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Effect of particle size based sorghum flour of physicochemical properties on sensory characteristics of roti prepared from Parbhani Moti and Parbhani Super Moti

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Abstract
In consideration of the nutritional and health benefits of sorghum roti the present inquiry was intended to develop the technology to prepare roti with the usage of correct size of sorghum flour. In this work, several physical–chemical and sensory parameters are determined and certain estimations of features were done in both sorghum flours. The proximate composition of sorghum grains of parbhani moti and parbhani super moti Colour, Shape, Wt. of 1000 Seed (g), True Density (g/ml), Bulk Density (g/ml), angle of repose, Moisture(%), Ash, Total Protein, Total Carbohydrate, Crude Fibre Pearly White, Very Bold, 33.5±0.02, 1.141±0.7, 1.21±0.9,32°14′, 8.12±0.02, 1.97±0.03, 8.59±0.01, 78.39±0.03, 2.94±0.04 and Creamy White, Bold, 32.2±0.06, 0.71±0.09,0.60±0.04, 30°27′, 9.24±0.03, 1.62±0.02, 7.89±0.05, 73.20±0.02, 2.59±0.01 respectively.

Keywords: Sorghum, sensory characteristics, physical – chemical attributes, flours in different sieves sizes

Introduction
Sorghum bicolor (L.), also termed as sorghum, is a grain-producing plant that originated in Africa and is used for human nourishment, animal feed, and ethanol production. After rice, wheat, maize, and barley, sorghum is the world's fifth most significant cereal crop. Although Sorghum bicolor is usually an annual, certain varieties are perennial. Sweet sorghum cultivars are sorghum cultivars planted primarily for feed, syrup production, and ethanol production. In poor countries, sorghum is critical to food security. It's used in a variety of dishes, including breads, porridges, pastes, and griddlecake (Coulibaly W.H. *et al.*, 2020) [2]. Sorghum bicolor has a variety of uses in African traditional medicine due to its high level of phenolic compounds, nutritional fibres, and antioxidant activity, and many of these uses have been documented in the literature (Devi S.P. *et al*., 2011) [3]. In India, a decoction of sorghum seeds is used to treat renal and urinary tract symptoms as a demulcent and diuretic. The biocompounds that give sorghum its red colour also have antibacterial, antifungal, and anti-anemic capabilities, according to numerous research (Lim T. K., 2013) [10].
Sorghum is a crop that is widely farmed for food and feed all over the world; it is one of the main staples for the world's poorest and most vulnerable people; it is a crucial staple food in many regions of the developing world, particularly in drier and more marginal semi-tropical climates (Elkhalifa *et al*., 2005). Sorghum is a staple meal in Africa and ranks third among cereals for human consumption; it is Sudan's most important grain crop (Elkhalifa and ElTinay, 2002) [4]. Sorghum protein is higher than rice, similar to or higher than maize protein, and generally comparable to wheat protein (Klopfenstein and Hoseney, 1996) [9].
Sorghum has a high mineral content, but its nutritional quality is mostly determined by its chemical makeup, namely the presence of tannin, phytic acid, polyphenol, and trypsin inhibitors, all of which are undesirable and for which attempts are made to reduce their level in the seed (Elsheikh *et al*, 2000) [7].

Materials and Methods
Materials
Grains of sorghum harvested Sorghum Research Center, Vasantrao Naik Marathwada University, Parbhani, Maharashtra, provided the Parbhani Moti and Parbhani Super Moti

cultivars. All of the grains were washed, sorted, and winnowed using various sieves. Sorghum grains were milled in Brabender quandrumat junior AACCI 26-50.01 method). Different sorghum samples were chosen to examine the relationship between sorghum quality and flour quality

Proximate composition of sorghum roti

Raw materials such sorghum flour and sorghum roti were analyzed for proximate composition including moisture, fat, protein, total carbohydrate, crude fiber, ash and mineral composition was carried out as per the methods given by AOAC, 2005 [1].

Determination of minerals composition of sorghum roti

Two grams of defatted sample was weighed and heated at 550ºC. Then, the obtained ash were digested with concentrated Hydrochloric acid (HCL) on hot plate. The digested material was then filtered using whatman No. 42 filter paper and the final volume made to 100ml with distilled water that was further used for analysis with respects to iron, calcium, potassium, contents by using methods Ranganna (1986) [12].

Sensory evaluation

The sensory evaluation of products was done by 10 semi-trained panel members comprised of academic staff members of the College of Food Technology, Parbhani; using 9 point Hedonic scale. The products were rated on a 9 point Hedonic Scale with relevant descriptive terms ranging from 9 'like extremely' to 1 'dislike extremely'. The best sample was chosen for future research based on the sensory score card evaluation. The impact of changes in product quality during storage on product sensory characteristics was also evaluated.

Processing equipments

Department of Food Process Technology, College of Food Technology, VNMKV Parbhani provided the necessary equipment and machinery, such as an electronic balance with a weight measurement accuracy of 0.0001g, a Vernier calliper for thickness, and a Sieves analyzer for obtaining different mesh sizes of flour.

Sieves analyser

Results and Discussion

Physico chemical properties of sorghum grains of different varieties

Data pertaining to various physicochemical properties of sorghum flour were determined for colour, shape, true density, angle of repose, moisture, fat, protein, carbohydrates, ash and crude fiber and results obtained are depicted in Table 1.

Table 1: Physicochemical parameters of different sorghum cultivar

Physical Parameters	Parbhani Moti	Parbhani Super Moti
Colour	Pearly White	Creamy White
Shape	Very Bold	Bold
Wt. of 1000 Seed (g)	33.5±0.02	32.2±0.06
True Density (g/ml)	1.141±0.7	0.71±0.09
Bulk Density (g/ml)	1.21±0.9	0.60±0.04
angle of repose	32°14′	30°27′
Moisture(%)	8.12±0.02	9.24±0.03
Ash	1.97±0.03	1.62±0.02
Total Protein	8.59±0.01	7.89±0.05
Total Carbohydrate	78.39±0.03	73.20±0.02
Crude Fibre	2.94±0.04	2.59±0.01

The information in Table 1 outlines the physical characteristics of various sorghum types. Parbhani moti (33.5 g) has the greatest thousand kernel weight than Parbhani super moti (32.2). The results found for sorghum were very similar to those reported by Nimkar and Chattopadhyay (2001) [11].

Color was represented in the values of hue, value, and chroma, and the samples were compared to the Munsell colour chart (Hoseney, 1994). Parbhani Moti and Parbhani Super Moti had pearly white and creamy white colours, respectively.

The bulk density of Parbhani moti was calculated to be (1.21 g/ml), while the bulk density of Parbhani super moti was (0.60 g/ml). In their investigation on the physical features of sorghum grains, the real densities of the grains were determined using the values for moti (1.141 g/ml) and super moti (0.71 g/ml). The result obtained for sorghum was in close resemblance with the result recorded by vannalli *et. al*., (2008) [14]

Angles of repose of sorghum grains were computed, and it was discovered that moti (32°14′) and super moti (30°27′) displayed the same angle of rest. The result achieved for sorghum was very similar to the result reported by (Rooney and Miller, 1982) [13].

Physical and chemical characteristics of different sorghum flours

Data pertaining to various physicochemical properties of sorghum flour were determined for colour, shape, true density, angle of repose,moisture, fat, protein, carbohydrates, ash and crude fiber and results obtained are depicted in Table 1.

Table 2: Physicochemical analysis of sorghum flours of varieties

Chemical properties (%)	Mean Value (%)	
	Parbhani moti	Parbhani super moti
Moisture	10.05±0.03	11.89±0.03
Ash	2±0.7	1.9±2.0
Protein	11.3±2.0	10.4±0.04
Carbohydrate	71.30±0.04	71.32±0.8
Crude Fibre	2.13±0.3	2.11±0.2
Crude Fat	2.18±0.05	2.16±0.6
Potassium	575±0.01	530±0.05
Magnesium	290±2.30	249±0.09
Zinc	2.17±0.05	2.10±0.09

*Each value represents the average of three determinations

Parbhani super moti had the greatest moisture content in both sorghum and flour at 11.89 percent, whereas Parbhani moti in sample had the lowest at 10.08 percent. Table 2 shows the average ash level of wheat cultivars and two types of flour, Parbhani moti and Parbhani super moti. The sample with the highest ash content was 2%, and the one with the lowest was 1.9 percent. The ash content of flour parbhani super moti is lower than parbhani moti. Table 2 displays the protein composition of sorghum and flour products.

The Parbhani moti samples had the highest protein level, at 11.03 percent, and the Parbhani Super Moti flour samples had the greatest protein level, at 10.4 percent. Sorghum flour from parbhani moti and parbhani super moti was tested analytically. Parbhani moti (2.13 percent crude fibre) had the most, whereas parbhani supermoti had the least (2.12 percent). The diluting and filtration procedures are eased by using customised fibre bags.

Mineral content is higher in both sorghum cultivars than in other grains. Among the several minerals The phosphorus content of parbhani moti is 289 mg/100g.

Standardization of a flat bread recipe based on particle size formed from several sorghum genotypes

Table 3: Formulation of different particle size flour on flat bread (Roti)

Sr. No.	Treatment	Particle Size(µm)	Sorghum Flour (gm)	Water (ml)	Rolling Capacity (cm)
1	T_0	150	50	37	11
2	T_1	180	50	36	10.7
3	T_2	212	50	35	7
4	T_3	250	50	33	6

A 9-point hedonic scale was used to rate the sensory acceptability of the prepared sorghum-based roti. Treatment (T_1) with sorghum flour size (180µm) and water in the ratio of (50:36) rated the highest in comparison to the other treatments.

10 semi-trained panel members comprising of academic staff members of the College of Food Technology, Parbhani, assessed the goods using a 9-point Hedonic scale. The products were graded on a 9-point Hedonic Scale, with descriptive phrases ranging from 9 (very like) to 1 (very detest). Based on sensory scores, the best sample was chosen for future investigation.

T_0 T_1 T_2 T_3

Fig 1: Preparation of gluten-free flat bread using various mesh sizes of flour

Table 4: Sensory evaluation of roti made from Parbhani moti

Treatments	Sensory Characteristics				
	Colour & Appearance	Flavour	Texture	Taste	Overall Acceptability
T_0	8.0	7.7	7.9	7.8	8.0
T_1	8.0	8.5	8.0	8.0	8.5
T_2	7.3	7.4	7.1	7.0	7.4
T_3	6.5	6.7	6.0	6.3	6.4
S.E±	0.0204	0.0118	0.0204	0.0152	0.0354
CD at 5%	0.0599	0.0346	0.0599	0.0446	0.1037

Sensory analysis was conducted using a 9-point hedonic scale. Table 4 depicts the sensory quality of whole rotis in terms of colour and appearance, flavour, texture, taste, and overall acceptability. The sensory score for sorghum roti is 8.5, followed by weeks stored (8.0), 10 weeks stored (7.4), and 4 weeks stored (7.4). (6.0).

Table 5: Sensory evaluation of roti made from Parbhani super Moti

Treatments	Sensory Characteristics				
	Colour & Appearance	Flavour	Texture	Taste	Overall Acceptability
T_0	7.0	7.1	6.9	7.0	7.2
T_1	7.5	8.0	7.5	7.5	7.8
T_2	7.0	6.9	7.0	7.0	7.0
T_3	6.5	6.3	6.0	6.0	6.2
S.E±	0.018	0.0354	0.0192	0.0118	0.0152
CD at 5%	0.0528	0.1037	0.0564	0.0346	0.0446

*Each value is average of three determinations

Conclusion

Sensory evaluation results revealed that as the amount of sorghum flour substituted increased, the colour and appearance, flavour, texture, taste, and overall acceptability varied dramatically. Thus based on the collected data, it can be concluded that different particle size of sorghum Parbhani moti and parbhani super moti are vital for good quality of roti.

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