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Studies on shelf life extension of sorghum *roti*

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Abstract: Potassium sorbate and ascorbic acid were used in the preservation of sorghum *roti* without significant changes in its sensory qualities. The sample with 0.5 g potassium sorbate and 100 ppm ascorbic acid was found best in terms of all parameters. It had a shelf life of 6 days. The other samples T_2 and T_3 had shelf life of 14 and 19 days respectively. But there were certain disagreeable effects in the physical and sensory characteristics of *roti* due to high concentrations of above chemicals. The sorghum *roti* possess low susceptibility to losing its moisture and texture due to use of polyethylene bags of 150 gauge. The method requires further studies which will help to reduce its undesirable characteristics.

Keywords: Sorghum *roti*, preservation, potassium sorbate, ascorbic acid, TPC, yeast and mould

Introduction

Sorghum (*Sorghum bicolor* L. Moench) is the king of cereals and is one of the important food crops in dry lands of tropical Africa, India and China (Shobha *et al.,* 2008). India ranks second in the world for sorghum production and first with respect to many regionally important crops like millets and pseudo-cereals. Sorghum is the principal staple food of Maharashtra, and is also an important food of Karnataka, Madhya Pradesh, Tamil Nadu and Andhra Pradesh. Sorghum can be milled to produce starch or grits (semolina) from which many ethnic and traditional dishes can be made. 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 (Rao and Murty, 1981).

There is a considerable variation in sorghum for levels of proteins, lysine, lipids, carbohydrates, fiber, calcium, phosphorus, iron, thiamine, and niacin (Chavan *et al.,* 2009). Sorghum has chemical composition similar to or better than rice and wheat in some respects. The grains contain high fiber and non-starchy polysaccharides and starch with some unique characteristics. Protein quality and essential amino acid profile of sorghum is better than many of the cereals. Sorghum in general is rich source of B-complex vitamins.

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 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. (Subramanian and Jambunathan, 1981). Because sorghum flour is gluten-free flour, it is very tough to spread the dough without breaking the shape and one really needs 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 (Michniewicz *et al.,* 1991; Vietor *et al.,* 1992; Nandini *et al.,* 2001). Typically *bhakri* is accompanied by various curries, chutney (*thecha* - a thick paste of really hot green or red chilies) and raw onion (Murty and Subramanian, 1981). *Bhakri* has its own advantages from dietary point of view. Being made from cereals, it is high in dietary fiber but at the same time very easy to digest**.** However it has very low shelf life. It gets dried and spoiled after 10-15 h of preparation. The research works to extend the shelf life by use of chemicals is scanty. It was therefore felt worthwhile to undertake the present research work to extend the shelf life of sorghum *bhakri* by using ascorbic acid and potassium sorbet.

Materials and Methods

Physico-chemical analysis

Sorghum of M35-1 (Maladandi) cultivar was

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procured from local farmer. These sorghum grains were analyzed for physical parameters i.e. colour, shape weight and volume of 1000 grains. Colour and size of the whole sorghum grains were observed visually and recorded. One thousand kernels were counted and their weight was noted and volume of the thousand kernels was measured in measuring cylinder. Density of the grains was calculated from thousand-kernel weight and volume (Mishra and Gupta, 1995). The sorghum was analyzed for moisture, protein, ash, crude fibre and total carbohydrates as per the procedure suggested by Ranganna (1986).

Preparation of sorghum roti

The flour was made from milling grains, sieved and fine flour was made in to dough with hot water (45^0C). The 100 g sorghum flour was taken for preparation of *roti.* The potassium sorbate at three different concentrations viz. 0.5, 1.0 and 1.5 g each and ascorbic acid solution of 100 ppm concentration were prepared. It was added in the flour and then kneaded nicely to make soft dough of uniform consistency. The dough was well kneaded, divided into small balls, flattened on a hard wooden or metal surface sprinkled with a small quantity of flour and was baked on both sides on a hot pan (Shobha *et al.,* 2008). The prepared *rotis* were then packed in polyethylene bags (150 gauges) and stored at room temperature for studying the extension of shelf life.

Evaluation of microbial quality of sorghum roti

The *roti* prepared with varying concentration of potassium sorbet and ascorbic acid were subjected microbial analysis. Total plate count, and yeast and mould count were estimated by using nutrient agar and potato dextrose agar respectively with the help of pour plate technique. The microbial count was taken up to 18 days at the interval of three days after preparation. The results were expressed in terms of colony forming unit (CFU)/ per g of sample (Chandru *et al.,* 2010).

Sensory evaluation of sorghum roti

The sensory evaluation for different quality parameters like taste, color, appearance, flavor, texture and overall acceptability was carried out after every three days up to 18 days by semi trained panel of 10 judges on a 9 point hedonic scale (Amerine *et al.*, 1980).

Results and Discussion

Physico-chemical analysis

The sorghum grains were subjected to physico-chemical. The data showed that sorghum grains were White pearly and very bold with specific gravity of 1.15. M 35-1 (*Maldhandi*) a sorghum cultivar is known for its good quality of *roti* due to having pearly white grain color Chavan *et al.* (2009). Also Shobha *et al.* (2008) had analyzed 10 different genotypes of sorghum and reported similar results for the 'M35-1' genotype. On the basis of physical parameter it conforms that the sorghum grains taken for the study was of M35-1 i. e. *Maldhandi* genotype.

The proximate analysis of the sorghum showed that it is a rich source of carbohydrate (81.16±0.36%), protein (8.93±0.080%), crude fiber (1.32±0.020%), fat (1.98±0.025%) and total minerals (1.38±0.025%). Shobha *et al.,* 2008 had studied 10 different cultivars and found similar results for M35-1 cultivar.

Effect of storage on sensory quality of Sorghum roti

The sorghum *roti* samples were analyzed for the organoleptic characteristics at the interval of 3 days after preparation. The organoleptic evaluation was done to study the effect of potassium sorbet and ascorbic acid on the sensory characteristics of sorghum *roti.* The results are shown in Table 1. The sensory scores showed that there were no considerable differences in colour, flavour, appearance and overall acceptability between the control sample of sorghum *roti* (T_0) and those prepared with the concentrations of ascorbic acid 100 ppm and potassium sorbet 0.5, 1.0, 1.5 respectively on freshly prepared samples. The sample containing 0.5g of potassium sorbet (T_1) showed the decline in appearance, texture and colour after 3rd day. However, this had good taste compared to the (T_2) and (T_3). The sample (T_3) had good color, fair texture and appearance. Its taste was adversely affected which showed the great decline in its overall acceptability. However, this sample showed the longest shelf life as compared to the other samples. The results of organoleptic evaluation showed that addition of ascorbic acid potassium sorbet did not affect the sensory quality. Sensory quality of sorghum *roti* was unaffected upto 3rd day of storage for all the sample. The sample (T_2) had good appearance, color and texture. There was a gradual decline in those characteristics after 6th day. This sample had a shelf life of 14 days but its overall acceptability was affected badly due to development of odor in the sample on 14th day. Chavan *et al.* (2009) reported that the M 35-1 (*Maldhandi*) a sorghum cultivar is known for its good quality of *roti* due to having its flour having higher water holding capacity, and good organoleptic taste.

Table 1. Effect of different preservatives on sensory quality of stored sorghum *roti*

Samples	Storage period (days)						
	0	3	6	9	12	15	18
	Color and appearance						
T_0	9.5	Dis.	Dis.	---	---	---	---
T^0_1	9.5	8.0	5.5	Dis.	---	---	---
T^1_2	9.5	8.5	7.0	6.5	6.5	Dis.	---
T^2_3	9.5	8.5	7.5	7.0	7.0	6.0	5.0
	Flavor						
T_0	9.5	Dis.	Dis.	---	---	---	---
T^0_1	9.0	8.5	5.0	Dis.	---	---	---
T^1_2	8.5	8.0	7.0	6.5	6.0	Dis.	---
T^2_3	8.0	7.5	6.0	5.5	5.5	5.0	4.5
	Texture						
T_0	9.5	Dis.	Dis.	---	---	---	---
T^0_1	9.5	9.0	8.0	Dis.	---	---	---
T^1_2	9.0	8.5	7.5	7.0	6.0	Dis.	---
T^2_3	9.0	8.5	7.5	7.0	6.5	5.5	5.0
	Taste						
T_0	9.5	Dis.	Dis.	---	---	---	---
T^0_1	9.0	7.0	4.0	Dis.	---	---	---
T^1_2	9.0	7.5	6.0	6.0	5.5	Dis.	---
T^2_3	8.5	8.0	6.5	6.0	5.5	5.0	4.5
	Overall acceptability						
T_0	9.5	Dis.	Dis.	---	---	---	---
T^0_1	9.5	7.0	4.0	Dis.	---	---	---
T^1_2	9.5	7.5	6.5	6.5	6.0	Dis.	---
T^2_3	8.5	8.0	7.0	7.0	6.5	5.0	4.5

Results are mean of 3 determinations
T_0- control, T^0_1- 0.5 g Pot. Sorbet + 100 ppm ascorbic acid, T^1_2- 1.0 g Pot. Sorbet + 100 ppm ascorbic acid, T^2_3-1.5g Pot. Sorbet + 100 ppm ascorbic acid

Effect of storage on microbial quality of Sorghum Roti

Microbial analysis was done to study the microbial quality of sorghum *roti* by using Pour Plate Technique. The analysis was done at the interval of three days after the preparation of Sorghum *roti* with the different concentrations of potassium sorbet while the concentration of ascorbic acid was kept constant. The obtained results are presented in Table 2 and 3. The control sample showed surface growth on 3 day whereas T_1 and T_2 showed surface growth on 6 and 18 days respectively for total plate count, and yeast and mould count. Sample T_3 was in good condition up to 18 days storage. There was growth of molds on the surface of *roti*. The growth of bacteria was in increasing order in first four days and then their population goes on decreasing. The growth of yeasts and molds also goes on increasing. There were fluctuations in the growth of bacteria as well as yeast and molds. At start there was increase in bacterial population, then decline followed by further increase in their population. As per the WHO (1994) guideline the total plate count, and Yeast and mould count should be less than 2×10^5 and 1×10^4 per gram respectively.

Table 2. Effect of preservatives on total bacterial count of sorghum *roti*

Storage period (days)	Total bacterial count (CFU/g)			
	T_0	T_1	T_2	T_3
0	15×10^1	10×10^1	8×10^1	7×10^1
3	34×10^5 and surface growth	60×10^2	40×10^2	36×10^2
6	----	229×10^2	96×10^2	60×10^2
9	----	23×10^3 and surface growth	165×10^2	149×10^2
12	----	----	240×10^2	218×10^2
15	----	----	280×10^2	248×10^2
18	----	----	360×10^2 and surface growth	260×10^2

Results are mean of 3 determinations

Table 3. Effect of preservatives on yeast and mould count of sorghum *roti*

Storage period (days)	Total yeast and mould count (CFU/g)			
	T_0	T_1	T_2	T_3
0	5×10^2	2×10^3	21×10^2	5×10^2
3	34×10^3 and surface growth	6×10^3	24×10^2	20×10^2
6	----	31×10^3 and surface growth	36×10^2	46×10^2
9	----	----	60×10^2	15×10^3
12	----	----	74×10^2	26×10^2
15	----	----	28×10^3	48×10^2
18	----	----	62×10^3 and surface growth	29×10^3

Results are mean of 3 determinations

Conclusion

Potassium sorbate and ascorbic acid can be used in the preservation of Sorghum *roti* without significant changes in its sensory qualities. The sample with 0.5 g potassium saorbate and 100 ppm ascorbic acid was found best in terms of all parameters. It had a shelf life of 6 days. The other samples T_2 and T_3 had a shelf life of 14 and 18 days. There were certain disagreeable effects in the physical and sensory characteristics of *roti* due to high concentrations of above chemicals. The sorghum *roti* possess low susceptibility to losing its moisture and texture due to use of good quality of polyethylene bags. The method requires further studies which will help to reduce its undesirable characteristics.

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