Biological Forum – An International Journal 14(4a): 232-237(2022)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Studies on Malting Characteristics of different Sorghum Genotypes and its Utilization to Prepare Traditional Fermented Product i.e., Ambil

Anerao K.K.[1], Gadhe K.S.[2], Gaikwad S.S.[1], Sadaf T.[1] and Ghatge P.U.[3]*
[1]*Research Scholar, Department of FCN, CFT, VNMKV, Parbhani (Maharashtra), India.*
[2]*Associate Professor and Head, Department of FCN, CFT, VNMKV, Parbhani (Maharashtra), India.*
[3]*Assistant Professor, Department of FCN, CFT, VNMKV, Parbhani (Maharashtra), India.*

(Corresponding author: Anerao K.K.)*
(Received 16 September 2022, Accepted 09 November, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: The present investigation focused on development of traditional fermented product i.e., ambil prepared from malted sorghum flour; the three different sorghum genotypes (Parbhani Moti, GP-1539, GP-2017-5) being utilized for the study. The effect of malting on anti-nutritional profile and total phenolic content for all the three genotypes was evaluated. The malted flour of Parbhani moti has higher reduction in tannin (0.06 ± 0.03) and phyate levels (2.26 ± 0.02) as compared to the raw sorghum. The total phenolic content of malted sorghum genotypes reduced upto 10 per cent as compared to raw sorghum flour The malt flour was utilized in formulation of ambil by initially preparation of slurry followed by addition of buttermilk and spices. The ambil was further analyzed for proximate composition, total phenolic content, viscosity and organoleptically acceptance. The nutritional profile of ambil represented the highest protein in GP-1539 followed by GP-2017-5 and Parbhani moti. The total phenolic content of ambil was found higher in GP-1539 *i.e.*, 195.21 ± 1.42 mg/100 g. The highest scores for overall acceptability of ambil was recorded for GP-1539. The demanding part of the present research work aims at enhancing the nutritional content of sorghum genotypes by application of malting treatment, and its value-addition to traditional product. The goal is to fulfil the gaps of millet processing by value-addition and hence eradicating nutritional security.

Keywords: Genotypes, phenolics, anthocyanin, malting, ambil.

INTRODUCTION

India ranks second in the production of sorghum, with many other such crops as millets and pseudo-cereals with similar functionality (Chavan *et al.*, 2017). Sorghum is a staple food in the states of Maharashtra and parts of Karnataka, Madhya Pradesh, Tamil Nādu, Gujarat and Andhra Pradesh. Though sorghum known for its nutritional quality, the consumption of this cereal is decreasing due to easy availability of rice and wheat through public distribution system and easy methods of processing and cooking of fine cereals (such as rice). Sorghum being a robust source of numerous phytochemicals including tannins, phenolic acids, anthocyanins, phytosterols and policosanols, are proven to have significant impact on human health (Awika and Rooney 2004). Sorghum being gluten-free cereal in nature; Consumption of the crop focuses on provision of vital elements like carbs, protein, vitamins, and minerals, as well as nutraceuticals like antioxidants, phenolics, and cholesterol-lowering waxes (Taylor *et al*., 2006). The idea of upgrading includes the elements of production, technology, knowledge, and skills and denotes the transition from low-value-added to higher-value-added activities (Deribe & Kassa 2020). The requirement of special skill in preparing sorghum rotis and non-availability of ready-made sorghum flour and suji in the market are deterrents for wider use of sorghum as food.

Sorghum (*Sorghum bicolor*) ranks the fifth most staple crop all over the world in term of world grain production. It is also a good source of proteins, calories and minerals in developing countries (Queroz, 1991). Sorghum is a popular type of Millet in India to make Rotis and other bread. It is locally known as Jowar. Organic jowar is a rich source of iron, protein, and fibre and, due to the presence of policosanols which aids in lowering cholesterol levels. Sorghum has a low glycaemic index and also increases satiety. The various traditional food preparations in India encompass various products like Roti, Annam, Sankati, Kanji, Upma etc. (Ratnavathi, 2014). Teff, rice, and sorghum are primarily used in conventional food items. In a relatively small amount, the production of infant foods and feed products is more commonly linked to the agro-processing use of sorghum (Deribe & Kassa 2020). Colored sorghum grains rich in anthocyanins have been identified as promising ingredients for the development of whole-grain functional foods (Francavilla and Joye 2020). The value-addition of these grains into newer products presents selection, ease of use, quality, cost-efficiency, and potential to improve the nutritional value (Prabhakar *et al.*, 2017).

One of the oldest methods of processing sorghum is still considered to be fermentation, which is still important due to the health benefits it gives to food. Typically, sorghum fermentation alters and improves the nutritional value, flavour, shelf life, fragrance, and structural characteristics (Adebo, 2020).

Fermented millet porridge is a nutritious food, especially prepared by use of millet flour, buttermilk/curd, and other spices; rich in fermentable micro-flora which helps in improving the digestibility, an effective against celiac diseases (Afoakwah *et al*., 2022). Ambil is a locally produced, naturally lactic fermented beverage popular in the border districts of Maharashtra adjacent to Karnataka like Osmanabad, Latur, Solapur, Kolhapur etc. It is also popular in Bidar, Gulbarga, Bijapur, Raichur and Belgam districts of Karnataka. In view of the nutritional, therapeutic importance and growing needs of traditional fermented foods and effective utilization of sorghum, our effort is to provide scientific information useful to develop the technology for the large-scale preparation and spread of this traditionally important beverage to maximum possible people of India and abroad. The present study mainly focused on malting of sorghum, and its utilization for development of fermented product Ambil considering the three genotypes as Parbhani moti (white), GP-1539 (red) and GP-2017-5 (yellow).

MATERIAL AND METHODOLOGY

A. Raw material

(i) Sorghum Genotypes. Sorghum [*sorghum bicolor* (L.) Moench] genotypes *i.e*., IS-23891 (chalky white), GP 1539 (Red), and GP-2017-5 (Yellow) were procured from the Seed Technology Research and Breeder Seed Production Unit V.N.M.K.V. University Parbhani, Maharashtra.

(ii) Culture of Dahi (Curd). Fresh culture of curd was prepared from milk procured from the department of dairy science and animal husbandry, and stored at cold (0-5 °C) conditions until use.

(iii) Spices. The spices required for preparation of ambil were procured from local market of parbhani.

B. Methodology

(i) Grain sorting and Cleaning. Grains were sorted manually to remove broken kernels and foreign material. Thereafter, sorted samples, in triplicates of 200 g batches were surface sterilized by immersion for 40 min in hypochlorite solution having 1per cent (v/v) available chlorine. Subsequently, the grains ware drained and washed severally in tap water (Morrall *et al.,* 1986).

(ii) Malting of Sorghum. Sorghum malt was prepared according to the procedure given by Kulkarni *et al.* (1991). The sorghum grain was cleaned, weighed, washed, and steeped in water (1:3 sorghum: water) for 18 hours so as to attain a 45 per cent moisture level. The water was changed every two hours and sodium benzoate was added to prevent fungal growth during germination. The steeped grain was drained, loaded onto perforated trays lined with muslin cloth, and covered with moist muslin. The trays were placed in a seed germinator at 20°C and 95 per cent relative humidity for 72 hours. The germinated grain was dried at 55°C in an air-flow drier for 24 hours to reduce its moisture content from 42 per cent to 8per cent. The withered rootless were gently brushed off, and the malt was ground in a laboratory Brabender mill. It was preserved in air-tight glass jars and high-density polyethylene bags kept at a low temperature until use (Morall *et al*., 1986).

Preparation of sorghum malt flour:

Sorghum
↓
Cleaning
↓
Steeping (18hrs)
↓
Germination
(72hrs, at 20, 95per cent RH)
↓
Drying at (55°C)
↓
Separation of Sprouts
↓
Grinding
↓
Sieving
↓
Sorghum malt flour

Flow sheet: Process for preparation of Sorghum malt Flour

(iii) Preparation of Ambil. A traditional lactic acid starter culture was prepared by inoculating fresh milk with small quantity of curd. The fermentation of sorghum involved suspending 50 g of flour 50 ml boiled (Ratio of malted Flour: water = 1:1), cooled water, leaving the slurry for fermentation at 28 °C after inoculation of 2-4 ml of curd, until the pH dropped to 4.2, which occurs after about 6-8 h for malted flour. The fermentation pH was determined at regular intervals, and the soured slurry of above composition was mixed with 10 ml of boiling water and cooked, with constant stirring, for 5 min to stop the fermentation activity. The Ambil was prepared by homogeneous churning of cooked fermented sorghum slurry into buttermilk and spice mix prepared earlier in following ratio (cooked slurry: Buttermilk: Spice mix: 250g: 100ml: 20 g). The composition for all sorghum cultivars was kept constant and ambil was prepared.

Table 1. Formulation of Ambil by utilizing malt flour.

Ingredients	Quantity
A. Cooked slurry (1:1)	
Malted sorghum flour	125
Water	125
B. Buttermilk	100 ml
C. Spice mix (20 g)	
Ginger paste	35
Garlic paste	35
Cumin seeds	5
Cinamon	5
Clove	5
Black pepper	5
Chilli powder	10

Preparation of Ambil:

Sorghum
↓
Cleaning
↓
Steeping
↓
Germination
(72hrs, at 20°C, 95per cent RH)
↓
Sorghum malt flour
↓
Slurry
↓
Fermentation (6-8hrs, at 28°C)
↓
Cook slurry (5 min in small quantity of water)
↓
Addition of spice mix
↓
Packaging and Storage
(Refrigeration recommended)

Flow sheet: Process for preparation of ambil from malted Flour

(iv) Anti-nutritional and total phenolic and anthocyanin content. The anti-nutritional factors determined by raw and malted flour was determined for tannins and phytic acid, whereas the total phenolic contents of raw and malted sorghum flour was evaluated.

(v) Proximate analysis of Ambil. The moisture content, ash contents were determined by the standard method (AOAC, 1990). The determination of protein content was estimated by the Kjeldahl (1983) method by initially calculating nitrogen content and further protein from the nitrogen content. The crude fat was extracted and measured by the Soxhlet apparatus using n-hexane, as per A.A.C.C., (2000). The crude fibers and total carbohydrates were performed according to the methodology described by Ranganna (1986).

(vi) Organoleptic evaluation of Ambil. The organoleptic evaluation of ambil prepared by sorghum malt flour was performed by 9-point hedonic rating scale, by the semi-trained panel members.

(vii) Viscosity of Ambil. The viscosity of Ambil was determined using Brookfield Viscometer using spindle 61.

RESULTS AND DISCUSSIONS

The results for the effect of malting compared to raw flour of sorghum genotypes are presented below. Moreover, the utilization of malt flour in fermented product Ambil for its nutritional, total phenolic and organoleptic is presented below.

A. Effect of malting on anti-nutritional factors of sorghum genotypes

The anti-nutrients interact negatively with the bio accessibility of essential elements in the digestive tract particularly iron and zinc; moreover, tannins further reduce the digestibility of sorghum' proteins. The general mechanism involves the formation of insoluble complexes at physiological pH, due to the ability of phytic acid and tannins to bind proteins and divalent cations.

Table 2: Effect of malting on anti-nutritional factors.

Genotypes	Tannin (mg/100gm)		Phytic Acid (mg/100gm)	
	Raw	Malted	Raw	Malted
Parbhani moti	0.21 ± 0.06	0.06 ± 0.03	6.27 ± 0.1	2.26 ± 0.02
GP-1539	0.30 ±0.12	0.09 ± 0.04	8.80 ± 0.21	3.20 ± 0.06
GP-2017-5	0.34 ±0.04	0.10 ± 0.05	7.19 ± 0.14	2.59 ± 0.03

The tabulated data revealed that after malting ANF's in sorghum were reduced. The malted sorghum flour of Parbhani moti has higher reduction in tannin (0.06 ± 0.03) and phyate levels (2.26 ± 0.02) as compared to the raw sorghum. Similarly, other two genotypes show the same effect on malting treatment. Malting of sorghum reported the decrease level of tannins from 2.6 mg/g and 0.1 mg/g and phytic acid reduction upto 77 per cent (Feyera, 2021).

B. Effect of malting on total phenolic and anthocyanin content of sorghum genotypes

The variation of TPC in raw and malted sorghum cultivars could be due to a number of factors such as genotype, growing location and growing system.

The data for total phenolic content in the malted grain samples of the sorghum cultivars (Parbhani moti, GP-1539 and GP-2017-5) were 164.22 ± 1.7 mg/100gm, 260.28 ± 1.5 mg/100gm, and 198.36 mg/100gm, respectively. Thus, TPC decreased almost 10 per cent upon malting. However, there is increase in whole anthocyanin content in malted flour 16.48 ± 1.4 mg/ 100 g, 75.41 ± 1.2 mg/100 g and 40.38 ± 1.08 mg/100 g as compared to raw sorghum which is approximately 1.5 per cent as compared to raw sorghum. The results obtained was nearer to the results obtained by (Khoddami *et al.*, 2017) as it depicts the malting of sorghum enhances the anthocyanin content, which might be due to could be due to de novo synthesis and polymerization of the phenolics during germination.

C. Proximate analysis of Ambil

The proximate study of Ambil sample for all the three sorghum genotypes represented in Table 4.

Table 3: Effect of malting on anti-nutritional factors.

Genotypes	Total Phenolic Content (TPC) (mg/100gm)		Total Anthocyanin Content (mg/100gm)	
	Raw	Malted	Raw	Malted
Parbhani moti	182.46 ± 1.2	164.22 ± 1.7	11.52 ± 0.21	16.48 ± 1.4
GP-1539	289.20 ± 1.5	260.28 ± 1.5	53.30 ± 0.18	75.41 ± 1.2
GP-2017-5	220.40 ± 0.78	198.36 ± 1.3	27.74 ± 1.6	40.38 ± 1.08

Table 4: Proximate composition of Ambil.

Genotypes	Chemical properties of sorghum grain					
	Moisture (%)	Fat (%)	Protein (%)	Carbohydrates (%)	Crude fibres (%)	Ash (%)
Parbhani moti	78.10	0.70	2.81	16.43	1.76	0.18
GP-1539	79.43	0.45	3.93	14.20	1.65	0.12
GP-2017-5	81.10	0.52	3.17	13.47	1.41	0.15
SE±	0.0816	0.0091	0.0534	0.0455	0.0254	0.0028
CD at 5 %	0.2476	0.0276	0.1621	0.1381	0.0771	0.0086

Moisture content was ranged from (78.10 to 81.10 per cent), fat (0.39 to 0.70 per cent), protein (2.8 to 3.9 per cent), carbohydrate (13.4 to 16.4 per cent), crude fibres (1.4 to 1.7 per cent), and ash content (0.12 to 0.18 per cent). The protein content in the present investigation found 3.9 per cent for GP-1539 which was the highest protein content among selected genotypes whereas, the protein content of genotype GP-2017-5 was 3.1 per cent. The genotype Parbhani moti gave a lower level of crude protein content which was 2.8 per cent. In addition to genetic factors, environmental effects may be a cause for the wide variation in protein content (Geleta *et al.*, 2005).

The carbohydrate content was found at 72.36 g/100g and comparable with the ranges of 13.47 per cent to 16.43 per cent. The values recorded for the carbohydrate content of the genotypes Parbhani moti, GP-1539, GP-2017-5, were 16.43 per cent, 14.20 per cent, and 13.47 per cent respectively. The mean value for crude fibre content for genotype Parbhani moti (1.7 per cent), GP-1539 (1.6 per cent), and GP-2017-5 (1.4 per cent). From the results obtained it is evident that there is no significant difference in crude fibre content was observed.

D. Mineral composition of ambil

Concerning the phosphorous content Genotype GP-1539, recorded the highest amount of phosphorous which is (215.9 ppm). Likewise, the values of phosphorous content observed for genotypes GP-2017-5 and parbhani moti were (180.37 ppm) and (169.4 ppm). From the results obtained it is seen that the genotype Parbhani moti gave a significant lower phosphorous content.

From the results obtained it can be concluded that the calcium content ranged from 13.68 to 28.37 (ppm). A higher level of calcium content was found in the genotype GP-1539 which is (28.37 ppm). The genotype GP-1539 gave a higher level of calcium which is (28.37 ppm) whereas, the calcium content exhibited by genotype Parbhani moti is (13.68 ppm).

The genotype GP-1539 recorded a higher level of iron content (4.16 ppm) however, the iron content of the genotype GP-2017-5 and parbhani moti showed a significant difference in iron values which is (1.52 ppm) and (2.73 ppm) respectively. The lowest iron content was found in genotype GP-2017-5.

Table 5: Mineral composition of ambil.

Mineral composition of grains (mg/100gm or ppm)				
Genotypes	Calcium	Phosphorous	Iron	Zinc
Parbhani moti	13.68 ± 0.82	169.4 ± 1.58	2.73 ± 0.5	1.25 ± 0.09
GP-1539	28.37 ± 0.68	215.9 ± 1.42	4.16 ± 0.2	1.40 ± 0.6
GP-2017-5	24.12 ± 0.72	180.37 ± 1.28	1.52 ± 0.4	1.10 ± 0.07

* Each value is a mean of three determinations

E. Organoleptic score of Ambil

The above table interprets the sensory profile of product developed i.e., Ambil of 3 varieties as Parbhani Moti, GP-1539 and GP-2017-5.

The Table 5 reveals that the highest score for overall acceptability was obtained by T_1 (GP-1539) variety as compared to T_0 (Parbhani Moti) and T_2 (GP- 2017-5). The colour and taste of T_1 (GP-1539) scored higher than T_0 (Parbhani Moti) and T_2 (GP- 2017-5). The flavor of T_0 (Parbhani Moti) noted to score highest *i.e.*, 8.2 as compared to T_1 (GP-1539) and T_2 (GP- 2017-5).

The texture of T1 (GP-1539) scored higher compared to T_0 (Parbhani Moti) and T_2 (GP- 2017-5).

F. Viscosity of Ambil

The viscosity of ambil is depicted in Table 6, where the speed of spindle and temperature of ambil was maintained throughout as 20 rpm and 25.

The control sample T_0 recorded moderate viscosity when comparison was done with other two genotypes. However, genotype GP-1539 gave highest value for viscosity which was 26713.3 mpa s with maximum torque of 89.0 per cent. Similarly, values for torque and viscosity for samples T_0 was 53.1 per cent, and 1873.5 per cent, for T_2 was 49.1 per cent and 1473.5 per cent. It was found in accordance with as temperature and viscosity are inversely proportional to each other whereas, maximum torque which must be more than 50 per cent for viscosity determination is desirable.

Table 6: Organoleptic score for Ambil.

Parameters / Genotypic variety	Color & appearance	Taste	Flavor	Texture	Overall acceptability
T_0 (Parbhani Moti)	8	8.2	8.2	8	8
T_1 (GP-1539)	8.2	8.4	8	8.2	8.2
T_2 (GP- 2017-5)	7.8	7.9	7.8	7.6	7.8
SE	0.1106	0.1016	0.0670	0.0260	0.0782
CD @ 5%	0.3356	0.3084	0.2032	0.0791	0.2373

Table 7: Viscosity of Ambil

Genotype	Speed (rpm)	Temperature (°)	Torque (%)	Viscosity (mpa.s)
Parbhani moti (T_0)	20	25	53.1%	1873.5%
GP-1539 ($T_{1)}$	20	25	89.0%	26713.3
GP-2017-5 ($T_{2)}$	20	25	49.1%	1473.5%

CONCLUSION

The present investigation trials were carried out to develop Ambil from different sorghum genotypes and suitability of the cultivar was judged to finalize the best suited variety for standardization and nutritional profile of the Ambil beverage. The Genotype GP-1539 scored highest for overall acceptability followed by followed by Parbhani moti and GP-2017-5 was found to be least acceptable. The future aspects of sorghum lie in development of value-added products (popped/ puffed), malted, fermented, etc. The promising approach lies in utilizing the color sorghum genotypes rich in anti-oxidant and anthocyanin content.

FUTURE SCOPE

In the future sorghum grain has enormous potential for development into healthy and functional food as it is gluten free, high in resistant starch and rich source of nutrients as well as rich in bioactive phenolic compound. Phenolic compounds found in sorghum are rare class of pigments which are found in grains. Malting of sorghum reduces antinutritional factors and improve nutritional quality of sorghum. Consumption of sorghum grains helps prevent cancer also aid in reducing oxidative stress. Production of fermented food products from sorghum is feasible from the economic point of view. That will increase the utilization of sorghum for food and industrial purposes, in turn helping to raise the living standards of Indian population.

REFERENCES

A.A.C.C. (2000). Approved Methods of the American Association of Cereal Chemists, 10th Edn, AACC, St. Paul, MN, USA.

Adebo, O. A. (2020). African Sorghum-Based Fermented Foods: Past, Current and Future Prospects. *Nutrients*, *12*, 1111.

Afoakwah, Newlove, Mahunu, Gustav and Tahir, Haroon Elrasheid (2022). Fermented Millet for Porridge Production: A Model for Improved Gastrointestinal Health, *10*.

AOAC (Association of Official Analytical Chemists). (1990). Official methods of analysis.

Awika, J. M. and Rooney, L. W. (2004). Sorghum phytochemicals and their potential impact on human health. *Phytochemistry*, *65*(9), 1199–1221.

Chavan, U. D., Nirmal, S. V., Shinde, M. S., Pawar, G. H., Gadakh, S. R., & Dalvi, U. S. (2017). Nutritional quality of hybrid sorghum genotypes. *International Journal of Current Microbiology and Applied Sciences*, *6*(2), 586-592.

Deribe, Y., & Kassa, E. (2020). Value creation and sorghum-based products: what synergetic actions are needed?. *Cogent Food & Agriculture*, *6*(1), 1722352.

Feyera, M. (2021). Overview of Malting and Fermentation Role in Sorghum Flour , Primarily for Antinutrient Reduction. *Journal of Human Nutrition & Food Science*, *9*(1), 1–9.

Francavilla, A. and Joye, I. J. (2020). Anthocyanins in whole grain cereals and their potential effect on health. *Nutrients*, *12*(10), 1–20.

Geleta, N., Labuschagne, M. T., Osthoff, G., Hugo, A. and Bothma, C. (2005). Physical and chemical properties associated with food quality in sorghum. *South African Journal of Plant and Soil*, *22*(3), 175–179.

Khoddami, A., Mohammadrezaei, M. and Roberts, T. H. (2017). Effects of sorghum malting on colour, major classes of phenolics and individual anthocyanins. *Molecules*, *22*(10), 1–17.

Kjeldahl, J. (1883). "New method for the determination of nitrogen in organic substances. *Analytical and Bioanalytical Chemistry*, *22*(1) : 366-383.

Kulkarni, K. D., Kulkarni, D. N., & Ingle, U. M. (1991). Sorghum malt-based weaning food formulations: preparation, functional properties, and nutritive value. *Food and nutrition bulletin*, *13*(4), 1-7.

Morrall, P., Boyd, H. K., Taylor, J. R. N. and Walt, W. V. D. (1986). Effect of germination time, temperature and moisture on malting of sorghum. *Journal of the*

Institute of Brewing, 92(5), 439-445.
Prabhakar, B., More, D. R., Srilatha, P., & Fulchand, C. R. (2017). Screening of Sorghum Varieties for Papad Preparation. *Int. J. Curr. Microbiol. App. Sci*., *6*(7), 1116-1124.
Queroz, M. De. (1991). Sorghum and millets in human nutrition. *In Science* (Issue 27).
Ranganna, S. (1986). *Handbook of analysis and quality control for fruit and vegetable products*. Tata McGraw-Hill Education.
Ratnavathi, C. V. (2014). Sorghum Utilization as Food. *Journal of Nutrition & Food Sciences, 4*(01), 1–8.
Taylor, J. R. N., Schober, T. J. and Bean, S. R. (2006). Novel food and non-food uses for sorghum and millets. *Journal of Cereal Science, 44*(3), 252–2.

How to cite this article: Anerao K.K., Gadhe K.S., Gaikwad S.S., Sadaf T. and Ghatge P.U. (2022). Studies on Malting Characteristics of different Sorghum Genotypes and its Utilization to Prepare Traditional Fermented Product i.e., Ambil. *Biological Forum – An International Journal, 14*(4a): 232-237.