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Effect of sweet potato flour of two local varieties on quality of breads

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Abstract

The study was carried out in order to find out the effect of substitution of wheat flour with sweet potato flour of two local varieties (Local Sada and Local Lal) on the quality of bread. This study was also concerned with the analysis of proximate compositions of sweet potato and results showed that, fresh local sada and local lal sweet potato varieties contained moisture 70.10 and 66.78%; ash 4.46 and 4.21%; fat 0.71 and 0.74%; protein 1.75 and 1.63%; carbohydrate 22.98 and 26.64%; vitamin-C 8.86 and 9.49 mg/100g respectively. The compositions of sweet potato flour were also analyzed and showed that local sada and local lal sweet potato flour contained moisture 5.25 and 5.32%; ash 4.12 and 4.17%; fat 0.75 and 0.81%; protein 9.80 and 9.21%; carbohydrate 80.08 and 80.49%; vitamin-C 2.45 and 2.31 mg/100g respectively. This analysis showed that the sweet potato flour is quite rich in protein content. The breads containing of sweet potato flour were prepared using standard formulation with 5, 10 or 15% substitution of wheat flour by sweet potato flour and evaluated their acceptability by a number of panelists. The result obtained showed that the color, taste, texture, flavor and overall acceptability of the breads containing sweet potato flour were equally acceptable with control bread. Statistical analysis showed that the overall acceptability of bread with sweet potato flour was equally acceptable as the control bread and bread with 10% substitution level (local lal) was moderately acceptable and other products (including 15% substitution) were ranked as like slightly.

Keywords: Sweet potato flour, Sweet potato powder, Breads, Baked products

Introduction

Sweet potato belongs to the family Convolvulaceae and is one of the most important food crops in the world. As a world crop, it ranks seventh from the view point of total production after wheat, rice, maize, potato, barley and cassava (Zuraida, 2003). The annual world production of sweet potato was 105.1 million tons (Mt) in 2011. China is the largest grower of sweet potatoes, providing about 70% of the world's supply (FAOSTAT, 2011).

Sweet potato is rich in carbohydrate, dietary fiber, B-carotene, ascorbic acid, folic acid and minerals (Bovell-Benjamin, 2007; ILSI, 2008). Therefore, sweet potato is now widely used as an important human diet around the world.

Processing of sweet potato flour offers some great facilities such as: facilitating storage and transport; reducing bulkiness and losses due to high perishability of fresh sweet potato; increasing shelf life and improving nutritive value due to the fact that as a great part of the water content is removed, the carbohydrates, proteins, fat and minerals are concentrated in the tissues of dried food products. It also offers the facilities of creating new income opportunities for farmers such as new markets and new sources of income; changing some of the negative attitudes about sweet potato consumption, and enabling them to be an important commercial crop with a wide range of uses (Truong & Ramesh, 2010).
Generally, breads are prepared from wheat flour but small amount of other cereal flours can also be used to give better nutritional value, special flavor or structural properties. Hagenimana *et al.* (1992) reported that addition of orange-fleshed sweet potato flour in chapattis and bans greatly increase the total carotenoids content. Various proportion of sweet potato flour can be used with wheat flour to improve nutritive values in terms of fiber and carotenoids. It can also be used to lower the gluten level that can causes coeliac disease (Tilman *et al.,* 2003).

Today, people are more conscious about their foods. They always find foods that are convenient with great taste, reasonable price and carry important nutritional value. So, breads prepared using sweet potato flour can be a great choice because of its ready-to-eat nature, good nutritional value and low cost (Anonymous, 2006).
Considering the above factors, the present study has been undertaken with the following objectives:

(i) To analyze the compositions of fresh sweet potato and sweet potato flour.
(ii) To develop sweet potato flour substituted breads and assess the overall acceptability of the processed products.

Materials and Methods

The experiment was performed in the laboratory of the Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensingh. The materials used in this study such as, drying trays, polythene bags, chemical solvents, distilled water were provided by the Food Technology laboratory. Wheat flour, sugar, salt, dalda, yeast (active dry yeast) and other ingredients were collected from the local market.

Proximate analysis

Proximate chemical composition represents the gross content of important chemical constituents such as moisture, protein, fat, carbohydrate, vitamin-C, specific minerals and ash.

Moisture content

The moisture content of the fresh and dried samples were determined in accordance to moisture measurement method for sweet potato AOAC (2000) method.

Ash Content

Total ash content was determined according to AOAC (2000) method.

Fat content

AOAC method (2005) was used to determine crude fat content of the samples.

Protein content

Protein was determined using AOAC (2005) method.

Total carbohydrate

Carbohydrate content of the samples was determined as total carbohydrate by difference that is by subtracting the measured protein, fat, ash and moisture from 100 (Pearsion, 1970). Total carbohydrate content of foods has, for many years, been calculated by difference, rather than analyzed directly.

Preparation of sweet potato flour

The fresh sweet potatoes were collected from local market. Then, they were processed to remove dirt and other field damaged portion. Cleaned sweet potato were chopped into small pieces with knife and dried at 65^0C for about 16 hours using cabinet dryer. After cooling to room temperature, the dried sweet potatoes were ground into flour in a grinder. Then they were sieved and packaged in polythene bags and stored at room temperature for further use in the preparation of bread.

Formulation of sweet potato bread

The formulation of breads from local sada and local lal sweet potato flour are given in Table 1.

Procedure for preparation of bread

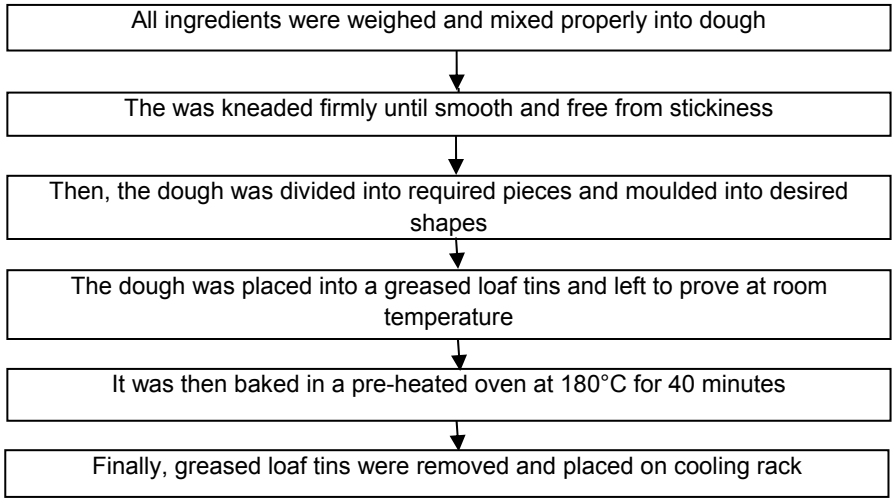

Fig. 1. Flow chart for preparation of bread from sweet potato

Table 1. The formulation of breads from local sada and local lal sweet potato flour

Ingredients	Sample Code						
	401	402	403	301	302	303	555
Sweet potato flour (g)	5	10	15	5	10	15	0
Wheat flour (g)	95	90	85	95	90	85	100
Dry yeast (g)	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Sugar (g)	5	5	5	5	5	5	5
Salt (g)	2	2	2	2	2	2	2
Dalda (g)	5	5	5	5	5	5	5
Water (ml)	70	70	70	70	70	70	70

[Here, 555 = Control bread, 401= Bread with 5% local sada sweet potato flour, 402 = Bread with 10% local sada sweet potato flour, 403 = Bread with 15% local sada sweet potato flour, 301= Bread with 5% local lal sweet potato flour, 302 = Bread with 10% local lal sweet potato flour, 303 = Bread with 15% local lal sweet potato flour]

Results and Discussion

Proximate composition of sweet potato

Proximate composition of local sada and local lal sweet potato varieties are shown in the Table 2.

Table 2. Comparison of composition between fresh local sada and local lal sweet potato varieties

Components	Local Sada Variety		Local Lal Variety	
	wb	db	wb	db
Moisture Content (%)	70.10	234.45	66.78	201.02
Ash (%)	4.46	14.92	4.21	12.67
Fat (%)	0.71	2.37	0.74	2.23
Protein (%)	1.75	5.85	1.63	4.91
Carbohydrate (%)	22.98	76.86	26.64	80.31
Vitamin-C (mg/100g)	8.86	29.63	9.49	28.57
Energy (kcal)	105.31		119.74	

Moisture

The moisture content of local sada and local lal sweet potato varieties are shown in Table 2. From table, it is shown that local sada fresh sweet potato contains 70.10% (wb) and local lal fresh sweet potato contains 66.78% (wb) moisture content. This value is lower than Wenkam (1983) who indicated that fresh sweet potato had a moisture content of 87.8% (wb). The variation in moisture content of sweet potato might be due to varietal effects, stage of maturity, gaps between harvesting time and analysis etc.

Ash

In this study ash content in fresh sample was found to be as high as 4.46% and 4.21% in local sada and local lal fresh sweet potato respectively. But Goodbody (1984) reported the total ash content in fresh sweet potato as 1.7%. This variation might be due to the varietal effect because different varieties contain different mineral matters.

Fat

The study showed that the fat content was 0.71% and 0.74% in local sada and local lal varieties respectively and the results were nearly similar to that obtained by Paul and Southgate (1979) who revealed that the fat content in fresh sweet potato was 0.61%. This variation might be due to varietal effects.

Protein

As presented in Table 2, the protein content was 1.75% and 1.63% in local sada and local lal fresh sweet potatoes respectively. But Villareall *et al.* (1979) indicated that protein content in fresh sweet potato was 2.8%.

Total carbohydrate

This study showed that carbohydrate content of local sada and local lal sweet potato varieties were 22.98 and 26.64% respectively. These values were nearly similar to the value reported by Villareall *et al.* (1979) who quoted that fresh sweet potato contained 27% of carbohydrates.

Vitamin C

The vitamin C contents of sweet potato were 8.86mg/100g in local sada variety and 9.49mg/100g in local lal variety. But Wenkam (1983) quoted that, the fresh sweet potato contains vitamin C of 12.86 mg/100g. But on drying, these were reduced from 8.86 mg/100g to 2.45 mg/100g and 9.49mg/100g and 2.31 mg/100g in local sada and local lal varieties respectively. The losses observed in analysis result from peeling, cutting, soaking and drying because Vitamin C is heat sensitive and water soluble.

Energy

Bovell-Benjamin (2007) quoted that sweet potato contained 116.25 kcal of energy and Teow *et al.* (2007) indicated that sweet potato contain energy of 135 kcal. In this study the calculated energy was 105.31 kcal and 119.74 kcal for local sada variety and local lal variety respectively. These values are nearly similar to the value calculated by Bovell-Benjamin (2007). The energy was determined by adding the results of multiplying fat content by 9 and carbohydrate and protein content by 4.

Compositions of sweet potato flour

Table 3 shows that there is profound difference between the compositions of fresh sample and flour. From table, the protein content is as high as 10.34 and 9.21% (db) for local sada and local lal variety respectively. This is because the sweet potato used for preparing flour was freshly harvested (collected directly from field) and moisture content was higher than (almost 80%) the fresh sample previously analyzed (cf Table 3). Table also shows that sweet potato flour contains fat content of 0.79 and 0.85% (db), ash content of 4.35 and 4.40% (db), vitamin-c content of 2.59 and 2.44 mg/100g for local sada and local lal variety respectively. This seems reasonable as protein is not destroyed at low temperature (60^0 C). Okos *et al.* (1992) observed that protein loss during drying was a major nutritional problem. Roy (2012) also observed no loss in protein during drying of corn. Fat content and vitamin-C content were somewhat affected by among others oxidation and heat (Villatal and Hawkes, 1992).

Table 3. Compositions of sweet potato flour

Components	Local Sada Variety		Local Lal Variety	
	wb	db	wb	db
Moisture Content (%)	5.25	5.54	5.32	5.62
Ash (%)	4.12	4.35	4.17	4.40
Fat (%)	0.75	0.79	0.81	0.85
Protein (%)	9.80	10.34	9.21	9.73
Carbohydrate (%)	80.08	78.98	80.49	79.4
Vitamin-C (mg/100g)	2.45	2.59	2.31	2.44

Sensory evaluation of bread

Seven samples of composite bread and the control were served to 10 panelists who were familiar with the sensory attributes- color, flavor, texture and overall acceptability of the samples. A nine point hedonic scale was designed to measure the degree of preference of the samples.

A two way of analysis of variance (ANOVA) (Table 4) was carried out for color preference and the result showed that, there was no significant difference in color acceptability of sweet potato bread. The score for color of sweet potato bread range from 6.85 to 7.43. The highest score has been recorded for the bread containing 5% local sada sweet potato flour and 95% wheat flour. This means that this sample was ranked as like moderately.

Table 4. Mean score for color, flavor, texture and overall acceptability of various sweet potato breads

Sensory Attributes	Sample code						
	401	402	403	301	302	303	555
Color	7.43[a]	7.14[a]	7.29[a]	7.27[a]	6.85[a]	7.28[a]	7.28[a]
Flavor	7.00[a]	7.00[a]	6.71[a]	7.00[a]	7.00[a]	6.71[a]	6.85[a]
Texture	7.43[a]	6.86[ab]	6.43[b]	6.86[ab]	7.14[ab]	6.71[ab]	6.71[ab]
Overall acceptability	6.86[a]	7.14[a]	7.00[a]	7.29[a]	7.43[a]	7.14[a]	7.00[a]

[Here, 555 = Control bread, 401= Bread with 5% local sada sweet potato flour, 402 = Bread with 10% local sada sweet potato flour, 403 = Bread with 15% local sada sweet potato flour, 301= Bread with 5% local lal sweet potato flour, 302 = Bread with 10% local lal sweet potato flour, 303 = Bread with 15% local lal sweet potato flour]

A two-way analysis of variance (ANOVA) (Table 4) for flavor of sweet potato bread was carried out and the result showed that, there was no significant flavor difference among sweet potato breads. From table 4.4, it was found that, samples 401, 402, 301 and 302 secured same score (highest score) and samples 403 and 303 secured lowest score. So, it is clear that all samples were statistically equal.

The score for texture of samples ranged from 6.43 to 7.43 (Table 4) with the highest score (7.43) obtained by the 5% local sada sweet potato bread (401) and lowest in the bread of 15% substitution of local sada sweet potato flour with wheat flour (403) and except 403, all other samples are equally acceptable. The table also showed that the control sample secured 6th position in case of texture.

The scores for the overall acceptability (Table 4) of the prepared sweet potato breads were comparable to those of 100% wheat bread and ranged from 6.86 to 7.43 and all the products were equally acceptable. On the basis of overall acceptability, score sample 302 (contains 90% wheat flour and 10% local lal sweet potato flour) may be termed as moderately acceptable. It should however be stated that all products are equally accepted with ranking from like moderately to like slightly.

Conclusion

Different experiments under this study were carried out in the laboratory of the Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensingh. This study was conducted to analyze the proximate compositions of fresh sweet potato and sweet potato flour. After collecting the fresh sample, the proximate compositions were found to be 70.10% and 66.78%; 1.75% and 1.63%; 0.71% and 0.74%; 4.46% and 4.21%; and 22.98% and 26.64% of moisture, protein, fat, ash, and total carbohydrate on wet weight basis for local sada and local lal sweet potato varieties respectively. The proximate compositions of sweet potato flour were also analyzed and found profound difference between fresh and sweet potato flour.

Sweet potato flour can be used as alternatives to wheat flour for the preparation of a number of food products. It is generally used in foods to improve the textural properties and enhance the nutritional values. Processing technologies for producing sweet potato flour at large scale operation has been developed in many countries. With regard to the dehydrated forms, selection of sweet potato varieties with high levels of dry matter and phytonutrients should go hand in hand and by adopting technological improvements to reduce processing cost. It has been observed that substitution of 5%, 10% and 15% wheat flour by sweet potato flour has a positive effect on flavor, color, texture and overall acceptability of bread.

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