

Original Research Article

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Sorghum (*Sorghum bicolor*) Malting and its Incorporation in Bread Preparation

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ABSTRACT

Sorghum (*Sorghum bicolor*) is a gluten free, whole grain packed with complex carbohydrates and minerals. Its consumption is limited due to lack of adoption in diversified food products and easy availability of other chief cereals. With this background a study was undertaken to process sorghum grain by malting technique and to incorporate its flour in bread preparation. Grain sorghum samples were procured, studied for physical characteristics and processed by malting at different periods, then ground into flour and analyzed for nutritional composition. Nutritionally best variation of malted sorghum was selected for incorporation in bread preparation by replacing refined wheat flour at 10, 20 and 30 per cent. Further prepared bread samples were subjected for sensory analysis and computed its nutritional value. Findings highlighted that, density of the sorghum grain is 1.17g/ml. Period of malting did not affected flour recovery. Nutrient composition include moisture, protein, fat, ash, crude fiber, carbohydrate and energy varied from 6- 6.7 per cent, 9.37 to 11.37, 1.87 to 3.27, 1 to 1.12, 2.0 to 2.4, 79.5 to 73.5g/100g and 369 to 375.76 Kcal/100g Respectively. Among the flour samples, 72hr malted sorghum flour had good nutritional value which was further utilized for incorporation in bread preparation. Among the different incorporation levels, 10 per cent was found to be best accepted with good sensory scores. Incorporation of sorghum flour has slightly improved nutritional value of prepared bread. In this regard, future research must be focused towards increasing the incorporation level of malted sorghum flour instead of wheat flour to develop low gluten food products, which reduces demand for wheat and encourage the formers to grow this nutritionally important millet.

Keywords

Sorghum Malting,
Nutritive value,
Bread preparation,
Sensory evaluation

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Introduction

Sorghum (*Sorghum bicolor*) is commonly named as Jowar, the “King of millets”. It is one of the staple cereals for millions of people, particularly in Africa, India and central Asia. India has the largest share (32.3%) of the world’s area under sorghum and ranks second in production after the US.

It is the fifth major cereal crop in the world after wheat, rice, maize and barley. In acreage, it ranks fifth and accounts for 3.5% of total cereal grain production (FAO, 2002).

Though sorghum contain known amount of nutritional quality, the consumption is limited due to easy availability of rice and wheat through public distribution system and easy

methods of processing and cooking of fine cereals (Ratnavathi, *et al.*, 2013). Malting is one of the important processing method, which enhance the in-vitro protein digestibility and minerals availability by reduction of anti-nutritional factors (Tannin and phytate). The malting of sorghum modifies the sorghum grain components that can decrease the starch gelatinization temperature and increase the water-holding capacity of sorghum flour, thereby improving the property of sorghum flour need for bread preparation (Sharma *et al.*, 2014). However the emerging trend in sorghum as an industrial raw material includes production of snacked products like bread, biscuits, confectionery and weaning foods. Sorghum was found to be the best substitute for wheat in composite flours. A wheat and sorghum proportion of 70:30 was found to be the best in preparation of bread instead of whole wheat bread, because of its nutritional importance (Omary *et al.*, 2012).

Bread is ready to eat, cheap and convenient food product that can be consumed by all age groups. Due to changing food consumption patterns resulted by urbanization bread consumption has increased in recent days. However, health conscious consumers prefer value added food products than their conventional counter part (Makanjuola, *et al.*, 2019). Therefore, in the present study attempt has been made to incorporate malted sorghum flour in preparation of bread and to study its nutritional significance through selected aspects.

Materials and Methods

Procurement of sample

Grain of sorghum (*Sorghum bicolor*) was procured from Department of Agronomy, University of Agricultural Science, GKVK (Gandhi Krishi Vignana Kendra), Bangalore.

Other ingredients required for bread preparation were procured from the local market.

Physical characteristics of sorghum grain

Sorghum grain was studied for physical characteristics such as colour, shape, 1000 kernel weight (g), 1000 kernel volume (ml) and density (g/ml) according to standards methods.

Preparation of malted sorghum flour

Sorghum grains were soaked in water for 24hr and the soaked water was changed twice. The soaked grains were germinated for three different periods of 24, 48 and 72 hr, by placing in room temperature covered with cotton cloth. Germinated grains were dried using hot air oven at 50°C for 3-4 hr until the moisture content reached 5.6 per cent and the sprout portions were manually removed. Malted grains were milled into fine powder and packed in air tight container.

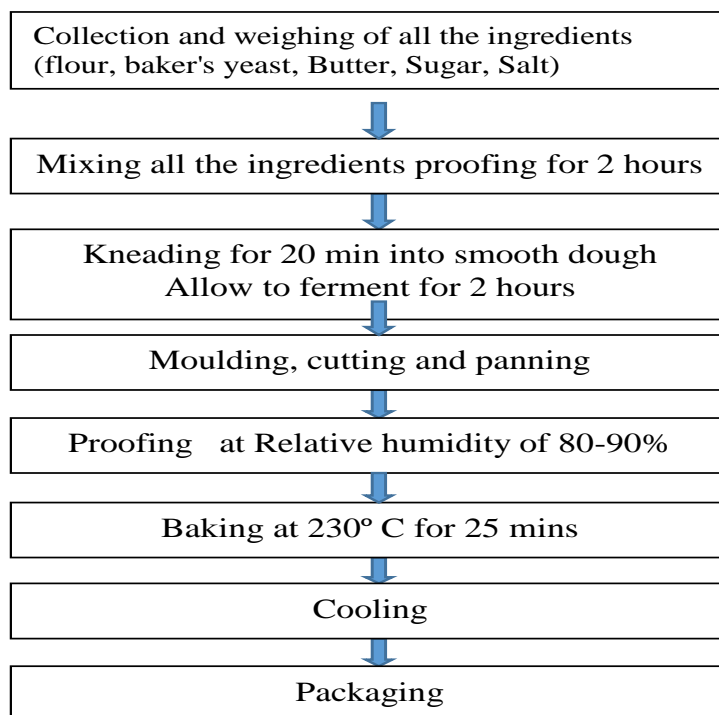
Nutritional Quality Evaluation of flour

Malted sorghum flour prepared with different germination periods was analyzed for moisture, protein, fat, crude fiber, ash, carbohydrates and energy by following standard protocol (Association of official agricultural chemist AOAC, 1980).

Formulation of Bread

Based on nutritive value, 72 hour germinated malted flour (MSF3) was used to prepare bread. Malted sorghum flour was incorporated at 10, 20 and 30per cent in bread preparation. Control bread sample was prepared from 100 per cent refined wheat flour without incorporation of malted sorghum flour. Steps followed for preparation of bread is as follows.

Flow chart for preparation of bread



Sensory evaluation of developed products

The developed products were evaluated by semi-trained judges for different sensory attributes such as colour and appearance, texture, flavor, taste and overall acceptability using 1 to 9 point hedonic scale (Amerine *et al.*, 2013).

Statistical analysis

The statistical analysis was done using Microsoft Excel and SPSS software. One-way analysis of variance (ANOVA) was applied for sensory parameters to analyze difference between incorporation level of malted sorghum. Nutritive value analysis was subjected for F test. Significant difference was defined as $p \leq 0.05$.

Results and Discussion

Research findings pertaining to physical characteristics of sorghum grain, nutritional

composition and sensory analysis is presented with following subheadings.

Physical properties of sorghum grain

Visual observation of sorghum grain revealed that sorghum is creamy white in color and round in shape. The mean 1000-kernel weight and volume was found to be 41.01g and 34.17ml respectively (Table 1). Density of the sorghum grain is 1.17g/ml. These findings are comparable with the findings reported by Simonyan (2007).

The kernel weight of sorghum varies based on moisture content. It is reported that, when the moisture content is 8.89 per cent, the mass is 34.91g, which increased to 61.12g at 16.50 per cent. Accordingly kernel volume also influenced by moisture per cent. However 1000 kernel volume ranged from 34.91-61.12 g within moisture range of 8.89- 16.50 per cent.

Recovery of malted sorghum flour

Various processing methods are employed to obtain malted sorghum powder. Increase or decrease in initial weight of Sorghum grain is presented in table 2. Per cent recovery of the malted sorghum flour is 93 per cent. The main reasons for decrease in malted sorghum powder weight is drying which results in loss of moisture. Removal of vegetative growth and milling loss contribute to significant reduction in recovery of flour.

Nutritional composition of malted sorghum flour

Proximate nutrient analysis was carried out for malted sorghum flours (MSF1 – 24hr

germinated sorghum flour, MSF2 – 48hr germinated sorghum flour, MSF3 – 72hr germinated sorghum) and the results are presented in Table 3.

Nutritional analysis revealed that, moisture (6.7%), protein (11.37%), fat (3.27%), crude fiber (2.04%) and total energy (375.76 kcal) content was more in MSF 3 compared to other samples. Significant differences were observed for protein, fat, crude fiber and carbohydrate. However, moisture, total ash and energy content did not differed significantly. It was observed that MSF 3 has good nutritional composition compared to other samples analyzed.

Table.1 Recovery of sorghum flour after processing

Parameters	MSF1	MSF2	MSF3
Initial weight of sorghum(g)	100	100	100
Weight of sorghum after germination(g)	120	116	117
Weight of sorghum after drying	95	96	95
Milling loss(g)	7	6.5	7
Recovery of powder after sieving(g)	93	93	93
Per cent recovery (%)	93	93	93

Note: MSF1- 24hr Malted Sorghum flour, MSF2- 48hr Malted Sorghum, MSF3- 72hr Malted Sorghum flour

Table.2 Proximate composition of variation in malted sorghum flour (100g)

Sorghum Variations	Moisture (%)	Protein (g)	Fat (g)	Ash (g)	Crude fiber(g)	CHO (g)	Energy (Kcal)
MSF1	6	9.37	1.87	1.17	2.07	79.53	369.13
MSF2	6.67	10.58	1.87	1	2.2	78.23	367.73
MSF3	6.7	11.37	3.27	1	2.4	73.57	375.76
F-Value	NS	*	*	NS	*	*	NS
S.Em±	1.72	0.11	0.74	0.09	0.03	0.73	7.86
CD at 5%	5.95	0.38	2.57	0.33	0.13	8.38	27.23

*significant at 5 % level. MSF1-24hr malted sorghum flour, MSF2- 48hr malted sorghum flour, MSF3- 72hr malted sorghum flour

Table.3 Mean sensory score of sorghum bread prepared with malted sorghum (n=21)

Variation	Appearance	Texture	color	flavor	Taste	Overall acceptability
WB1	8.42	8.1	8.75	8.12	8.03	8.18
SB1	8.02	7.64	7.7	8.14	8.17	7.89
SB2	7.7	6.83	7.66	7.38	7.75	7.59
SB3	7.42	6.35	7.26	7	7.10	6.75
F-Value	NS	*	*	*	*	*
SEm±(0.05)	0.235	0.328	0.22	0.169	0.196	0.202
CD at 5%	0.673	0.941	0.633	0.484	0.563	0.579

Table.4 Nutrient composition of best accepted sorghum bread per 100g

Nutrients	Control	10% MSF incorporated bread
Protein(g)	10.57	10.67
Fat(g)	1.16	1.42
Ash(g)	0.58	0.65
Crude fiber(g)	2.87	2.83
Carbohydrates(g)	77.30	76.83
Energy(Kcal)	1542.85	1433.5

According to El-Beltagi, *et al.*, (2012), reported germination increase the crude protein from 10.62-12.46 per cent, fat 2 per cent, and ash 1 per cent. Significant reduction in carbohydrate levels upon germination is due to increased amylase activity and breakdown of glucose molecules. These results observed similar to the present research.

Similarly, the findings of Narsih *et al.*, (2012) reported that germination and soaking time improves the nutritional quality of sorghum and reported the values for protein (8.03%), fat (1.64%), fiber (1.45%) and ash (2.24%). These findings are in supportive to present research.

Sensory score of Sorghum Bread

Sensory analysis of bread samples prepared with incorporation of malted sorghum flour is presented in Table 4. Sensory evaluation was

conducted semi-trained panel members using 9- point hedonic scale. The bread with 10 per cent of sorghum flour was most accepted among all the variations, with highest scores of 8.02, 7.64, 7.7, 8.14, 8.17 and 7.89 for appearance, texture, color, aroma, taste and overall acceptability respectively. Control scored 8.42, 8.1, 8.75, 8.12, 8.03 and 8.18 for appearance, texture, color, aroma, taste and overall acceptability respectively. Sensory evaluation scores for overall acceptability showed that control has the highest (8.18) followed by 10 per cent level (7.9) incorporation of sorghum flour. As the level of incorporation of malted sorghum flour increased sensory scores were decreased significantly at 5 per cent level except for appearance. The result revealed that 10 per cent malted sorghum incorporate bread is best accepted.

Arlene *et al.*, (2018) investigated on Development and Evaluation of Low Gluten

Composite Bread from Sorghum Cultivars, Composite bread was made using two combinations of sorghum flour (20 and 30%) with refined wheat flour. The sensory evaluation of samples revealed higher scores for 20% Incorporated Bread based on their color, taste and overall acceptability.

Nutritive value of best accepted Sorghum bread

The best accepted sorghum bread of 10% incorporation and control bread are computed for nutritive composition using food composition table. Computed values of protein, fat, carbohydrate, energy and crude fiber and ash for control and MSF 3 are presented in table 4. The findings revealed that, protein (10.67g), fat (1.42g) and ash (0.65g) was slightly more in MSF3 incorporated bread compared to control. Malted sorghum flour incorporation resulted in nutritionally comparable with whole wheat bread with acceptable sensory parameters. These findings support the gluten free baking which is need of recent days.

In conclusion the sorghum grain has good nutritional value but its utilization is limited due to its grittiness and high fiber coating interfering with protein and starch digestibility. Malting is one of the processing method help to overcome digestibility and increases the nutritive value. In bread preparation malted sorghum flour can be incorporated up to 30 per cent and best accepted at 10 percent incorporation level with good sensory scores. However, there is slight improvement in nutritional value of malted sorghum flour incorporated bread compared to control. Hence, future research must be focused towards increasing the incorporation level of malted sorghum flour instead of wheat flour to develop low gluten food products. Development of such products reduces the demand for wheat which is a high

value crop and encourage the formers to grow this nutritionally important millet.

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