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Development And Standardization of Bajara Biscuits (*Pennisetum glaccum*) with Added Pomegranate Peel Powder and their Physical and Sensory Attributes

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Abstract: ***Pearl millet (Pennisetum glaucum) is also known as Bajara, is one of the most popular millet grown in tropical semi-arid regions of the world. Pearl millet is unique among all millets because of it is rich in protein, polyphenols, calcium, dietary fibre. The present study was to develop and popularize bakery products using pearl millet. Pearl millet is nutritionally rich and important millet in the diet of humans. The aim of this research is to review the potential health benefits of pearl millet. Pearl millet is a gluten free cereal grain, so it is beneficial to gluten intolerant people. The popular bakery product such as biscuits was developed by fortifying wheat flour with pearl millet flour. The different sample prepared were WB 1, WB 2 and WB 3 in the ratios of (Wheat flour: Bajara flour) 60:40, 50:50 and 40:60 respectively. The physical properties and Sensory evaluation of bajara biscuit was carried out. The sensory result showed that WB 2 was rated most acceptable by a panel of judges on a nine point hedonic scale. The physical properties like width, thickness and spread factor was analysed.***

Keywords: Pearl millet, Bakery product, Sensory evaluation, Physical properties, Gluten

1. Introduction

Baked products have popularities in the populace because of their availability, ready to eat convenience and having good shelf life [1]. Because of their low moisture content this ensures less chance of microbial spoilage, therefore large scale production and distribution possible [2]. Common bakery products include biscuits, cookies, pastries, muffins, cake, bread etc. Biscuits, among all the bakery products, are more significant since they are vastly used as snacks by children and adult [2].Attempts are being made in recent days to improve nutritional qualities and functionalities of biscuits, due to competition in the market for healthier, natural functional products, in cost effective manner [3]. It is produced by mixing various ingredients like flour, fat, sweeteners and water to form dough. The dough formed unlike bread is not allowed to ferment, and then it is baked in the oven [4].

A new trend was also observed where biscuits where prepared with fruit peel powder, otherwise marked as a waste material emerging from food processing industries [5], [6]. Recently, the interest in the antioxidant properties of phenolic constituents from pomegranate fruits (*i.e.*, arils and peels) has emerged [7]. This is because waste products (e.g. fruit peels) from processing of agricultural commodities could offer practical and economic sources of active antioxidants [8], [9], [10]. These wastes and by-products of fruits are an abundant source of antioxidant and polyphenols [8].Gluten intolerance persons (Celica) allergic to gliadin, millets are the gluten free [11]. Therefore, attempts are made for the formulation of biscuits, in which wheat flour partially replaced with pearl millet (bajara) flour and fortified with pomegranate peel powder. Plant phytochemicals or natural antioxidants have been associated with many health benefits [12]. Because many diseases cause due to reduce level of antioxidants or increased level of free radicals [13]. Free radicals are highly reactive molecules containing one or more unpaired electrons in their outermost shell and the only way of neutralizing them and their harmful effects in through Antioxidant which help in breakdown of chemical reaction that cause transfer of electrons from healthy cells into free radicals [14].

Pearl millet also known as bajara is one of the important millet grown in tropical and semi-arid region of the world. 32% production of pearl millet found in India [11]. The amino acid composition has significant effect on the nutritional quality of protein. The amino acid profile of pearl millet is better than that of sorghum and maize and is comparable to wheat, barley, and rice [15].

It has high energy, less starch, low GI (55) and is gluten free [11]. Flavonoids and phenolic acid are both highly active antioxidant which is present in pearl millet (0.9%) and (4.08mg/g) respectively. The total antioxidant activity of pearl millet is (1.33±0.003mg/ml)(calculated in terms of ascorbic acid) [13]. Pearl millet are known to contain about 12 %proteins, 5 % ether extractives (including fats) and 67%

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carbohydrates, and it is said to be a rich source of minerals and vitamins of the B group [16].

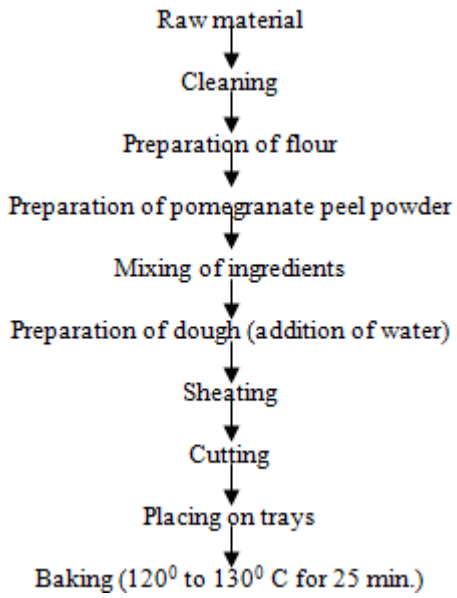
The pomegranate (*Punica granatum*) belongs to the Punicaceae family and is a nutrient dense food source rich in phytochemical compounds [17].India is the largest producer of pomegranate (*Punica granatum*) next only to Iran [18]. Fruits and vegetable processing in India generates substantial quantities of waste [18]. It had been previously reported that these wastes and by-products of fruits are an abundant source of antioxidant and Polyphenols [18]. Pomegranate peel is a rich source of tannins, flavonoids and other phenolic compounds [19]. The total phenolic content and antioxidant content is (249.41mg/g) and (0.6mg/g) and having antioxidant activity is (92.7%) [20].

2. Materials and Methods

2.1 Procurement of Raw Material

The wheat and bajara was used as a base material for the preparation of flour mix with pomegranate peel powder and other ingredients used in the preparation of biscuits included, sugar, baking soda, baking powder, ghee, milk powder and water. All ingredients were purchased from local market of Nashik city in bulk, to avoid varietal difference

2.2 Processing of Biscuits



2.2.1 Cleaning

The wheat, bajara grains were taken and cleaned to remove the stones, dust, woods and any other foreign materials from the grains.

2.2.2 Preparation of wheat flour

The clean and healthy wheat grain was used for preparation of flour. Wheat grain was finely grind in an electric grinder and passed through a 60 mesh size sieve. The powdered sample was stored in air tight container until further use for experiments.

2.2.3 Preparation of bajara flour

The clean and healthy grain of bajara was used for preparation of flour. Bajara grain was finely grind in a electric grinder and passed through a 60 mesh size sieve. The powdered sample was stored in air tight container until further use for experiments.

2.2.4 Preparation of pomegranate peel powder

The pomegranate peels were taken from market. The pomegranate peels were washed manually. After washing, the peels were cut into pieces. The peel was dried in the tray drier at a temperature of 60±1ºC for 5-6 hrs. Dried pomegranate peels were ground in the grinder to reduce the particle size. The ground material is then allowed to pass through sieve size 30 mesh; the larger particle on the sieve was again taken for grinding and passed through the sieve. The peel powder was then packed in the air tight polyethylene pouch separately and stored.

2.2.5 Preparation of flour mix for biscuits

Formulation was prepared by blending wheat flour and bajara flour in different proportions. For the purpose of standardization of flour mix, a number of preliminary trials were conducted. Different combinations of flour of wheat and bajara *viz*., 60:40, 50:50, 40:60 were used to prepare flour mix for biscuits shown in table no.2.2.5.

Table 2.2.5: Preparation of flour mix per 100 gm

Samples	Wheat flour	Bajara flour
WB1	60	40
WB2	50	50
WB3	40	60

Where* W- Wheat flour, B- Bajara flour

2.2.6 Preparation of biscuits

The biscuit was prepared after the flour preparation, following a standard formulation, with the addition of pomegranate peel powder are shown in Table 2.2.6. Dry ingredients (like flour, soda and baking powder, pomegranate peel powder) were mixed and sieved twice for uniform mixing of leavening agents to the flour and also other ingredients. Milk powder was mixed in small amount of water separately in a bowl. Ghee was taken in a bowl and heated until it melts. Then powdered sugar was added to the dry ingredient and mixed properly. Soft dough was prepared by addition of the melted ghee and then dissolved milk powder with sprinkling small quantity of water. Dough was rolled and then biscuits were cut into round shape using biscuit cutter no.3. Biscuits was then kept in a baking oven for 20-30 min at 120-130^{0}C for uniform baking.

Table2.2.6: Standardized recipe of biscuits

Ingredients	*Amount in gm*
Flour mix	100
Sugar	50
Milk powder	20
Pomegranate peel powder	3
Baking powder	3
Baking soda	2

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2.3 Sensory Evaluation

Biscuits were evaluated by a panel of judges. The parameters studied were colour, taste, flavour, texture and overall acceptability. The score card for the evaluation of the biscuits was provided along with instructions to each judge. The recipes were evaluated for sensory characteristics by the panel of judges.

2.4 Physical Evaluation

A.A.C.C methods [21] were adopted in order to determine the width, thickness, and spread factor of biscuits.

2.4.1 Width (cm)

Six biscuits were placed edge to edge, their total width was measured and average width was determined by taking mean value.

2.4.2 Thickness (cm)

The average thickness of biscuits was measured by placing six biscuits one on top of another and measuring their height and taking average

2.4.2 Spread factor (cm)

Spread factor was obtained with the help of following formula: SF = (width/thickness) × 10
Correction factor at constant atmospheric pressure was 1.

3. Results and Discussion

3.1 Preparation of flour blends

To develop the flour blends, bajara grain and wheat grain were procured and processed separately. Then both the flours were mixed in different ratio *viz*, 60:40, 50:50, 40:60% respectively were used to prepare 100g flour mix for biscuits along with subsequent quantity of pomegranate peel powder.

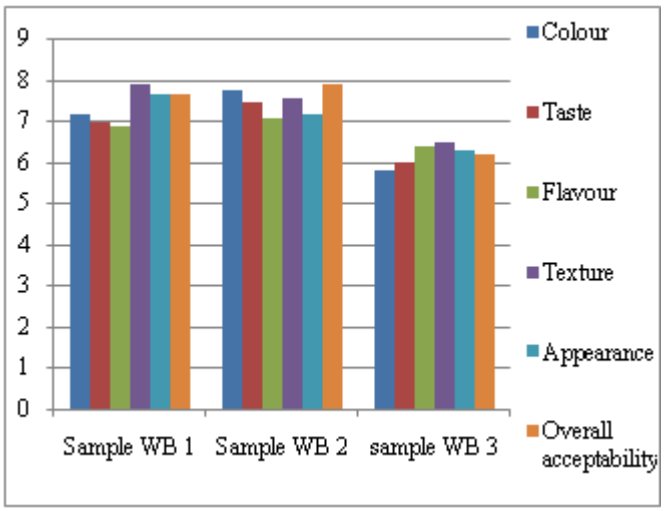
3.2 Sensory evaluation of biscuits

Results of sensory evaluation of biscuits prepared with 40, 50 and 60 % of bajara flour i.e. WB1, WB2 and WB3 were given in Table 3.2. It was found that replacement upto 50% of wheat flour by pearl millet was most acceptable by the trained sensory panel. Data revealed that the overall acceptability of Sample WB 2 and Sample WB 1 was 7.9 and 7.7. It was found that replacement of 60% wheat flour by pearl millet was unacceptable by sensory panel because the appearance of the bajara biscuits was affected i.e. darker in colour and bitter in taste and also found cracks in texture of biscuits. Hence, in the present investigation bajara flour can be incorporated upto 50% was found most acceptable as a standardized recipe.

Table 3.2: Sensory score of the biscuits prepared from flour mix

Samples	Colour	Taste	Flavour	Texture	Appearance	Overall acceptability
WB 1	7.2	7.0	6.9	7.9	7.7	7.7
WB 2	7.8	7.5	7.1	7.6	7.2	7.9
WB 3	5.8	6.0	6.4	6.5	6.3	6.2

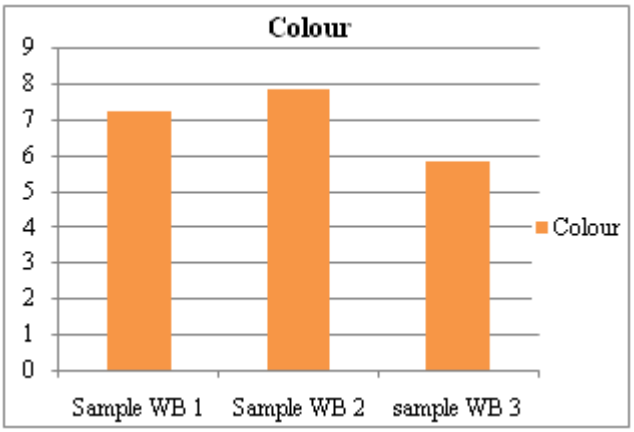
*where W- Wheat flour, B- bajara flour



*where W: Wheat flour, B: Bajara flour
Figure 3.2: Average sensory analysis data

3.2.1 Colour

The analysis of variance of colour attribute revealed that there is significant change in colour of the biscuits. Figure no. 3.2.1 shows that the colour at 60 % (Sample WB 1) level of bajara flour biscuits got the lowest score and at level of 50% (Sample WB 2) bajara flour biscuits were most acceptable.



*where W: Wheat flour, B: Bajara flour
Figure 3.2.1: Average sensory analysis data of colour

3.2.2 Taste

The analysis of variance of the taste attribute revealed that there was change in the taste biscuits due to addition of bajara flour. Figure no. 3.2.2 shows that at level of 60% (Sample WB 1) of bajara flour got the lowest score and the level of 50% (Sample WB 2) got the highest score because of combination of both wheat as well as bajara flour taste.

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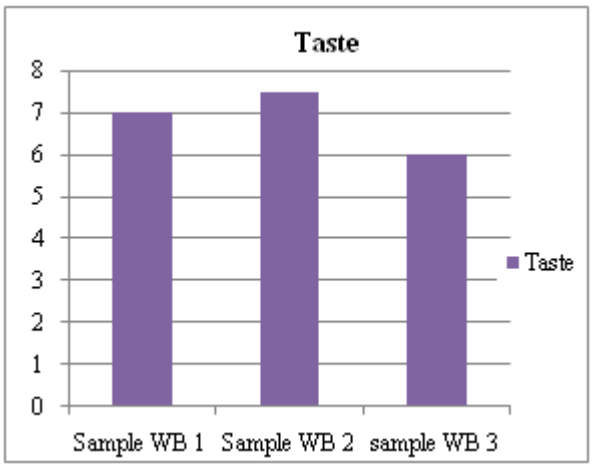
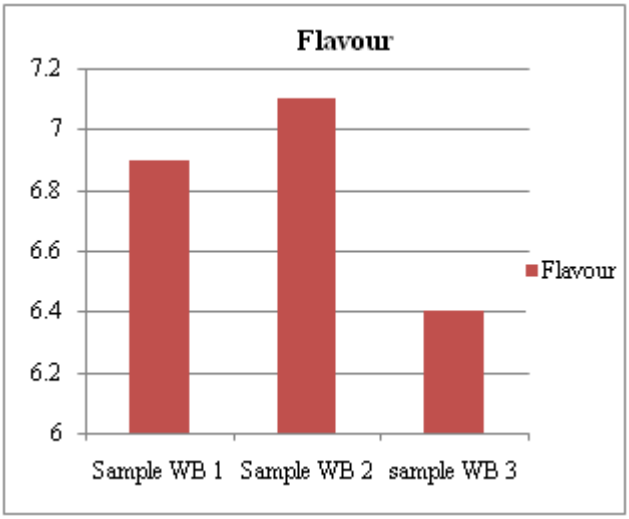


*where W: Wheat flour, B: Bajara flour

Figure 3.2.2: Average sensory analysis data of taste

3.2.3 Flavour

The analysis of variance of the flavour attribute revealed that there was change in the flavour of biscuits due to addition of bajara flour. Figure no. 3.2.3 shows that at the 50% level of bajara flour got the highest score whereas at level of 60% of bajara flour got the lowest score.

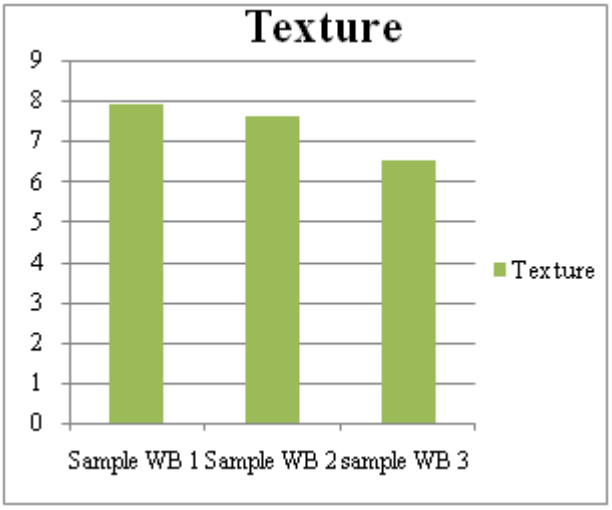


*where W: Wheat flour, B: Bajara flour

Figure 3.2.3: Average sensory analysis data of flavour

3.2.4 Texture

The analysis of variance of the texture revealed that there was significant effect on texture of the biscuits when bajara flour added. The result shows that the texture profile of bajara biscuits is higher in sample WB 1 as shown in figure no. 3.2.4.There was a decrease in the quality score for the texture of the biscuits with an increase in the bajara flour addition.



*where W: Wheat flour, B: Bajara flour

Figure 3.2.4: Average sensory analysis data of texture

3.2.5 Overall acceptability

The result of overall acceptability of bajara biscuits shown that the sample WB 2 in ratio of 50:50 was most acceptable other than two sample WB 1 (60:40) and WB 2(40:60) as shown in figure no. 3.2.5.

*where W: Wheat flour, B: Bajara flour

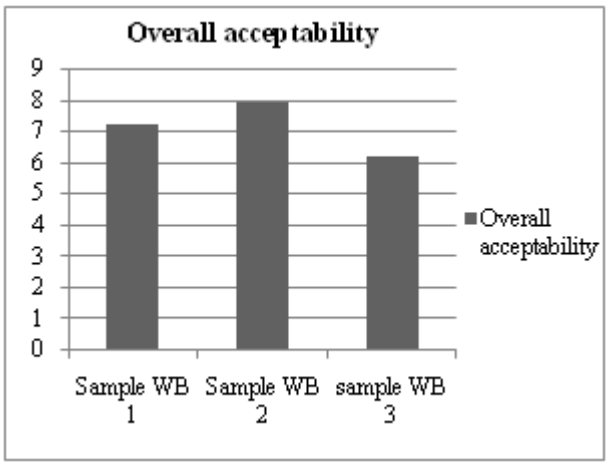


Figure 3.2.5: Average sensory analysis data of overall acceptability

3.3 Physical Analysis

All biscuits prepared with different level of bajara flour were analysed for physical characteristics. Their width, thickness and spread factor was measured.

Table 3.3: Physical analysis of biscuits prepared from flour mix

	Sample WB 1	Sample WB 2	Sample WB 3
Width (cm)	4.5 ± 0.2	4.8 ± 0.2	4.1 ± 0.1
Thickness (cm)	0.7 ± 0.1	0.6 ± 0.1	0.5 ± 0.3
Spread Factor (cm)	64.2 ± 0.5	80.0 ± 0.2	82.0 ± 0.4

*where W: Wheat flour, B: Bajara flour. Values are the mean ± standard deviation of means. All samples were taken in triplicates.

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4. Conclusion

Pearl millet flours can successfully be incorporated for the development of biscuits to provide benefit to the consumers. The physical property such as width, thickness and spread factor of different samples was analysed. Wheat flour: pearl millet flour taking in the proportion of 50:50 has scored maximum for almost all sensory quality attributes such as colour, flavour, taste, texture and overall acceptability and having width (4.8 ± 0.2) thickness (0.6 ± 0.2) and spread factor (80 ± 0.2). Biscuits preparation upto 50% replacement of wheat flour using pearl millet and 3% pomegranate peel powder which according to the sensory results of panel members was the most accepted variation. It was found that replacement of 60% wheat flour by pearl millet was unacceptable by sensory panel because the appearance of the bajara biscuits was affected i.e. darker in colour and bitter in taste and also found cracks in texture of biscuits. Hence, in the present investigation bajara flour can be incorporated upto 50% was found most acceptable as a standardized recipe.

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