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Studies on physico-chemical properties and minerals content from different sorghum genotypes

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Abstract
Physico-chemical characteristics of grains play a very important role in determining the quality of grains. The present investigation was planned to evaluate the three sorghum varieties *viz*. M 35-1 (Maldandi), CSV-22R and Parbhani Jyoti for physico-chemical properties and mineral content. Results revealed that highest value of kernel size and bulk density was recorded for Parbhani jyoti (4.05mm) and (0.70 g/ml) respectively. The genotype M35-1 gave a significantly higher level of protein (10.49%) content as well as the presence of lipids dietary fibre, tannins and minerals. The Genotype M35-1 had higher level of phosphorus content (515 mg/100g) while lowest value for phosphorus was found in Parbhani jyoti (371 mg/100g). The genotype Maldandi (M-35-1) recorded higher level of iron content (4.26 mg/100g). The higher value of calcium and magnesium content was found in genotype Parbhani jyoti (27.50mg/100g) and magnesium content (228 mg/100g) respectively. While lowest value for magnesium was found in CSV-22R (213mg/100g).

Keywords: sorghum, genotypes, physicochemical properties, minerals content, phytochemicals

Introduction
Sorghum (*Sorghum bicolor* L.) is one of the major crop grown for human consumption in arid and semi-arid regions of Africa and Asia (Subudhi *et al.,* 2002). Sorghum is the principal staple food of Maharashtra, and is also an important food of Karnataka, Madhya Pradesh, Tamil Nadu and Andhra Pradesh. India is the third largest producer of sorghum in the world with 5.54 million tons in 2013-14 and almost entire production of sorghum (95 per cent) in the country comes from above regions. (GOI, 2011) [9]. Nutrients content of sorghum are more or less limited to major entities like carbohydrates, protein, fats, fiber, Polyphenols. The factors such as polyphenols add promising antioxidant capacity to sorghum and coupled with fiber content of the cereal indicates it's potential as functional food. Sorghum has 11.9 per cent of moisture and about 10.4 per cent of protein and a lower fat content of 1.9 per cent. The fibre and mineral content of grain sorghum is around 2.1 per cent and 1.6 per cent respectively. It is a good source of energy and provides about 349 K cal/100g and gives 72.6 per cent of carbohydrates (Gopalan *et al*., 1996) [10]. Sorghum provides a good basis for gluten-free products and recommended as safe for celiac patients. Therefore, the future promise of sorghum in the developed world is for wheat substitution for people with celiac disease or allergies to gluten (Bogue and Sorenson, 2008) [.3]. There is a considerable variation in sorghum for levels of protein, lysine, lipids, carbohydrates, fiber, calcium, phosphorus, iron, all these parameters imparts sorghum grain quality (Hulse, 1980) [12]. Hence, the objective of this investigation is to determined the physico-chemical properties of different sorghum genotypes and their mineral content to evaluate and compare the nutritional quality of different sorghum genotypes.

Materials and Methods
Materials
Sorghum [Sorghum bicolor (L.) Moench] varieties like M35-1(Maldandi), CSV-22R, Parbhani Jyoti were procured from Sorghum Research Station Parbhani, Maharashtra. Chemicals (analytical grade) and glassware required during experiments were used from Laboratory. Equipments required in the present investigation were available in College of Food Technology, Vasantrao Naik Marathwada Krushi Vidyapeeth, Parbhani.

Methods
Physical characteristics of Sorghum Varieties
Physico-chemical characteristic is an important which determines consumer acceptability, and hence the study of characteristics of the grains becomes a basic step in any research.

The sorghum grains are subjected to physical analysis of geometric mean diameter, thousand kernel weight, thousand kernel volumes, bulk density, water absorption capacity and angle of repose. It conform that the quality of sorghum grain. This were studied by following the procedures as described below. All the estimations were done in duplicates. The size of the seed was measured using calipers to the nearest of 0.01 mm.

Geometric Mean Diameter (Length, Width and Thickness)

The dimensions of sorghum seeds were measured as length and thickness and width. Following equation was used for determining the Geometric Mean Diameter of seeds (Gursoy and Guzel, 2010) [11].

Geometric Mean Diameter= (Length X Width X Thickness) $^{1/3}$

1000 kernel weight

Neat, clean and sorted 1000 grains weight was measured by electronic balance and average weight was calculated.

1000 kernel volume

Volume of thousand grams of dry seed was measured by water displacement in millilitres**.**

Bulk Density

Bulk density (BD) of grain was measured by standard method given by (A.O.A.C, 1990) [1].

Angle of Repose

The angle of repose is the angle between the base and the slope of the cone formed on a free vertical fall of the grain mass to a horizontal plane when material is free falling or sliding. It was determined by making a circular pile of the grains freely falling. The height of pile was taken (h) and its radius (r) was also taken. Angle of repose was then calculated by following formula.

$$\text{Angle of Repose } (\theta) = \tan (h/r)$$

Water absorption capacity

It is defined as the maximum amount of water that 1 g of material will imbibe and retain under low speed centrifugation. To estimate water absorption capacity, five gram flour was weighed in 50 ml centrifuge tube, 30 ml water was added and stirred with glass rod for 5 min, then allows to stand for 30 min, at ambient conditions, then centrifuged at 4500 rpm for 25 min. The volume of free liquid was measured and the retained volume was expressed as ml of water absorbed per gram of sample on dry basis.

Chemical Characteristics of Sorghum Varieties

Sorghum varieties were analyzed for moisture content, ash, fat, protein and total carbohydrate. All the determinations were done and the results were expressed as the average value.

Moisture

Moisture content was estimated adopting (A.O.A.C, 1990) [1] method. The following was used to measure moisture content.

$$\% \text{ Moisture} = \frac{\text{Initial weight} - \text{final weight}}{\text{Total weight of sample}} \text{ X } 100$$

Ash Content

(A.O.A.C, 1990) [1] method using muffle furnace was used to determined ash content of the samples. The percent ash was calculated using following formula.

$$\% \text{ Ash} = \frac{\text{Weight of crucible with ash} - \text{Weight of empty Crucible}}{\text{Total weight of sample}} \times 100$$

Fat Content

(A.O.A.C, 1990) [1] method using soxhlet apparatus was used to determined crude fat content of the samples. The percent of crude fat was expressed as follows.

$$(\%) \text{ Crude fat} = \frac{\text{Final weight of flask} - \text{Empty weight of flask}}{\text{Weight of sample}} \times 100$$

Protein

Protein content was determined using (A.O.A.C, 1990) [1] method. Percentage of nitrogen and protein calculated by the following equation.

$$\%N = \frac{\text{CBR X Normality of } H_2SO_4 \text{ X Moles of Nitrogen X D.F.}}{\text{Weight (g) of sample}} \text{X } 100$$

Where,

CBR = Corrected Burette Reading

Normality of acid (H_2SO_4) = 0.01N

Moles of Nitrogen = 0.14

D.F= Dilution Factor

Total protein= %Nitrogen X Protein factor (6.25)

Total Carbohydrate

Total carbohydrate content of the samples were determine as total carbohydrate by difference, that is by subtracting the measured protein, fat, ash and moisture from 100 (Pearson, 1976) [19].

Crude fiber

The crude fiber content of sorghum determined by (A.O.A.C, 1990) [1] method.

$$(\%) \text{ Crude fiber} = \frac{\text{Weight of residue} - \text{Weight of ash}}{\text{Weight of sample}} \times 100$$

Determination of Minerals

Mineral content of food was estimated by method given by (Ranganna, 1986).

Statistical analysis

The results of various physical and chemical measurements of grain quality were analysed. The Analysis of variance was calculated using standard ANOVA procedure. (Panse and Sukhatme 1967). The analysis of variance revealed that significance at $P< 0.05$ level. The standard error (SE) and critical difference (CD) at 5 % level were mentioned where required.

Results and Discussion

Physical appearance of Sorghum Cultivars

The sorghum cultivars are hard seeds generally bold and round in shape. Colour of sorghum cultivar M35-

1(Maldandi), Parbhani Jyoti, and CSV-22R, were pearly white creamy white, dull white respectively. In sorghum, phenolic compounds, particularly anthocyanins and condensed tannins are major contributors of colour of the grains (Awika and Rooney 2004) [2]. Results were nearer to the results physico-chemical properties of sorghum genotypes reported by (Jambamma *et al.*, 2011) [13].

Table 1: Physical appearance of Sorghum Cultivars

Sr. no.	Cultivars	Physical appearance of Sorghum Cultivars		
		Colour	Munshell Notation for Colour	Shape
1.	M35-1(Maldandi)	Pearly white	10YR 6/2	Round
2.	Parbhani Jyoti	Creamy white	5Y 7/2	Bold
3.	CSV-22R	Dull white	10YR 8/2	Round

Physical properties of different sorghum cultivars

The individual grains have different physical characteristics that may dictate end product quality. (Liman *et al.,* 2012) [14]. The data pertaining to physical properties is presented in Table-2.

Table 2: Physical properties of different sorghum cultivars

Cultivars	Physical properties of sorghum grains					
	Thousand Kernel weight (g)	Thousand Kernel volume (ml)	Bulk density (g/ml)	Angle of repose (Degrees)	Kernel size G.M.D.(mm)	WAC (%)
Parbhani Jyoti	33.1	23	0.70	32º10´	4.05	33.4
CSV-22R	34.2	24	0.69	30° 11′	3.9	31.2
Maldandi	34.30	28.3	0.68	31º15´	4.0	32.3
Mean	33.90	25.11	0.6489	31.084	3.99	32.311
SE±	12.510	9.553	-	11.138	1.169	11.593
CD at 5 %	37.664	28.760	-	33.529	3.5189	34.898

*Each value is a mean of three determinations

Physical properties of sorghum were studied and it was found that the highest thousand kernel weight (34.4g) and thousand kernel volume (28.3 ml) was observed for sorghum cultivar Maldandi(M35-1).Whereas the lowest weight and volume for the parbhani jyoti was (33.1g) and (23 ml) was observed respectively. This variation may be due to genotypic differences. The weight of thousand kernels is influenced by meteorological factors, methods of farming and genotypic differences (Liman *et al.,* 2012) [14].

The sorghum genotype Parbhani jyoti had recorded the highest bulk density (0.70 g/ml) and the lowest bulk density was observed for genotype Maldandi (0.60g/ml). The sorghum grains are subjected to the measurement of kernel size as Geometric mean diameter. The highest value of kernel size of sorghum cultivar was recorded for Parbhani jyoti was (4.05mm). Whereas lowest value of kernel size observed in CSV-22R (3.9 mm). Angle of repose was determined using a method described by (Mohsenin, 1986) [15]. The highest angle of repose observed for genotype Parbhani jyoti was 32º10´ whereas lowest was observed for sorghum cultivar CSV-22R (30° 11′). The highest water absorption capacity was found in sorghum cultivar Parbhani jyoti (33.4 ml) and the lowest was observed in CSV-22R (31.2 ml). The obtained values for physical properties recorded in the present study were in good agreement with the values reported by (Murthy *et al.,* 1981; Jambamma *et al.,* 2011; Butti *et al.,* 2016) [16, 11, 7].

Nutritional Composition of Sorghum cultivars

The nutritional composition of *Maldandi*, Parbhani jyoti, CSV-22R sorghum cultivars was calculated in respect of their various biochemical parameters such as carbohydrates, protein, fibre content, fat and ash content of the sorghum grain were determined and given in table-3.

Table 3: Nutritional composition of different sorghum cultivars

Cultivars	Chemical properties of grains (g / 100 g)					
	Moisture (%)	Fat (%)	Protein (%)	Carbohydrates (%)	Crude fibers (%)	Ash (%)
Parbhani Jyoti	8.2	1.80	10.39	71.01	2.10	1.45
CSV-22R	7.0	1.55	10.42	73.20	3.20	1.15
Maldandi	8.2	1.68	10.49	72.30	2.90	1.21
Mean	7.8333	1.6789	10.433	72.790	2.7333	1.2700
S.E±	0.0881	0.0079	0.0057	0.2580	0.00577	0.0057
CD at 5%	0.3047	0.0274	0.0199	0.8916	0.01994	0.0199

*Each value is a mean of three determinations

The moisture content was ranged from 8.2 to 7.0%. It is evident from Table that highest moisture content of sorghum cultivar Parbhani jyoti and *Maldandi* was most similar that was (8.2%). the genotype Parbhani jyoti content the higher level of fat (1.80 %) followed by *Maldandi* (1.68%). The genotype *Maldandi* gave a significantly higher level of protein (10.49%) whereas low level of crude protein recorded in parbhani jyoti that was (10.39%). The variation in the protein content among the sorghum genotypes is due to their genetic background/variability but it is non- significant. Similar trend was also observed in present investigation. The similar results were reported by (Chavan, 2016) [7].

Total carbohydrate content in the Sorghum varieties was found in the range of 71.01% to 74.30% respectively. The crude fiber content in grain ranged from 2.10% to 3.20%. The sorghum CSV-22R gave statistically superior level of crude fibre (3.20%) followed by Parbhani jyoti (2.10%). Results obtained were similar to the (U.D. Chavan *et al.,* 2015) [6].

The ash content in grain sorghum reported that higher level of Ash reported in Parbhani jyoti (1.45%) and lower level in the cultivar *Maldandi* (1.21%) Ash content was observed. (Vannalli *et al.,* 2008) [21] Revealed that proximate composition of for ash ranged from 1.14 to 1.72%.

Mineral composition of sorghum cultivars

The results Presented in table-4 indicated that sorghum grains are good source of the mineral content which has very high importance in the human diet. Therefore inclusion of sorghum in daily diet will help to supply necessary amount of minerals to human body. Nutritionally sorghum is good source of nutrients especially minerals. The data pertaining to mineral analysis of different sorghum cultivars is presented in Table-4.

Table 4: Mineral composition of sorghum cultivars

Cultivars	Mineral composition of grains (mg/100gm)			
	Calcium	**Phosphors**	**Iron**	**Zinc**
Parbhani Jyoti	27.50	371	3.91	3.14
CSV-22R	19.82	504	4.09	3.04
Maldandi (M-35-1)	13.85	515	4.26	2.58
Mean	20.357	463.33	4.0086	4.0086
SE±	0.1589	0.5773	0.0057	0.0057
CD at 5%	0.5491	1.9948	0.0199	0.0199

*Each value is a mean of three determinations

It was observed from the table-4 that the calcium content of sorghum cultivar ranged from 13.85 to 27.50 (mg/100gm). The higher level of calcium content was observed in genotype Parbhani jyoti that is (27.50mg/100g), The Genotype *Maldandi* exhibited lower level of calcium content (13.85mg/100g). Chavan and Patil (2009) [4] observed calcium content in sorghum grain was (25 mg/100g). Phosphorus content in different genotype of sorghum grain ranged from 371 to 515mg/100g. The sorghum cultivar *Maldandi* had higher level of phosphorus content (515 mg/100g). The Iron content in the sorghum grain ranged from 3.91 to 4.26 mg/100g. The genotype *Maldandi* (M-35-1) recorded higher level of iron content (4.26 mg/100g). Zinc content in different genotype of sorghum grain ranged from 2.58 to 3.14 mg/100g. The genotype Parbhani jyoti showed higher level of zinc (3.14mg/100g), whereas lower level of zinc recorded in M-35-1(2.58mg/100g). Chavan and Patil (2010) [5] observed zinc content in the sorghum grain was (3.91 mg/100g).

Results were in conformity with findings of Chavan *et al.* (2015) [6]. It was concluded the sorghum is a rich source of iron (Fe) and phosphorus (P) that can act as a source of dietary mineral (Fe and P) and hence used in fortification of food stuffs (FAO 1995) [8].

Conclusion

Thus in light of scientific data of the present investigation, it may be concluded that the evaluation of different cultivars of sorghum M35-1(Maldandi), CSV-22R, Parbhani Jyoti for physico-chemical characteristics are very important for designing and development of process machineries as well as for the development of products of higher nutritional quality.

References

1. AOAC. Official Methods of Analysis. Trends Food Science Technology. Association of Official Analytical Chemists, Washington DC, USA, 1990.
2. Awika JM, Rooney LW, *et al.* Sorghum phytochemicals and their potential aspects on human health. Phytochemistry. 2004; 65:1199-1221.
3. Bogue J, Sorenson D, *et al.* The Marketing of Gluten-free Cereal Products. Gluten-free Cereal Products and Beverages, Elsevier Inc, New York. 2008, 393-412.
4. Chavan UD, Patil JV, Shinde MS, *et al.* Nutritional and *Roti* quality of sorghum genotypes. Indonesian Journal of Agricultural Science. 2009; 10(2):80-87.
5. Chavan UD, Patil JV. Grain Sorghum Processing. IBDC. Publishers Lucknow, India. 2010, 124-125.
6. Chavan UD, Pansare SS, Patil JV, Shinde MS, *et al.* Preparation and Nutritional Quality of Sorghum Papads. International Journal of Current Microbiology Applied Science. 2015; 4(5):806-823.
7. Chavan UD, Jagtap YK, Shinde MS, Patil JV *et al.* Preparation and nutritional quality of sorghum *Chakli*. International Journal of Recent Scientific Research. 2016; 7(1):8404-8411.
8. FAO Sorghum and millets in human nutrition. FAO Food and nutrition Series No. 27. Rome, Italy. 1995, 64.
9. GOI Agriculture statistics at a glance. Directorate of economics and statistics, New Delhi. 2011, 142-516
10. Gopalan C, Ramasastri BV, Balasubramanian SC. Nutritive Value of Indian Foods, National Institute of Nutrition, Indian Council of Medical Research, Hyderabad, India, 1996.
11. Gursoy S, Guzel E, Determination of physical properties of some agricultural grains. Research Journal of Applied Sciences Engineering and Technology. 2010; 2(5):492-498.
12. Hulse JH, Laing EM, Pearson OE. Sorghum and Millets: Their composition and nutritive value. IDRC, Ottawa, Academic Press Canada. 1980, 977.
13. Jambamma, Imaya KA, Kailappan R, *et al.* Study of Physico-Chemical Properties of food grain sorghum and product ready-to-cook mix from sorghum. International Journal of Recent Scientific Research. 2011; 1(3):96-99.
14. Liman L, Thomas JH, Donghai W, Jeff DW, Scott RB *et al.* Characterization of sorghum grain and evaluation of sorghum flour in a Chinese egg noodle system. Journal of Cereal Science. 2012; 55:31-36.
15. Mohsenin NN, Physical properties of plant and animal materials. 2nd Ed, Gordon and Breach Science Publishers, New York, USA. 1986, 63-107.
16. Murty DS, Patil HD, House LR, Sorghum *roti*: II genotypic and environmental variation for roti quality parameters. *ICRISAT.* 1981, 79-91.
17. Butti P, sanganamoni M, Shivashankars, Nagendra babu *et al.* studies on physico-chemical analysis of sorghum varieties. International journal of agricultural science and research. 2016; 6(1):87-92.
18. Panse VS, Sukhatme PV. Statistical Methods for Agriculural Workers. Indian Council of Agricultural

Research, New Delhi, India. 1984, 70-72.
19. Pearson D. The Dictionary of Nutrition and Food Technology. Fifth edition. Butter Worth Publisher, London. 1976, 701-827
20. Rangana S. Handbook of analysis and quality control for fruits and vegetable products. II edition, Tata McGraw-Hill Publication, Co., New Delhi, India. 2011, 426-520
21. Vannalli S, KasturibaB, Naik RK, Yenagi N *et al*. Nutritive value and quality characteristics of sorghum genotypes. Karnataka Journal of Agriculture Science. 2008; 20(3):586-588.