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Sensory and physicochemical properties of gluten free pearl millet crackers fortified with sorghum and soybean flour

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Abstract

The present investigation was aimed to development of gluten free pearl millet crackers with incorporation of different proportions of sorghum and soybean flour by without fermentation, was assessed on the nutritional and Sensory quality of crackers. Pearl millet is unique among all millets because of it is rich in protein, calcium, dietary fiber. The present study was to develop and popularize bakery products using pearl millet. The aim of research is to review the potential health benefits of cereal and legume combined product. Pearl millet and sorghum are gluten free cereal grains, so it is beneficial to gluten intolerant people. Soybean is an excellent source of protein contains 35-45% with all essential amino acids required for proper growth and maintenance of body. The popular bakery product such as crackers was developed by replacing wheat flour by pearl millet flour which is fortified by using sorghum and soybean flour. The different samples prepared were BSS₁, BSS₂ and BSS₃ in the ration of (Bajra: sorghum: soybean flour) 50:35:15, 60:30:10 and 50:40:10 respectively. The physicochemical properties and sensory evaluation of bakery crackers was carried out. The sensory result showed that BSS₂ was rated most acceptable by a panel of studies on a 9 point hedonic scale. The physical properties like weight, width, thickness, puffiness and spread factor was analyzed.

Keywords: Pearl millet, sorghum, soybean, crackers, nutritional composition

Introduction

Baked products have popularities in the populace because of their availability, ready to eat convenience and having good storage life (Vijaykumar *et al.*, 2013) ^[13]. Because of their low moisture content this have less microbial spoilage, hence more production and distribution possible. (Dhankar 2013) ^[3]. Crackers are a types of crisp baked products, chemically leavened or fermented (Ready *et al.*, 2019) ^[9]. Bakery is the rapied growing segment of gluten-free products, due to increasing availability of gluten-free flour alternatives (Dicairano *et al.*, 2018) ^[4]. Epidemiology studies have shown that regular consumption of whole grain food is protective against certain cancers, cardiovascular disease, type-2 diabetes and obesity (Slavin 2004) ^[12]. Supplementation of cereal flour with inexpensive staples such as legumes/ pulses helps in improving the nutritional quality of cereal product (Sharma *et al.*, 1999) ^[11].

Pearl millet (bajra) is an important coarse cereal crop in western India (Gujarat, Rajasthan and Haryana (Amarender *et al.*, 2013) ^[2]. It has potential for future human use due to its tolerance to difficult growing conditions such as drought, low soil fertility and high temperature and can be grown in areas where other cereal crops, such as maize (*Zea mays*) or wheat (*Triticum aestivum*), would not survive. Pearl millet (bajra) contains substantial amount of minerals such as iron, calcium, zinc and high level of fat, it is nutritionally comparable and even superior to major cereals due to the energy and protein value (Fasasi, 2009) ^[5]. Owing to lack of institutional support for millet crops in contrast to the institutional promotion of wheat, rice and maize continue to shrink the millet-growing region. While, pearl millet (bajra) is nutritious, it is underutilized in developed countries due to non-availability in convenient and ready to eat form. (Obilana, 2010) ^[7].

Sorghum is an excellent source of energy. The consumer food industry is a growing marketplace for sorghum. With so many Healthy benefits packed in every delicious grain, consumers are finding creative ways to use sorghum in recipes for breakfast, lunch, dinner and even snacks. (Ready *et al.*, 2019) ^[9].

Soybean (*Glycine max* L.) belong to family Leguminoase and native to china. Soyabean is economically cheap source of protein (40%) and fat (20%) therefore use widely all over the world. From acient time soybean called as meat of field because of it's protein quality equals

to beef protein and milk protein with amazing amino acid balance (Hosseini, 2011) [6].

The combination of cereals and pulses forms complete food for human beings. The combination of these three ingredients i.e. pearl millet, sorghum and soyabean in proportion (60:30:10) respectively were used to improve specific or overall quality of diet or processed products.

The objective of this study was to development of pearl millet crackers by without fermentation with incorporation of sorghum and soybean flour by totally replace wheat flour by pearl millet flour and to evaluate the impact of this flour on the nutritional and sensory properties of prepared product.

Materials and Methods

The present investigation was carried out in Department of Food Chemistry and Nutrition in Collage of Food Technology, VNMKV, Parbhani during year 2020-2021.

Materials

The raw material used during this study such as refined pearl millet flour, sorghum flour, soyabean flour, Sugar, Milk, Ammonium bicarbonate and cardamom were procured from Parbhani local market.

Equipments and machinery

Equipments such as analytical weighing balance, hot air oven, grinder, muffle furnace, soxhlet apparatus and Microkjeldhal digestion and distillation unit were available in the Department of Food Chemistry and Nutrition, College of

Food Technology, VNMKV, Parbhani.

Physicochemical composition of crackers

Proximate composition of Crackers prepared with different incorporation levels of pearl millet, sorghum and Soybean flour was examined according to Official Methods of Analysis of A.A.C.C. (2000) [1].

Crackers Preparation

Three different formulation used for crackers preparation are reported in table. Pearl millet flour were substituted with sorghum flour and soyabean flour at levels of 60%, 30% and 10%. All the other ingredients were weighed separately. The weighed ingredients were mixed. Milk was added accurately to form dough. The dough was then kneaded and rolled to a uniform thickness. The crackers were cut out with cutter. Then the crackers were baked at 160°C for 15-20 minutes, cooled to ambient temperature.

Table 1: formulation of pearl millet crackers incorporated with different levels of sorghum and soyabean flour.

Ingredient	Control	T ₁	T ₂	T ₃
Pearl millet flour(g)	100	50	60	50
Sorghum flour(g)	0	35	30	40
Soyabean flour(g)	0	15	10	10
Sugar(g)	40	40	40	40
Milk(ml)	35	35	35	35
Cardamom(g)	2	2	2	2
Ammonium bicarbonate(g)	2	2	2	2

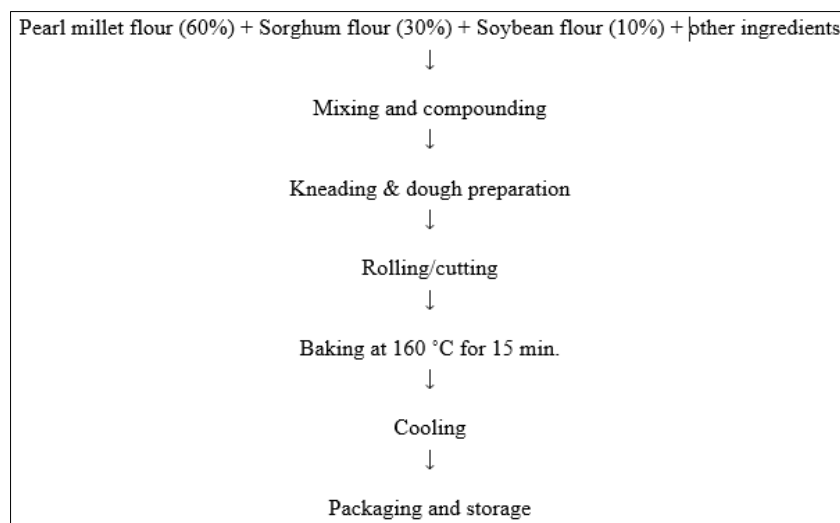


Fig 1: Flow sheet for preparation of pearl millet crackers

Results and Discussion

Chemical composition of Crackers: The data pertaining to various chemical properties such as moisture, fat, carbohydrate, protein, ash and crude fiber of selected product were determined and results obtained and illustrated are Table 2 respectively.

Table 2: Chemical composition of crackers

Parameters	Control	T ₂
Moisture (%)	2.4±0.05	2.2±0.04
Protein (%)	12.7±0.21	14.47±0.25
Fat (%)	8.8±0.15	12.63±0.18
Carbohydrates (%)	72.52±0.44	65.5±0.31
Ash (%)	1.57±0.01	2.0±0.02
Crude fiber (%)	2.01±0.03	2.2±0.04

*Each value represents the average of three determinations

The present investigation was carried out to study the suitability of different levels of pearl millet, sorghum and soybean flour incorporation on quality characteristics of Crackers. Crackers were subjected to proximate analysis and the data pertaining to proximate composition of crackers are summarized in Table 2.

The data obtained from the table 2 revealed that the pearl millet crackers comes under the category of non-perishable food commodity as moisture content in control and T₂ sample was 2.4 and 2.2% respectively. With compare to control T₂ sample contains more protein due to addition of soyabean flour in prepared sample and it was observed that protein content of control and T₂ sample was 12.7 and 14.47% respectively. Fat content of crackers was increased significantly with increasing the levels of sorghum and

Soyabean flour in T₂ sample. As compared to control T₂ sample contains more fat. Fat content of the control and T₂ sample was 8.8 and 12.63% respectively. T₂ sample contains less carbohydrate (66.5%) than the control sample (72.57%) as the millets were found to be good source of carbohydrate. Crude fiber content of the control sample was found to be more than T₂ sample as pearl millet having the good quantity of fiber content and fiber was found 2.01 and 2.2% in control and T₂ sample. Ash content in the control and T₂ sample was 1.57 and 2.0% respectively. Selected sample found to be the good source of nutrients with compare to control. These results are corresponds with the results report by (Udaybeer *et al.*, 2017) [14].

Physical properties of crackers

The physical properties of prepared crackers gives its quality such as appearance and packaging parameters which improve consumer attraction. The different physical properties including weight, thickness, width, puffiness and spread factor of control and selected (T₂) sample were evaluated and the data was presented in the table 3.

Table 3: Physical properties of pearl millet crackers

Parameters	Control	T ₂
Weight (g)	3.5	3.02
Thickness (cm)	0.44	0.48
Width (cm)	3.5	4.0
Puffiness (%)	65	68.75
Spread factor (%)	71	74

* Each value is average of three determinations

It was observed that the weight of crackers decreased gradually from 3.5 to 3.02 g with decreasing proportion of pearl millet flour. Also there was simultaneous increase in thickness from 0.44 to 0.48 cm in control and selected sample respectively, due to increasing fiber percent in selected product. Similarly the width of selected sample is more compare to control sample such as 4.0 cm to 3.5 cm respectively.

Puffiness present and spread factor increase in selected sample (74%) as compare to control sample (71%), because control sample having 100% pearl millet flour have

Table 5: Sensory evaluation of crackers

Sample code	Color and appearance	Flavor	texture	Taste	Overall acceptability
Control	8.0	7.0	6.8	8.0	8.0
T ₁	8.2	7.8	6.7	8.2	7.0
T ₂	8.3	7.9	6.9	8.3	8.1
T ₃	8.2	7.8	6.8	8.2	8.0
SE±	0.033	0.063	0.022	0.233	0.055
CD@5%	0.0709	0.135	0.425	0.496	0.106

The results obtained from the sensory score revealed that there was highest Overall acceptability score (8.1) for the T₂ sample with compare to control. For the parameters like colour, flavour and texture sample T₂ showed the highest score. While sample T₁ showed the lowest score for all the parameters with overall acceptability score (7.0).

Increasing the concentration of sorghum 40% or above that was found to be unacceptable by the consumers. So the acceptable limit of the sorghum and soyabean flour was found to be acceptable at 30% and 10% respectively. By considering the above parameters it was found that sample T₂ was having the highest score and superior than other samples. These

hydrophilic sites available for competing, for the limited free water in dough. Rapid partitioning of free water of these hydrophilic sites occurs during dough mixing and increases dough viscosity, thereby limiting the crackers spread. The results obtained are more or less similar to the study findings of (Sachitra *et al.*, 2017) [10].

Nutritional status of prepared crackers

It is important to analyze the retention of minerals in the final product. The present investigation evaluated the presence of minerals in organoleptically proved the best samples of crackers; Table 4 shows the results of mineral content in the crackers.

Table 4: Mineral composition in crackers

Minerals	Control	T ₂
Phosphorous (mg/100g)	284	351.24
Calcium (mg/100g)	39	58.75
Iron (mg/100g)	6.7	7.58
Magnesium (mg/100g)	126	141.6

* Each value is average of three determinations

The figures concerning phosphorus, calcium, iron and magnesium of the control and selected sample is given in table 4.10. The concentration of control and selected sample minerals was recorded to be 284 mg/100g, 39 mg/100g, 6.7 mg/100g, 126 mg/100g and 351 mg/100g, 58 mg/100g, 7.58 mg/100g and 141 mg/100g respectively. The mineral composition of selected sample were increase due to incorporation of sorghum and soybean flour into pearl millet flour.

Organoleptic evaluation of Crackers

The three samples (T₁, T₂ and T₃) and control were made differently with different level of pearl millet, sorghum and soyabean flour to achieve a highly acceptable product. The organoleptic evaluation of crackers carried out by a 10 semitrained panel member based on 9 point hedonic scale and the score were given by evaluating the sensory attributes for crackers such as color, appearance, flavour, texture, taste and overall acceptability which was compared with control sample and expressed table 5.

results are corresponds with the results reported by (Olufunmilayo *et al.*, 2015) [8].

Conclusion

On the basis of obtained result, gluten free flour combination could be used to produce good quality crackers with acceptable sensory qualities, these crackers are advantageous for people suffering from gluten intolerance & low income groups. It gives the health benefit of cereal and legume based product. Pearl millet flour as a replacement for refined wheat flour in the preparation of crackers was effective in enhancing its nutritional and sensory attributes. Nutritive value of

crackers improve in term of overall acceptability of crackers from mixed flour were found to have higher overall quality compared to control.

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