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Total Phenolic Content, Antioxidant Activity and Pasting Properties of Maize Flat Bread Supplemented with Asparagus Bean Flour

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Abstract—*The present study was aimed to study the total phenolic content, antioxidant activity and pasting properties of maize flat bread supplemented with asparagus bean flour. Flat bread was prepared from maize-asparagus bean composite flour wherein maize flour was supplemented with 15% asparagus bean flour. Total phenolic content of composite flat bread was 0.81 mg GAE/g and antioxidant activity was 28.10% while as control flat bread showed total phenolic content and antioxidant activity of 0.97 mg GAE/g and 29.50 % respectively. Pasting properties of composite flat bread showed decrease in peak, trough, breakdown, final and set back viscosity while as increase in pasting temperature with respect to control flat bread (100% maize flour).*

Keywords*: Flat bread, asparagus bean flour, total phenolic content, antioxidant activity, pasting properties.*

1. INTRODUCTION

In different regions of the world, the overreliance of local communities on carbohydrate-rich diets is being witnessed. At the same time demand for traditional and wholesome foods has been increasing. Developing food products by utilizing legumes along with cereals has assumed higher importance world over [1]. Cereal grains have been the most important plant group for human diet [2]. Maize (*Zea mays* L.) is the third leading food crop of the world after rice and wheat [3]. In India about 35% of maize is consumed in the form of unleavened flat breads or chapattis [4]. Maize contains major phytochemicals such as carotenoids, phenolic compounds and phytosterols [5]. It has been an appropriate food for patients suffering from celiac disease which is a digestive disorder in which the villi in small intestine gets damaged due to an immunological reaction to gluten [6]. Maize is deficient in lysine but has an adequate amount of sulfur-containing amino acids. Legumes are ranked second to cereals as an important source of human nutrition [7]. They are rich source of proteins, minerals, vitamins and fiber. Regular consumption of legumes has been reported to reduce the risk of chronic diseases [1]. There is higher importance of legumes in the development of novel food products [8]. However legumes are deficient in sulfur-containing amino acids but rich in lysine. Combination of cereals with legumes has been known to balance the amino acid profile of the developed food product and subsequently to improve its nutritive value [9]. Flat breads are well-known bread types of the world. About 1.8 billion people use flat breads world over [10]. Unleavened flat breads are a staple diet of majority of people living in the Indian subcontinent [3]. They are an economical source of protein and contribute to satiety via abundant dietary fiber [11]. Due to an increase in consumer demand for nutritious and healthy food products, composite flours of cereals and legumes have been used for the development of such products [12]. Flat breads made from composite flours are a novel approach in recent years [13].

Asparagus bean (*Vigna unguiculata subsp. sesquipedalis*) is an edible legume commonly known as "loung" in Kashmir (India). It is an important source of dietary protein. Inadequate knowledge of asparagus bean is responsible for its under utilization in different food formulations. Therefore in the present study maize flour was supplemented with asparagus bean flour in order to develop flat bread and its total phenolic content, antioxidant activity and pasting properties were observed.

2. MATERIALS AND METHODS

Maize (*Zea mays* var. C-15) was procured from Share-e-Kashmir University of Agricultural Sciences and Technology, Shalimar, J&K, India. Asparagus beans or seeds (*Vigna unguiculate* ssp. sesquipedalis) were purchased from a farmer at Pulwama, J&K. Maize grains and asparagus beans were cleaned, made free from dust and other foreign materials. Maize grains were milled in a stone mill (S.V. Industries Pvt. Ltd., Ajmer, India) and passed through sieve no. 60 (British Sieve Standards) to obtain fine flour. To produce asparagus bean flour, the seeds were dehulled in abrasion type dehulling machine (Osaw Industrial Products Pvt. Ltd., Ambala, India) and ground in a stone mill (S.V. Industries Pvt. Ltd., Ajmer, India) and then passed through sieve no. 60.

2.1. Preparation of composite flour

Maize flour was supplemented with 15% asparagus bean flour for the development of composite flour because 15% is considered optimum for the development of flat bread [14].

2.2. Preparation of flat bread

Flat bread was prepared from composite flour (15% asparagus bean flour: 85% maize flour) and control (100% maize flour) respectively by following the method reported by previous researchers with slight modifications [15,16]. Each combination was mixed with optimum water (75ml/100g) in a Hobart bench top mixer (5KPM50, USA) for 3 min. The optimum water was determined subjectively till smooth, cohesive, non-sticky dough which is easy to handle and suitable for continuous sheeting without cracking was obtained. The dough was given a rest for half an hour. Dough (50g) was rounded, placed in the centre of a specially designed platform. In order to facilitate the rolling of dough to a uniform thickness of 2 mm, an open rectangular aluminum frame was used. The frame was placed in the groove provided on the

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platform. The dough was rolled with the help of a wooden rolling pin. The length of rolling pin exceeded the width of frame. Therefore, roller force was applied to the dough only when its thickness exceeded the height of the frame. The dough sheet was then cut into a circle of 15 cm in diameter by using a die with sharp edge. The raw flat bread was carefully removed from the platform and baked at baking temperature (225 °C) for baking time 1 (120 sec for surface 1) and baking time 2 (116 sec for surface 2) on a thermostatically controlled hot plate. It was allowed to cool for 10 min at 25 °C and used for further analysis.

2.3. Total phenolic content

Total phenolic content was estimated by Folin- Ciocalteu spectrophotometric method followed by [17] with slight modifications. About 1 g sample was extracted with 10 ml of methanol at 25°C for 2 h. Then, 0.15 ml of Folin- Ciocalteu reagent was added to 0.3 ml aliquot of extract. The mixture was set aside to equilibrate for 5 min and then 0.3 ml of 7 % sodium carbonate was added to it. The mixture was then incubated at 25 °C for 90 min and the absorbance of mixture was read at 725 nm by using DR 6000 UV-vis spectrophotometer (Hach, Germany). Methanol was used as blank. The results were expressed as mg of Gallic acid equivalents (GAE) /g of sample.

2.4. Antioxidant activity

Antioxidant activity was measured by using the method described by [18]. About 1 g sample was extracted with 10 ml methanol for about 2 h and centrifuged at 3000g for 10 min. About 0.1 ml aliquot of supernatant was reacted with 3.9 ml of 6×10^{-5} mol/L of DPPH solution. The absorbance at 515 nm was examined at 0 and 30 min using methanol as blank. The antioxidant activity was analyzed as % discoloration:

$$\{1-\left[\frac{A\ of\ sample\ at\ 30\ min}{A\ of\ sample\ at\ 0\ min}\right]\}\times 100$$

Where, A is absorbance.

2.5. Pasting properties

Pasting properties of freeze dried and grounded flat bread samples were determined by Rapid Visco Analyzer (Perten, Australia). Flour suspensions of 3.5g/25g distilled water were used and their viscosity profiles were recorded. The heating was carried out from 50 to 95°C at 6°C per min after equilibrium time of 1 min at 50°C and a holding time of 5 min at 95°C. The cooling was carried out from 95 to 50°C at 6°C per min with a holding for 2 min at 50°C. Parameters including pasting temperature, peak viscosity, trough viscosity (minimum viscosity at 95°C), breakdown viscosity (peak – trough viscosity), final viscosity (viscosity at 50°C) and setback viscosity (final – trough viscosity) were recorded.

3. RESULTS AND DISCUSSION

Total phenolic content and antioxidant activity of flat bread samples is presented in Table 1. It has been found that foods rich in phenolic compounds possess antioxidant activity [19]. The phenolic compounds act as antioxidants and play an important role in protection against damages caused by oxidation and free radicals [20]. The antioxidants play a significant role in defense against various chronic diseases, cancers, premature ageing and oxidative deterioration of foods; therefore have health promoting effect [21]. Significant difference ($p\leq0.05$) was observed in phenolic content and antioxidant activity of control and

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composite flat bread. Control flat bread had phenolic content and antioxidant activity of 0.97 mg GAE/g and 29.50% respectively while as composite flat bread had phenolic content and antioxidant activity of 0.81 mg GAE/g and 28.10% respectively. The higher total phenolic content and antioxidant activity of control flat bread is due to abundance of phenolic compounds in maize and antioxidant activity is directly correlated to phenolic content [22].

The pasting properties of flat bread samples are shown in Table 1. Significant difference was observed in pasting behavior between the two flat breads. Composite flour flat bread showed highest pasting temperature of 85.40°C followed by control flat bread which had a pasting temperature of 82.50°C. Peak viscosity of control and composite sample was 1887.20 cP and 509.00 cP respectively. Trough viscosity of control and asparagus bean flour supplemented maize flat bread was 706.67 and 454.50 cP respectively. Control sample had higher break down viscosity of 1180.33 cP followed by composite sample which had a break down viscosity of 54.50 cP. Final viscosity of control was 2562.00 cP while as for composite flat bread it was 1285.00 cP. Setback viscosity for control flat bread was 1855.33 cP followed by composite flat bread which had lower setback viscosity of 831.20 cP. Set back viscosity is related to retrogradation and reordering of starch molecules. Lower set back values indicate a lower rate of starch retrogradation. Similar results on pasting properties were found in flat breads prepared from whear flour and pulse flour [11].

Table 1: Total phenolic content, antioxidant activity and pasting properties of flat bread samples

Parameters	Control flat bread	Composite flat bread
Total phenolic content (mg GAE/g)	0.97±0.07 [a]	0.81±0.01 [b]
Antioxidant activity (%)	29.50±0.50 [a]	28.10±0.36 [b]
Pasting properties		
Pasting temperature (°C)	82.50 [b]	85.40 [a]
Peak viscosity (cP)	1887.20 [a]	509.00 [b]
Trough viscosity (cP)	706.67 [a]	454.50 [b]
Breakdown viscosity (cP)	1180.33 [a]	54.50 [b]
Final viscosity (cP)	2562.00 [a]	1285.70 [b]
Setback viscocity (cP)	1855.33 [a]	831.20 [b]

Results are expressed as means ± standard deviations. Means with same superscripts in a row are not significantly different ($p \leq 0.05$) as assessed by duncan's multiple range test.

4. CONCLUSION

Total phenolic content and antioxidant activity was observed in flat bread. Therefore its consumption can have health promoting effect. There was a difference in pasting properties between the flat bread samples. Lower setback viscosity of composite flat bread than control sample suggests that the former would be softer as its retrogradation is lower.

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