grain, the production of which is declining. In the present investigation, two genotypes of little millet were studied for the physical, chemical and functional properties.

MATERIALS AND METHODS

Local genotype and improved variety Sukshema were selected for the study. The local genotype was collected from farmers' field in Narendra village, Dharwad district. Sukshema genotype was procured from Agricultural Research Station, Hanumanamatti, Haveri district. Dehulling of the samples was carried out in a commercial mill designed for dehulling of the millets at Haveri, a millet growing area. The dehulled grains were cleaned in one lot and used for the study. All the estimations were carried out in triplicates.

The various physical characteristics studied were size, shape, colour, thousand grain weight, thousand grain volume, bulk density, hydration capacity, hydration index, swelling capacity and swelling index, using standardized methods. Chromatic components, L (lightness), a (redness) and b (yellowness) values of sample were measured using spectrophotometer (CM-260d/2500d model of Konica Minolta).

The moisture, protein, fat and ash contents were determined using AOAC (Anon., 1990) procedures, crude fibre by Jacobs (1979) carbohydrates and calcium by Raghuramulu *et al.* (1983). The energy was computed using Atwater constants. Iron, zinc, copper and manganese were estimated using Atomic Absorption Spectrophotometer (model: AAS GBC Avanta). Tannins (Schanderl, 1970), total phenols (Bray and Thorpe, 1954) and phytates (Wheeler and Ferrel 1971) were estimated. Sugars (Somogy, 1955), starch (Anon., 1990), amylose, amylopectin (Soubhgya and Bhattacharya, 1979) and dietary fibre (Asp *et al.*, 1983) contents were analysed by standard procedures. The functional properties of the flour from dehulled samples examined were bulk density, water and oil absorption capacity (Rosario and Flores, 1981), swelling power and per cent solubility (Schoch, 1964) and gelation capacity (Sathe *et al.* 1982). The results were statistically analysed using independent t test.

RESULTS AND DISCUSSION

The physical characteristics of little millet genotypes are presented in Table 1. The mean length of local genotype was 1.74 mm with a range between 1.63 to 1.85 mm. The length of Sukshema genotype ranged from 1.73 to 1.96 mm with a mean value of 1.81 mm. The length of Sukshema grain was significantly higher than local genotype. The width of local and Sukshema grains were 1.53 and 1.55 mm, respectively. The local genotype had a thickness of 1.06 mm, while the thickness of Sukshema genotype was 1.09 mm. However, no significant differences were apparent between the genotypes for width and thickness. Both the genotypes were spherical in shape.

For the colour of grains, the mean L value of local genotype was 84.57 and Sukshema was 84.78. The mean a values were 1.98 and 2.20 for local and Sukshema, respectively. The mean b value was 11.47 for local and 12.67 for Sukshema. The values revealed that the Sukshema was lighter, redder (less green), yellower (less blue) and brighter than local genotype.

The mean thousand grain weight was 2.15 g for local and 2.33 g for Sukshema genotype. The thousand grain weight of Sukshema was significantly greater ($P < 0.05$) than that of local genotype. The mean thousand grain volume of genotypes was 1.60 and 1.65 ml for local and Sukshema, respectively. The bulk density of local genotype (1.33 g/ml) was higher than Sukshema genotype (1.30 g/ml).

The mean hydration capacity was 0.15 and 0.17 g per 1000 grains for local and Sukshema genotypes, respectively. The genotypes exhibited a hydration index of 6.67 in local and 7.66 in Sukshema. The difference did not reach statistical significance. Swelling capacity of grains was 0.15 and 0.20 ml per 1000 grains for local and Sukshema genotypes. The difference was significant at 5 per cent level. The swelling index of local genotype (9.38) was significantly ($P < 0.01$) lower than Sukshema genotype (10.41). Variations in the physical characteristics were evident which were typical of genotypes. These kind of variations in physical characteristics have been reported in other minor millet genotypes (Malleshi and Deshikachar, 1985 and Veena *et al.*, 2005)

The analysis of nutrients revealed genotypical differences (Table 2). Moisture content was significantly higher in local (11.43%) than Sukshema (10.67%). Lower protein content was recorded in local (8.49%) compared with Sukshema (8.96) genotype. The difference was significant at 1 per cent level. Significantly higher fat content was recorded in local (4.97%) than in Sukshema (4.10%).

The crude fibre contents were 3.10 and 3.05 g per 100 g in local and Sukshema genotypes, respectively. The mean ash content was 2.52 and 2.74 g per 100 g in local and Sukshema genotypes, respectively. No significant differences in crude fibre and ash contents were noticed among genotypes. The carbohydrate content of local (69.5%) genotype was significantly lower than

Sukshema genotype (70.47%). The calorific value of local genotype was 357 Kcal and Sukshema genotype was 355 Kcal.

The calcium content of local genotype (15.20 mg/100g) was lower than Sukshema genotype (18.73 mg/100g). However, no statistically significant difference was recorded between the genotypes. The iron content of local genotype (8.80 mg/100g) was higher than the Sukshema genotype (8.58 mg/100g). The statistical test revealed no significant difference in iron content between the genotypes. The zinc content of Sukshema (2.03 mg/100g) was significantly higher than the local genotype (1.58 mg/100g). The local genotype recorded higher copper (0.28 mg/100g) and lower manganese (0.32 mg/100g) contents than Sukshema genotype (0.26 and 0.36 mg/100g, respectively). However, no significant differences in copper and manganese contents were apparent between the genotypes.

The results of sugar, starch, dietary fibre and phytochemicals content of little millet genotypes are depicted in Table 3. The mean sugar content of local genotype was lower than Sukshema genotype. The reducing, non-reducing and total sugar content of local genotype was 1.23, 2.63 and 3.86 g per 100 g, respectively. The Sukshema genotype recorded 1.33, 2.75 and 4.08 g per 100 g of reducing, non-reducing and total sugar content, respectively. No significant difference for the sugar content was observed between the genotypes.

The starch content of local genotype (57.12 g/100 g) was significantly ($P < 0.05$), lower than Sukshema genotype (59.19 g/100 g). The local and Sukshema genotypes recorded an amylose content of 24.31 and 25.47 g per 100 g, respectively. The amylopectin content was higher in Sukshema (33.75 g/100 g) than local (32.81 g/100 g). The statistical test revealed no significant difference between the genotypes for amylose and amylopectin contents.

The mean soluble dietary fibre content of local genotype (3.01 g/100 g) was lower than Sukshema genotype (3.25 g/100 g). Higher amount of insoluble dietary fibre was observed in local (5.24 g/100 g) genotype than Sukshema (5.15 g/100 g). The mean total dietary fibre content was higher in Sukshema (8.60 g/100 g) than local (8.25 g/100 g). The genotypes exhibited no significant difference for dietary fibre contents.

Tannin content was recorded to be 92.23 and 86.07 mg per 100 g in local and Sukshema genotypes, respectively. The difference was not significant statistically. The total phenols and phytates content were observed to be significantly higher in local genotype (74.20 and 115.13 mg/100 g, respectively) than Sukshema genotype (61.87 and 94.36 mg/100 g, respectively).

Varietal differences in chemical composition within the species of minor millets were reported by several investigators (Becker and Lorenz, 1978; Lorenz and Dilsaver, 1980; Lorenz, 1983; Malleshi and Deshikachar, 1985, Lorenz and Hwang, 1986; Mogra *et al.*, 1998; Kulkarni and Naik, 2000 and Veena *et al.*, 2005).

The functional properties of little millet genotypes are presented in Table 4. The water and oil absorption capacities of local genotype (0.82 and 0.64 g/g, respectively) were significantly lower than Sukshema genotype (0.88 and 0.66 g/g, respectively). No large and significant ($P<0.05$) differences in the water and oil absorption values were reported in pearl millet hybrids and varieties of pearl millet by Malik and Singh (2001). The swelling power of genotypes was observed to be 6.96 and 7.73 g per g in local and Sukshema genotypes, respectively. Sukshema genotype had significantly higher swelling power than local genotype. The solubility of local genotype was recorded to be 22.20 per cent and that of Sukshema genotype was 23.41 per cent. The difference in solubility was statistically not significant. The least gelation concentration of Sukshema (9.07%) was significantly lower than local (9.98%) genotype indicating lower concentration of the flour was required to form a gel. The pearl millet hybrids showed significantly lower mean gelation capacity than varieties (Malik and Singh, 2001).

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REFERENCES

- Anonymous, 1990, Official Methods of Analysis, Association of Official Analytical Chemists, 20th edition, Washington D. C.
- Anonymous, 2008, Agriculture Statistics at a Glance, Department of Agriculture and Co-operation, Ministry of Agriculture, Government of India, p. 28.
- Becker, R. and Lorenz, K., 1978, Saccharides in proso and foxtail millets. Journal of Food Scicience, 43(5) : 1412-1414.
- Bray, H. G., and Thorpe, W. V., 1954, Analysis of phenolic compounds of interest in metabolism. Methods in Biochemical Analysis, 1 : 22-27.
- Jacobs, B. M., 1979, The Chemical Analysis of Food and Food Products. Devanstrant Co. New Jersey, p. 597.
- Kulkarni, L. R. and Naik, R. K., 2000, Nutritive value, protein quality and organoleptic quality of kodo millet (*Paspalum scorbiculatum*). Karnataka Journal of Agricultural Sciences, 13(1) : 125-129.
- Lorenz, K., 1983, Tannin and phytate content of Proso Millets (Panicum miliaceum. Cereal Chemistry, 60(6) : 424-426.
- Lorenz, K. and Dilsaver, W., 1980, Proso millets. Milling characteristics, proximate compositions, nutritive value of flours. Cereal Chemistry, 57 (1) : 16-20.
- Lorenz K. and Hwang Y.S., 1986, Lipids in Proso millet (Panicum miliaceum) flours and brans. Cereal Chemistry, 63 (5) : 387-390.
- Malik, M. and Singh, U., 2001, Comparision of functional properties of hybrids and varieties of Pearl millet (Pennisetum americanum). Journal of Food Science and Technology, 36: 393-396.
- Malleshi, N. G. and Desikachar, H. S. R., 1985, Milling, popping and malting characteristics of minor millets. Journal of Food Science and Technology, 22 : 400-403.
- Raghuramulu, N., Nair, M. R. and Kalyansundaram, S., 1983, A manual of Laboratory techniques, NIN, ICMR, Hyderabad, India.
- Mogra, R., Bhatnagar, V. and Choudhry, M., 1998, Proximate principles and mineral composition of foxtail millets. Proceedings of Nutrition Society of India, Annual Meeting, Nov. 26-28, Hyderabad, p. 59.

- Rosario, R. D. and Flores, D., 1981, Functional properties of four types of mung bean flour. Journal of Food Science and Agriculture, 32: 175-178
- Sathe, S. K., Dehspnade, S. S. and Salunke, D. H., 1982, Functional properties of lupin seed (Lupinus mustabilis) protein and concentrate. Jounal of Food Science, 47 : 491-496.
- Schanderl, S. H., 1970, In : Methods in Food Analysis. Academic Press, New York, p. 70.
- Schoch, T. J., 1964, Swelling power and solubility of granular starches. In : Carbohydrate chemistry Ed. Whistler, R. L., Smith, R. J., Miller, N. J. and Wolform, M. I., Academic Press, New York, pp. 106-108.
- Somogyi, M., 1952, Sugar estimations. Journal of Biological Chemistry, 17 : 200-245.
- Soubhagya, C. M. and Bhattacharya, K. R., 1979, Simplified determination of amylase in milled rice. Starch, 31(5) : 159-163.
- Veena, B., Chimmad, B. V. Naik, R. K. and Shantakumar, G., 2005, Physicochemical and nutritional studies in barnyard millet. Karnataka Journal of Agricultural Sciences, 18(1): 101-105.
- Wheeler, E. L. and Ferrel, P. E., 1971, A method for phytic acid determination in wheat and wheat fractions. Cereal Chemistry, 48 : 312-320.

Table 1: Physical characteristics of little millet genotypes

Characteristics		Local	Sukshema	't' value
Size#	Length (mm)	1.74±0.07	1.81±0.08	2.23*
	Breadth (mm)	1.53±0.03	1.55±0.04	1.55 NS
	Thickness (mm)	1.06±0.06	1.09±0.04	1.05 NS
Shape		Spherical	Spherical	
Colour	L (Lightness)	84.57±0.12	84.78±0.10	2.30NS
	a (Redness)	1.98±0.13	2.20±0.08	2.46NS
	b (Yellowness)	11.47±0.47	12.67±0.43	3.27*
1000 grain weight (g)		2.15±0.01	2.32±0.01	2.97*
1000 grain volume (ml)		1.60±0.05	1.65±0.05	1.74NS
Bulk density (g/ml)		1.33±0.02	1.30±0.02	2.89*
Hydration capacity (g/1000 grains)		0.15±0.01	0.17±0.02	2.45 NS
Hydration index		6.67±0.50	7.66±0.73	1.95 NS
Swelling capacity (ml/1000grains)		0.15±0.02	0.20±0.03	2.92*
Swelling index		9.38±0.18	10.41±0.11	8.71**

Mean of 10 observations
* - Significant at 5% level
** - Significant at 1% level
NS - Non-significant

Table 2: Nutrient composition of little millet genotypes (per 100g)

Nutrients	Local	*Sukshema*	't' value
Moisture (g)	11.43 ± 0.10	10.67 ± 0.11	8.85**
Protein (g)	8.49 ± 0.06	8.96 ± 0.12	6.38**
Fat (g)	4.97 ± 0.13	4.10 ± 0.10	8.91**
Crude fibre (g)	3.05 ± 0.13	3.25 ± 0.11	2.57NS
Ash (g)	2.57 ± 0.05	2.54 ± 0.10	0.54NS
Carbohydrate (g)	69.50 ± 0.45	70.47 ± 0.38	2.84*
Energy (Kcal)	357 + 3.46	355 + 2.65	0.79NS
Calcium (mg)	15.20 ± 1.05	18.73 ± 1.91	1.19NS
Iron (mg)	8.80 ± 0.69	8.58 ± 0.43	0.47NS
Zinc (mg)	1.58 ± 0.11	2.03 ± 0.25	2.91*
Copper (mg)	0.28 ± 0.02	0.26 ± 0.02	1.04NS
Manganese (mg)	0.32 ± 0.02	0.36 ± 0.03	2.09NS

* - Significant at 5% level
** - Significant at 1% level
NS - Non-significant

Table 3: Sugars, starch, dietary fibre & phytochemicals content of little millet genotypes (g/100g)

Parameters	Local	*Sukshema*	't' value
SUGARS			
Reducing	1.23 ± 0.13	1.36 ± 0.12	1.07NS
Non reducing	2.63 ± 0.37	2.78 ± 0.17	0.64NS
Total sugars	3.86 ± 0.66	4.14 ± 0.24	0.69NS
Starch	57.12 ± 0.70	59.19 ± 0.91	3.11*
Amylose	24.31 ± 1.19	25.47 ± 1.31	1.14NS
Amylopectin	32.81 ± 1.52	33.72 ± 0.63	0.96NS
DIETARY FIBRE			
Soluble dietary fibre	3.21±0.18	3.46±0.47	0.85NS
Insoluble dietary fibre	5.62±0.34	5.35±0.48	0.80NS
Total dietary fibre	8.83±0.83	8.81±0.26	0.05NS
PHYTOCHEMICALS			
Tannins	92.23 ± 4.28	86.07 ± 3.72	1.78NS
Total phenols	74.20 ± 3.44	61.87 ± 2.25	5.46**
Phytates	115.13 ± 4.47	94.36 ± 2.70	6.88**

* Significant at 5%
NS – Non-significant

Table 4: Functional properties of flour from little millet genotypes

Properties	Local	*Sukshema*	't' value
Bulk density (g/ml)	0.72 ± 0.01	0.73 ± 0.01	2.74NS
Water absorption capacity (g/g)	0.82 ± 0.01	0.88 ± 0.02	4.88**
Oil absorption capacity (g/g)	0.64 ± 0.008	0.66 ± 0.01	2.89*
Swelling power (g/g)	6.96 ± 0.15	7.73 ± 0.13	6.75**
Solubility (%)	22.24 ± 0.87	23.40 ± 0.69	1.81 NS
Least gelation concentration (%)	9.98 ± 0.28	9.07 ± 0.31	3.86*

* - Significant at 5% level
** - Significant at 1% level
NS - Non-significant