ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, 2022

A Study on Assessment of Nutritional Implications of Domestic Sorghum Flour Processing Methods

Keshamma E*
Associate Professor, Department of Biochemistry, Maharani Science College for Women,Palace Road, Bengaluru, Karnataka, India

***Corresponding Author**
Dr. Keshamma E
Associate Professor
Department of Biochemistry,
Maharani Science College for Women,
Palace Road, Bengaluru-560 001,
Karnataka, India
Email: keshamma.blr76@gmail.com

Abstract

Sorghum (*Sorghum bicolor* (L.) Moench) is an important food crop in many states of India. Sorghum is rich source of fiber as well as other nutrients like carbohydrates, protein and fat. Main component of sorghum grain is starch. Sorghum roti is round, flat, unleavened bread often used in the cuisine of western and central India. In the current study we aimed to evaluate the commonly adopted domestic Sorghum flour processing methods on nutritional quality of processed Sorghum flour product especially roti. The Sorghum grains of three different varieties *viz.* SV1, SV2, and SV3 available in local market were cleaned and milled to flour. The flour of Sorghum varieties *viz.* SV1, SV2, and SV3 were processed to roti. The unprocessed whole Sorghum flour and roties prepared from all the varieties of Sorghum flour were analysed for proximate composition and quantitative estimation of antinutrients *viz.* total phenol and tannic acid content were determined. Results delineated that better proximate composition and reduction in antinutritional components i.e., total phenols & tannin was observed after processing Sorghum flour varieties *viz.* SV1, SV2 and SV3. In conclusion, this study demonstrated that domestic processing of Sorghum flour i.e., preparation of roties from Sorghum flour was helpful in terms of reduction of antinutrients.

Keywords: Sorghum, Domestic processing, Roti, Phenols, Tannins

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, 2022

Introduction

The king of millets, Sorghum (*Sorghum bicolor* (L.) Moench), is an important food crop in the dry regions of tropical Africa, India and China. After rice, wheat, corn and barley, sorghum is

the fifth major cereal crop in the world. More than 750 million people who live in semi-arid tropical countries of Africa, Asia, and Latin America eat sorghum as their primary cereal food.[1] Sorghum is one of the primary food crops in many states of India and it is especially popular in non-irrigated dry land regions with little rainfall. It is primarily grown in dry and semi-arid areas. The immense plains of North America, sub-Saharan Africa, north-eastern China, the Deccan plateau of central India, Argentina, Nigeria, Egypt and Mexico are the current major sorghum producing countries.[2] Sorghum is rich source of fiber as well as other nutrients like carbohydrates (70-75%), protein (11.7%) and fat (1.8%). Main component of sorghum grain is starch.

In India Sorghum is traditionally consumed in the form of unleavened pan cake, Roti or Bhakari. Because of Sorghum is a principal food in many parts of the country. Though Sorghum grains are nutritious, the consumption of this cereal is decreasing due to non-availability of easy cooking raw materials from the sorghum. The other major reasons are; dying traditional food habits, requirement of special skill for preparing sorghum rotis. The most common products are leavened and unleavened breads, porridges, boiled grains and steam cooked products such as couscous. Sorghum flour also makes an excellent fry coating for fish, chicken and beef. Sorghum is also used in the preparation of several snacks and for popping, chewing, and malting.[3]

Sorghum roti is very popular in villages and small towns as an accompaniment to gravy meat and vegetable curries and is one of the traditional recipes of India. It is round, flat, unleavened bread often used in the cuisine of western and central India, especially in the

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, 2022

states of Gujarat, Sorghum roti is known by various names in the different languages of India: chapati (Hindi), bhakri (Marathi), rotla (Gujarati), rotte (Telugu), etc...[4,5]

Because Sorghum flour is gluten-free flour, it is very tough to spread the dough without breaking the shape and one reallyneeds hands-on experience and many failed attempts to get the skill. No leavening agents, oil/ghee are added. Just fresh sorghum flour, warm water and touch of fire - pure grain power in its glory. Arabinoxylans have been isolated from different cereals and responsible to play important role in maintaining water balance and rheological properties of dough.[6-8]

Indian cuisine is processed using a dry heat method called roasting, though at a lower temperature than parching. By lowering water activity, enzymatic activity, and microbial activity, it lengthens the shelf life.[9] The edibility, sensory qualities, and palatability of roasted sorghum grains are increased.[10]In the present study we aimed to study the effect of commonly adopted domestic Sorghum flour processing methods on nutritional quality of processed Sorghum flour processed product especially roti.

Materials and Methods

Sample Collection

The Sorghum grains of three different varieties *viz.* SV1, SV2, and SV3 available in local market of Chikkaballapur was purchased. Sorghum grain varieties were cleaned to remove dirt & other extraneous materials. The Sorghum grain varieties were milled from local market milling station. Around 500 g of flour of unprocessed Sorghum grain varieties was stored in clean and dry plastic container and stored at room temperature for further analysis.

Domestic Processing of Sorghum Flour

The flour of Sorghum varieties *viz.* SV1, SV2, and SV3 were mixed with boiled water i.e., quantity sufficient to make Sorghum flour dough. The dough was well kneaded, divided into small balls, flattened on a hard wooden or metal surface sprinkled with a small quantity of

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, 2022

flour and was baked on both sides on a hot pan.[11] The prepared rotis were then kept in bamboo basket covered with cloth piece and stored at room temperature.

The unprocessed whole Sorghum flour and roties prepared from all the varieties of Sorghum flour were analysed for proximate composition and quantitative estimation of antinutrients *viz.*total phenol and tannin content were determined.

Proximate Composition Analysis

The proximate composition *viz.* moisture, total ash, protein, fat, carbohydrate, and fiber were determined according standardAssociation of Official Analytical Chemist (AOAC) procedures.[12]

Moisture

Weigh accurately about 5 gm of sample in a previously dried and tared dish and place the dish with its lid underneath in the oven for 2 hours. The time should be reckoned from the moment the oven attains 130°C after the dishes have been placed. Remove the dish after 2 hours, cool in the desiccator and weigh. The dish should be placed back in the oven at half hour intervals till constant weight is achieved.

Calculation

Moisture % = (W1- W2) X 100/W1-W

Where,

W1 = Weight in gms of the dish with the sample before drying

W2 = Weight in gms of the dish with the sample after drying

W = Weight in gms of the empty dish

Total ash

Ignite the dried material in the dish left after the determination of moisture with the flame of a burner till charred. Transfer to a muffle furnace maintained at 550 – 600°C and continue ignition till grey ash is obtained. Cool in a desiccator and weigh. Repeat the process of heating, cooling and weighing at half hour intervals till the difference in weight in two

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, 2022

consecutive weighings is less than 1 mg. Note the lowest weight. If ash still contains black particles add 2-3 drops of preheated water at 60°C. Break the ash and evaporate to dryness at 100-110°C. Re-Ash at 550°C. Until ash is white or slightly grey.

Calculation

Total ash on dry basis (% by weight) = (W2 – W) X100/W1 – W

Where,

W2 = Weight in gm of the dish with the ash

W = Weight in gm of empty dish

W1 = Weight in gm of the dish with the dried material taken for test

Protein

Weigh quickly about 1-2 gm of the sample and transfer to a 500 or 800 mL Kjeldahl flask taking care to see that no portion of the sample clings to the neck of the flask. Add 0.7 gm of Copper sulphate, 15 gm of Potassium Sulphate and 40 mL of concentrated sulphuric acid. Also, Missouri catalyst tablets known as Kjeldahl tablets (Composition: 48.8% Sodium sulphate & 48.9% Potassium sulphate & 0.3% copper sulphate) can also be used. Add two to three glass beads. Place the flask in an inclined position on the stand in the digestion chamber and digest. Heat the flask gently at low flame until the initial frothing ceases and the mixture boils steadily at a moderate rate. During heating rotate the flask several times. Continue heating for about an hour or more until the colour of the digest is pale blue. If black specs are present after 30 minutes of digestion, wrap the vessel with aluminum foil and keep for 2-3 minutes. By doing this black specs would move down from the walls in the digestion mixture. If the specs are still present, remove the vessel from heat and allow to cool for 10 mins. Do not modify the heat intensity in the whole process. Alternatively, few drops of water may also be poured down across the side of the flask. Cool the digest and add slowly 200 ml of water. Cool, add a piece of granulated Zinc or anti bump granules and carefully pour down the side of the flask sufficient Sodium Hydroxide solution (450gm/L) to make the contents strongly

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, 2022

alkaline (about 110 mL) before mixing the acid and alkaline layer. Connect the flask to a distillation apparatus incorporating an efficient flash head and condenser. To the condenser fit a delivery tube which dips just below the surface of the pipetted volume of standard acid contained in a conical flask receiver. (Precaution: The receiving solution must remain below 45°C to prevent loss of ammonia). Mix the contents of the digestion flask and boil until 150 mL have distilled into the receiver. Add 5 drops of methyl red indicator and titrate with standardized 0.1 N Sodium Hydroxide solution. Carry out a blank titration simultaneously.

1 mL of 0.1 N H_2SO_4 = 0.0014gm N

Calculation

Calculate protein as = N x 6.25

Protein on dry wt. basis = Protein content x 100 / (100 – Moisture content)

Crude fat

The crude fat content of the sample was determined using AOAC (2005) [1] method and Soxhlet apparatus. The crude fat percentage was calculated using following formula.

Crude fat (%) = (weight of oil / weight of sample) X 100

Quantitative Estimation of Total Phenols

The concentration of total phenols in the unprocessed Sorghum varieties and roties prepared Sorghum flour varieties was determined by the Folin-Ciocalteu assay that involves reduction of the reagent by phenolic compounds, with concomitant formation of a blue complex, its intensity at 725nm increases linearly with the concentration of phenolics in the reaction medium.[13] The phenolic content of the unprocessed Sorghum varieties and roties prepared Sorghum flour varieties was determined from calibration curve and were expressed in mg gallic acid equivalent/g of Sorghum flour varieties.

Quantitative Estimation of Tannins

The tannin concentration in the unprocessed Sorghum varieties and roties prepared Sorghum flour varieties was determined following a modified version of the vanillin-HCl method.[14]The

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, 2022

tannin content of the unprocessed Sorghum varieties and roties prepared Sorghum flour varieties was determined from calibration curve and were expressed in mg gallic acid equivalent/g of Sorghum flour varieties.

Results

The proximate composition of unprocessed Sorghum flour verities and roties prepared from Sorghum flour varieties was represented in Table 1 and 2. Results depicted that Sorghum flour variety (SV1) possess better proximate composition when compared to other two varieties of Sorghum flour *viz.* SV2 & SV3. Similarly, roties prepared from Sorghum flour variety (SV1) possess better proximate composition when compared to roties prepared with other two varieties of Sorghum flour *viz.* SV2 & SV3.

Table 1: Proximate composition of unprocessed Sorghum flour varieties

Proximate Compositon	**Sorghum Flour Varieties**		
	SV1	**SV2**	**SV3**
Moisture, %	8.43	7.98	7.23
Total ash, %	1.61	1.45	1.32
Fat, %	1.71	1.68	1.56
Protein, %	7.54	6.87	5.98
Fibre, %	2.85	2.43	2.06
Carbohydrate, %	78.11	74.32	68.97

Values are expressed as Mean; n=3

Table 2: Proximate composition of roties prepared Sorghum flour varieties

Proximate Compositon	**Roties Prepared from Sorghum Varieties**		
	SV1	**SV2**	**SV3**

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, 2022

Moisture, %	8.25	7.80	7.05
Total ash, %	1.80	1.64	1.51
Fat, %	1.50	1.47	1.35
Protein, %	7.31	6.64	5.75
Fibre, %	2.95	2.53	2.16
Carbohydrate, %	79.07	75.28	69.93

Values are expressed as Mean; n=3

The proximate composition results obtained in our study for unprocessed Sorghum flour verities *viz.* SV1, SV2 and SV3 were comparable with the findings of various other research investigators reported in the literature.[15,16] There was slight increase in ash content of roties prepared from respective Sorghum flour verities as compared to unprocessed raw Sorghum flour varieties was observed. These findings were in concurrence with the results of Obadina et al., wherein authors reported increased ash content in pearlmillet after roasting.[17]

The results of quantitative estimation total phenols and tannin was plotted in Figure 1 and 2. Results delineated that, there was a significant amount of reduction in total phenols and tannin concentration was observed in roties prepared from Sorghum flour varieties as compared to unprocessed Sorghum flour varieties.

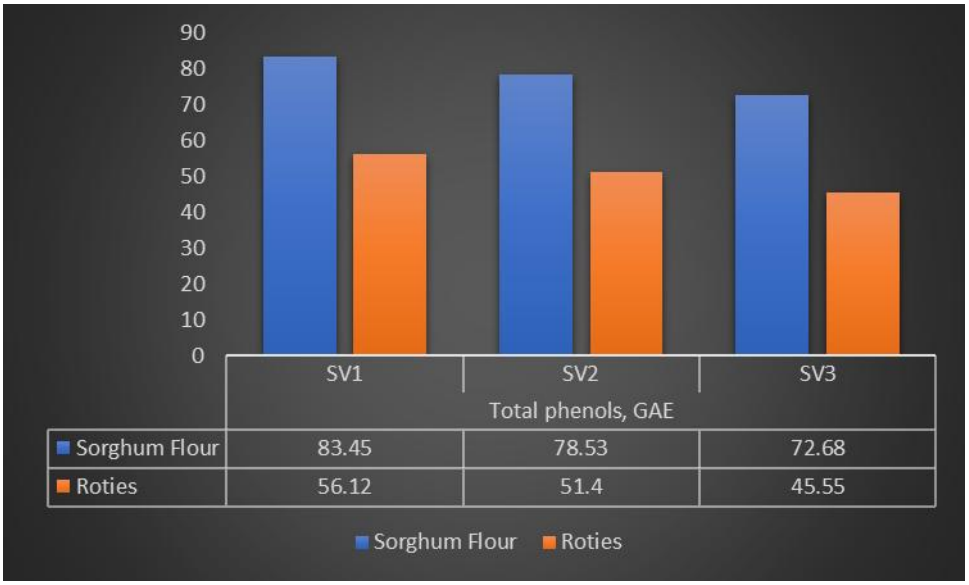

Figure 1: Quantitative estimation of total phenol

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, 2022

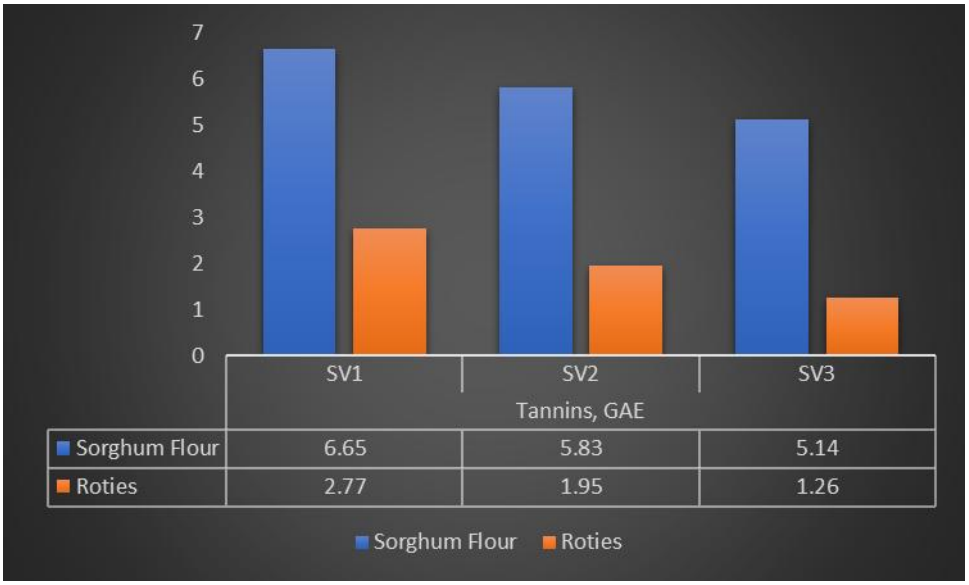

Figure 2: Quantitative estimation of tannins

Tannins are phenolic compounds that precipitate protein and cause reduced protein digestibility.[18] Tannins are known to inhibit the activities of digestive enzymes. The nutritional effect of tannin is related to their interaction with protein.[19] Several authors in the literature reported that domestic processing methods of Sorghum flour caused to decrease in antinutrients i.e., total phenols and tannins concentrations.[20-24]

Conclusion

In conclusion, better proximate composition and reduction in antinutritional components i.e., total phenols & tannin was observed after processing Sorghum flour varieties *viz.* SV1, SV2 and SV3 to roties. Therefore, this study demonstrated that domestic processing of Sorghum flour i.e., preparation of roties from Sorghum flour was helpful in terms of reduction of antinutrients.

References

1. Verma R, Kumar R, Nath DA. Drought resistance mechanism and adaptation to water stress in sorghum [*Sorghum bicolor* (L.) Moench]. Int J Bio-Resour Stress Manag. 2018;9(1):167-72.
2. Shingote AB, Sadawarte SK, Pawar VS, Gaikwad KK. Studies on chemical and mineral evaluation of raw rice, sorghum, ragi and green gram. The Pharma. Innov J. 2021;10(5):337-40.
3. Rao Prasada KE, Murty DS. Sorghum for special uses. In: Proceedings of the international symposium on sorghum grain quality; 1981. p. 129-34.
4. Subramanian V, Jambunathan R. Properties of sorghum grain and their relationship to roti quality. In: Proceedings of the international symposium on sorghum grain quality; 1981. p. 286-8.
5. Chavan UD, Jagtap YK, Shinde MS, Patil JV. Preparation and nutritional quality of sorghum chakali. Int J Recent Sci Res. 2016;7(1):8404-11.
6. Michniewicz J, Biliaderis CG, Bushuk W. Effect of added pentosans on some physical and technological characteristics of dough and gluten. Cereal Chem. 1991; 68:252-8.
7. Vietor RJ, Angelino SAGF, Voragen AGJ. Structural features of arabinoxylans from barley and malt cell wall material. J Cereal Sci. 1992;15(3):213-22.
8. Nandini CD, Salimath PV. Structural features of arabinoxylans from sorghum having good roti-making quality. Food Chem. 2001;74(4):417-22.
9. Severini C, Gomes T, De Pilli T, Romani S, Massini R. Autoxidation of packed almonds as affected by Maillard reaction volatile compounds derived from roasting. J Agric Food Chem. 2000;48(10):4635-40.

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, 2022

10. Aworh OC. The role of traditional food processing technologies in national development. In: Robertson GL, Lupein JR, editors. Food Science and Technology to improve nutrition and promote national development. International union of Food Science and Technology; 2008.
11. Shobha V, Kasturiba B, Naik RK, Yenagi N. Nutritive value and quality characteristics of sorghum genotypes. Karnataka J Agric Sci. 2008; 20:586-8.
12. AOAC. 18th ed Washington, DC., USA. 2005. Official Method of Analysis of the Association of the Analytical Chemists.
13. Singleton VL, Orthofer R, Lamuela-Raventós RM. Analysis of total phenols and other oxidative substrates by means of Folin-Ciocalteau reagent, Packer L. Methods Enzymol. 1999; 299:152-78.
14. Chanwitheesuk A, Teerawutgulrag A, Rakariyatham N. Screening of antioxidant activity and antioxidant compounds of some edible plants of Thailand. Food Chem. 2005;92(3):491-7.
15. Onoja US, Akubo PI, Gernar DI, Chinmma CE. Evaluation of complementary food formulated from local staples and fortified with calcium, iron and zinc. J Nutr Food Sci. 2014;4(1):3-6.
16. Sharma S, Singh E, Jain P. Effect of different household processing on nutritional and anti-nutritional factors in *Vigna aconitifolia* and *Sorghum bicolor* (L.) Moench seeds and their product development. J Med Nutr Nutraceuticals. 2015;4(2):95-100.
17. Obadina AO, Ishola IO, Adekoya IO, Soares AG, de Carvalho CWP, Barboza HT. Nutritional and physio-chemical properties of flour from native and roasted whole grain pearl millet (*Pennisetum glaucum* (L.) R. Br.). J Cereal Sci. 2016; 70:247-52.
18. Sulieman AE, Fatima FMI, Elamin EAE. Quantitative determination of tannin content in some sorghum cultivars and evaluation of its antimicrobial activity. Res J Microbiol. 2007;2(3):284-8.

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 9, 2022

19. Bartosz A, Judy S, Veikko K, Sylwia A, Aino S. Tannins and their complex interaction with different organic nitrogen compounds and enzymes-old paradigms versus recent advances. ChemPubSoc Europe. 2017;6(5):610-4.
20. Gernah DI, Ariahu CC, Ingbian EK. Effect of malting and lactic fermentation on some chemical functional properties of maize (*Zea mays*). Am J Food Technol. 2011;6(5):404-12.
21. Iwuoha CI, Aina JO. Effects of steeping condition and germination time on the alpha-amylase activity, phenolics content and malting loss of Nigerian local red and hybrid short Kaura sorghum malts. Food Chem. 1997;58(4):289-95.
22. Ikemefuna C, Obizoba AJV. Effect of soaking, fermentation and cooking on nutrient composition and some antinutritional factors of sorghum (Guinesia) seeds. Plant Foods Hum Nutr. 1991; 41:203-12.
23. Onwurafor EU, Onweluzo JC, Ezeoke AM. Effect of fermentation methods on chemical and microbial properties of mung bean (*Vigna radiate*) flour. Niger Food J. 2014;32(1):89-96.
24. Nour AAM, Ibrahim MAEM, Abdelrhman EF, Osman EF, Khadir KE, Hussain NF, et al. Effect of processing methods on nutritive value of sorghum (*Sorghum bicolor* L. Moench) cultivar. Am J Food Sci Health. 2015;1(4):104-8.