International Food Research Journal 20(3): 1379-1382 (2013)
Journal homepage: *http://www.ifrj.upm.edu.my*

Selection of genotype and development of technology for sorghum *hurda* production

*Chavan, U. D., Dalvi, U. S., Pawar, G. H. and Shinde, M. S.

Sorghum Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, India

Article history

Received: 27 March 2012
Received in revised form: 4 January 2013
Accepted: 10 January 2013

Keywords

Sorghum hurda
technology for hurda
Phule Uttara
RSSGV 46
storage

Abstract

For standardization of time and temperature for sorghum *hurda* preparation gas shegadi was used. For the comparison gas shegadi with microwave and cow dung bhatti fire for the preparation of sorghum *hurda* for the same time and temperature were used. The gas shegadi for medium flame (95-100°C) found more suitable for good quality *hurda* preparation. For storage study brown paper bag, cloth bag and plastic bag were used for packing and stored at room temperature (27 ± 2°C) and refrigerated conditions (10 ± 2°C). The cloth bag was found suitable for storage of sorghum *hurda* for 2 days at room and 4 days at refrigerated conditions. For the organoleptic evaluation using semi-trained judges and 1 to 9 point Hedonic scale was used. The genotypes RSSGV 46, P. Uttara, and RSSGV 56 were found very good having more than 8.0 organoleptic score for the taste and best for commercial exploitation of sorghum *hurda*.

Introduction

Sorghum (*Sorghum bicolor* L) is an important cereal crop for food and fodder of Indian next to rice, wheat and maize. Largest share of country's production is contributed by Maharashtra and Karnataka states. Due to its ability to grow in dry lands of tropical Africa, India and China it has become the staple diet of these countries also (Shobha *et al*., 2008). Sorghum is the main staple food of Maharashtra, Karnataka, and is also an important food of Madhya Pradesh, Tamil Nadu and Andhra Pradesh. Sorghum grains are polished with a pearling machine and processed in to flour as well as *rava* (*suji*) of different particle size (coarse *rava*, medium *rava* and fine *rava*). Nowadays sorghum can be processed in to various products such as pops, starch, and grits (*semolina/rava*) from which many ethnic/niche food products can be made. This reduces the coarseness of the product made and also removes the bitterness that is associated with the pericarp of the grain. Sorghum does not have gluten and hence becomes a very good ideal gluten free energy source for the people suffering from wheat or gluten allergies. Normally sorghum for consumption is used in the form of *Roti*, unleavened breads, porridges, boiled grains and steam cooked products such as couscous (Rao and Murty, 1981; Chavan *et al*., 2009; Sajjanar *et al*., 2009; Unhale *et al*., 2012). Sorghum has nutritional composition similar to or better than rice and wheat in some aspects. The grains contain high fiber and non-starchy polysaccharides and starch with some unique characteristics. There is a considerable variation in sorghum for levels of proteins, lysine, lipids, carbohydrates, fiber, calcium, phosphorus, iron, thiamine and niacin (Shobha *et al.*, 2008; Chavan *et al*., 2009). Protein quality and essential amino acid profile of sorghum is better than many of the cereals and millets. Sorghum in general is rich source of fiber and B-complex vitamins (Gopalan *et al*., 2000; Patil *et al*., 2010).

Grain sorghum is rich in fiber and minerals apart from having a sufficient quantity of carbohydrates (72%), proteins (11.6%) and fat (1.9%). Starch is the major constituent of the grain. Grain sorghum protein contains albumin globulin (15%), prolamin (26%) and glutelin (44%). Sorghum does not contain gluten and hence the dough does not have stickiness, to roll with the chapatti roller. The flour from sorghum is gluten free and is a safe energy source for people allergic to gluten. Minimal amounts of flavan-4-ols and phytic acid are present in white sorghum (Chavan and Patil, 2010).

There is a need to popularize sorghum foods as sorghum with its high mineral and fiber content and with low or slow starch digestibility makes an ideal food for diabetic and obese population in the urban as well as rural society. To identify specific genotype for specific purpose from sorghum is scanty. It was therefore; felt to identify the genotype for *hurda* purpose which will give benefits to the farmers and the consumers too. Nowadays agro-tourism business is increasing in the rural area and in that contest

*Corresponding author.
Email: *uttamchavan08@gmail.com*

supplying sorghum *hurda* as a niche product get the more profit to the farmer/producer.

Materials and Methods

Standardization of time and temperature

Gas shegadi (HP gas) method

For standardization of time and temperature for roasting of sorghum grains (sorghum *hurda* preparation) gas shegadi was used. The Phule Uttara (check variety) variety was used for this experiment. At soft dough stage for *hurda* quality testing the sorghum grains separated from the earhead by holding the panicle in both the hands and then rubbing it with palm was used for further treatment. In the preliminary study roasting time 3, 5 and 8 minutes and temperature 80-90^{o}C, 95-100^{o}C and 115-150^{o}C were used. The sorghum grains were roasted with the help of gas shegadi by gas supplied at low flame, medium flame and hot flame. The gas supplied at medium flame of (95-100^{o}C) temperature for 5 min was found superior on the basis of their organoleptic test. For comparison gas shegadi with microwave and cow dung bhatti fire for the preparation of sorghum *hurda* for the same time and temperature were used. The roasted sorghum hurda was stored in brown paper bag, cloth bag and plastic bag and kept at room temperature (27 ± 2^{o}C) and refrigerated conditions (10 ± 2^{o}C) for their storage study. For Selection and standardization of suitable variety for sorghum *hurda*, twenty two *rabi* sorghum genotypes were grown at Sorghum Improvement project, Mahatma Phule Krishi Vidyapeeth, Rahuri and harvested at soft dough stage for *hurda* quality testing. Grain separation, grain shape, grain colour, texture of grain and taste parameters were tested using standard methods (Amerine *et al*., 1980).

Micro-wave method

The tender sorghum grains were subjected to micro-wave treatment at 980C for 5 min (LG make Model No. MC-608AF, Capacity 30 L, output 900 W) for making sorghum hurda or roasted sorghum grains.

Traditional method

The sorghum tender panicles were subjected for baking in cow dung fire for 5 min. Then the roasted sorghum grains were separated by hand by holding the panicle in both the hands and then rubbing it with palm. The sorghum *hurda* prepared by three different methods were subjected for the sensory evaluation to a panel of ten semi-trained judges. Parameters evaluated by the judges included colour and appearance, texture, aroma/flavour, taste and overall acceptability. For the sensory evaluation of sorghum hurda 1 to 9 point hedonic scale [Like extremely (Excellent) – 9, Like very much (Very good) – 8, Like moderately (Good) – 7, Like slightly – 6, Neither likes nor dislike – 5, Dislike slightly – 4, Dislike moderately – 3, Dislike very much – 2, Dislike extremely – 1] was used (Amerine *et al*., 1980). Mean values of the scores and parametric observations were calculated and analyzed. Visual observations and sensory parameters of sorghum hurda of different varieties prepared were compared and recorded. The chemical analysis (moisture, total sugars, soluble proteins, free amino acids and phenolics) of the roasted grains were done according to the standard methods of AOAC, 1990.

Results and Discussion

Temperature and time standardization for roasting sorghum hurda

Form the preliminary study the gas shegadi used for preparation of sorghum *hurda* by supplying gas at low, medium and high flame stages. Out of that the medium flame (95-100^{o}C) temperature for 5 min gave good quality sorghum *hurda* (Table 1). The organoleptic score also got 9.0 for the medium flame gas shegadi treatment. Keeping the same temperature and time the microwave and cow dung bhatti fire also used for the preparation of sorghum *hurda*. The sorghum grain roasted in the micro-wave gave medium taste and cools the grains immediately. While the cows dung bhatti fire method gave good taste but more burnt grains and some ash particles with grains. This method does not have control on the burnt grain so it is called as traditional method of sorghum *hurda* preparation. The gas shegadi for medium flame (95-100^{o}C) temperature and 5 min time found more suitable for good quality *hurda* preparation (Table 2).

Table 1. Standardization of temperature and time for roasting of sorghum *hurda* grains (Gas Shegadi used)

Genotype	Time for roasting (min)	Low flame 80-90 ^{0}C	Medium flame 95-100 ^{0}C	High flame 115 - 150 ^{0}C
P. Uttara, (C) (RSSGV 3) (Quantity: 250g)	3	Raw taste	Medium quality	More roasting
	5	Medium quality	Good quality	More roasting
	8	Medium quality	Good quality more roasting	More roasting
	Organoleptic score 1 – 9 (Overall acceptability)			
	3	6	6	7
	5	6	**9**	6
	8	7	7	6

Effect of storage conditions on storage period of sorghum hurda

In this method the temperature and time can be

Table 2. Effect of different roasting methods on sorghum *hurda*

Genotype	Gas Shegadi (at medium level; 95-100°C; 5 min)	Microwave (98°C, 5 min)	Cow dung Bhatti/fire (No control on temp.5 min.)
RSSGV 46	Good taste, no burnt	Medium taste, no burnt	Good taste, more burnt
RSSGV 56	Good taste, no burnt	Medium taste, no burnt	Good taste, more burnt
P. Uttara	Good taste, no burnt	Medium taste, no burnt	Good taste, more burnt

Table 3. Effect of storage conditions on storage period of sorghum *hurda* (days)

Genotype	Room temperature (27 ± 2 °C)			Refrigerated condition (10 ± 2 °C)		
	Brown paper bag	Cloth bag	Plastic bag	Brown paper bag	Cloth bag	Plastic bag
RSSGV 46	1	2	1	2	4	2
RSSGV 56	1	2	1	2	4	2
P. Uttara	1	2	1	2	4	2

control manually and grains remain hot for longer time. Therefore, consumers can get the good taste of sorghum *hurda*. For storage study brown paper bag, cloth bag and plastic bag were used for packing and stored at room temperature (27 ± 2°C) and refrigerated conditions (10 ± 2°C). The brown bags got wet with tender sorghum grains and lost their storage life. Plastic bags got wet with water droplets accumulation due to the grains respiration and got damaged within 1-2 days. The cloth bag was found more suitable for storage of sorghum *hurda* for 2 days at room and 4 days at refrigerated conditions (Table 3).

Sensory evaluation of roasted sorghum (Sorghum Hurda*)*

The sorghum genotype RSSGV 46 and RSSGV 56 gave easy grain separation than the Phule Uttara. Grain shapes of these genotypes were oval/oblong and colour of the gain was medium green. Texture of the RSSGV 46 and Phule Uttara was soft while the RSSGV 56 was medium. From twenty two sorghum genotypes the genotype RSSGV 46, P. Uttara, and RSSGV 56 were found very good having more than 8.0 overall acceptability organoleptic score for sorghum hurda (Table 4).

Nutritional composition of sorghum hurda

The grain recovery from each earhead of the sorghum plant was highest for RSSGV 52 (88.2 g) followed by RSSGV 46 (87.6 g). The taste contributing character i.e. total soluble sugar content was highest in RSSGV 46 (5.09%) followed by Phule Uttara (5.49%) and RSSGV 56 (4.59%). The phenolics component which gives astringency to the taste character is lowest in the RSSGV 46 (0.39%) as compare to other promising genotypes. Therefore, while considering the yield of sorghum hurda and their nutritional quality RSSGV 46 and RSSGV 56 were found more promising than the Phule Uttara (Table 5) for commercial exploitation.

Table 4. Sensory evaluation of roasted sorghum (Sorghum *hurda*)

Sr. No.	Sample No.	Grain separation from Glum	Grain shape	Colour of grain	Texture	Taste
1.	RPOSV 2	H	R	MG	M	6.2
2.	RPOSV 3	M	W	FG	H	6.0
3.	RPASV 3	H	R	FG	H	5.6
4.	RSSGV 41	M	O	FG	S	7.4
5.	RSSGV 42	H	R	FG	M	7.0
6.	RSSGV 43	H	R	FG	H	5.9
7.	RSSGV 44	E	R	FG	H	6.7
8.	RSSGV 45	E	O	FG	M	7.7
9.	**RSSGV 46**	**E**	**O**	**MG**	**S**	**8.8**
10.	RSSGV 47	H	R	FG	H	6.8
11.	RSSGV 48	E	O	MG	H	7.7
12.	RSSGV 49	E	R	FG	H	6.8
13.	RSSGV 50	M	R	FG	M	6.4
14.	RSSGV 51	H	R	FG	H	6.3
15.	RSSGV 52	H	R	FG	H	5.6
16.	**RSSGV 56**	**E**	**O**	**MG**	**M**	**7.9**
17.	RSSGV 58	H	R	FG	H	6.2
18.	RSSGV 63	E	R	FG	H	6.1
19.	RSSGV 65	E	R	FG	H	6.1
20.	Surati	E	O	MG	M	8.1
21.	Gulbhendi	H	O	MG	S	8.5
22.	**P. Uttara, (c)**	**H**	**O**	**MG**	**S**	**8.7**

Grain separation	Grain shape	Grain colour	Texture	Taste (Score)
Easy – E	Round – R	Dark green – DG	Soft – S	Like extremely – 9 Like very much – 8
Medium – M	Oval/oblong – O	Medium green – MG	Medium –M	Like moderately– 7 Like slightly – 6

Ten semi-trained judges were used for the sorghum *hurda* (roasted sorghum) organoleptic / sensory quality evaluation.

Table 5. Nutritional composition (wet weight basis) of sorghum *hurda*

Sr. No.	Genotype	Recovery of grains/ear head, g	Moisture, %	Total sugars, %	Soluble proteins, %	Free amino acids, %	Phenolics, %
1.	RPOSV 2	50.1	50.25	0.65	0.79	83.58	0.33
2.	RPOSV 3	56.6	36.51	0.51	0.78	94.63	0.41
3.	RPASV 3	58.5	44.17	1.30	1.34	82.85	0.77
4.	RSSGV 41	61.3	53.98	1.46	1.34	80.05	0.56
5.	RSSGV 42	68.5	45.32	1.26	1.32	79.93	0.64
6.	RSSGV 43	77.5	42.98	0.54	0.66	83.88	0.31
7.	RSSGV 44	63.5	36.50	0.62	1.25	82.07	0.38
8.	RSSGV 45	60.3	51.53	0.68	1.29	80.13	0.58
9.	**RSSGV 46**	**87.6**	**57.55**	**5.09**	**1.33**	**78.47**	**0.39**
10.	RSSGV 47	67.0	42.55	0.78	1.09	89.23	0.58
11.	RSSGV 48	64.3	53.38	1.04	1.43	75.83	0.65
12.	RSSGV 49	67.4	44.00	0.73	1.18	89.13	0.32
13.	RSSGV 50	78.0	43.16	0.65	1.24	83.88	0.49
14.	RSSGV 51	66.2	41.88	0.53	1.41	85.63	0.55
15.	RSSGV 52	88.2	44.83	0.91	1.48	76.87	0.52
16.	**RSSGV 56**	**78.9**	**55.21**	**4.59**	**1.45**	**85.17**	**0.55**
17.	RSSGV 58	66.3	45.02	1.04	1.25	86.23	0.31
18.	RSSGV 63	64.2	43.76	0.81	1.43	79.86	0.54
19.	RSSGV 65	62.4	41.51	1.02	1.49	81.33	0.59
20.	Surati	70.6	48.23	4.87	1.13	76.43	0.45
21.	Gulbhendi	68.2	52.31	5.12	1.22	74.13	0.56
22.	**P. Uttara, (c)**	**75.2**	**56.00**	**5.49**	**1.32**	**83.68**	**0.57**
	Range	50.1-88.2	36.51-57.55	0.53-5.49	0.66-1.49	75.83-94.63	0.31-0.77
	Mean	68.2	46.85	1.80	1.24	82.41	0.50
	S. E. ±	9.27	5.93	1.77	0.22	4.76	0.12
	C. D. at 5%	27.8	17.81	5.32	0.67	14.30	0.37

Conclusion

For roasting sorghum hurda gas shegadi for medium flame (95-100°C) for 5 min was found

suitable for good quality hurda preparation. The cloth bag was found suitable for storage of sorghum hurda for 2 days at room and 4 days at refrigerated conditions. The genotype RSSGV 46 and RSSGV 56 were found promising and comparable to Phule Uttara (check) for yield and organoleptic quality also.

References

Amerine, M. A., Pangborn, R. M. and Rossler, E. B. 1980. Principles of sensory evaluation of food. Academic Press. New York.

A.O.A.C., 1990. Official Methods of Analysis, 15th Edn Association of Official Analytical Chemists Washington DC pp 113-127

Chavan, U. D. and Patil, J. V. 2010. Grain Sorghum Processing. IBDC, Publishers, Lucknow, India.

Chavan, U. D., Patil, J. V. and Shinde, M. S. 2009. Nutritional and roti quality of sorghum genotypes. Indonesian Journal of Agriculture Science 10: 80-87.

Gopalan, C., Sastry, B. V. R. and Balsubramanyam, S. C. 2000. Nutritive Value of Indian Foods. National Institute of Nutrition. I.C.M.R., Hyderabad.

Patil, P. B., Sajjanar, G. M., Biradar, B. D. Patil, H. B. and Devarnavadagi, S. B. 2010. Technology of *hurda* production by microwave oven. Journal of Dairying, Foods and Home Sciences 29: 232-236.

Rao Prasada, K. E. and Murty, D. S. 1981. Sorghum for Special Uses. Proceedings of the International Symposium on Sorghum Grain Quality. 129-134.

Sajjanar, G, M., Patil, P. B., Biradar, B. D., Hemalatha, S., Tonapi, V. A., Elangovan, M., Raghavendra Rao K. V. and Seetharama, N. 2009. Special Sorghum Varieties of North Karnataka for Traditional and Novel Foods, Value Addition and Entrepreneurship Development, National Research Center for Sorghum, Rajendranagar, Hyderabad and All India Co-ordinated Sorghum Improvement Project, Regional Agricultural Research Station, Bijapur, 586 101, Karnataka. Pages: 69 ISBN 81-89335-22-27.

Shobha, V., Kasturiba, B., Naik, R. K. and Yenagi, N. 2008. Nutritive Value and Quality Characteristics of Sorghum Genotypes. Karnataka Journal of Agriculture Science 20: 586-588.

Unhale D. S., Sakhale, B. K., Ranveer, R. C. and Pawar, V. D. 2012. Studies on shelf life extension of sorghum *roti.* International Food Research Journal 19: 733-736.