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Production and Quality Evaluation of Local "Madiga" Bread Enriched with Defatted Fluted Pumpkin Seed Flour

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Authors' contributions

This work was carried out in collaboration among all authors. Author DBKK designed the study, supervised and managed the analyses of the study. Author BSC performed the statistical analysis and managed the literature searches, Author SDA wrote the protocol and wrote the first draft of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

The objective of this work was to produce local (Madiga) bread from the blend of wheat and fluted pumpkin seed flour and to evaluate the nutrient composition and sensory properties of enriched Madiga produced from these flour blends. Defatted fluted pumpkin seed flour was used to substitute wheat flour at the following; (Wheat to Fluted pumpkin seed flour ratio); 100:0 (control), 90:10, 80:20, 70:30, 60:40%, 50:50, and labelled as samples A, B, C, D, E, and F, respectively. The ash content ranged from 1.20 – 2.55%, with sample A given significantly lower ash content (1.20%) than those of the enriched Madiga. Significantly higher ash values of 2.55%, 2.44% and 2.39% were recorded in samples E, F and D, respectively. There was no significance in the fat content of samples A and B. Percentage protein ranged from 6.79% – 9.36%. The crude protein content of all the enriched Madiga samples were significantly higher than that of the control, Crude fiber content ranged from 0.91% – 1.82%, with sample C given significantly higher value of 1.82% followed by samples D and F. Control local Madiga gave significantly higher carbohydrate content of 74.31%. The energy value per kcal/100g for samples B, C, D, E and F were 258.62, 284.16, 296.07, 296.96 and 278.81, respectively. Samples B and C received significantly higher value of 4.70 and 4.05, respectively, keeping these samples in the 'sweet' to 'very sweet' range. Samples B and C received significantly higher overall acceptability and were scored 3.85 and 3.70,

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respectively. These values were however, not significantly difference from 3.33 and 2.93 as scored in samples D and E, respectively. Substitution of wheat flour with 10, 20 and 30% defatted fluted pumpkin seed flour was effective in producing enriched Madiga bread, thus recommended.

Keywords: Madiga bread; enriched; fluted pumpkin seed; nutrient composition.

1. INTRODUCTION

'Madiga' is a local bread product usually consumed by the people in the Niger Delta region of Nigeria. It is produced from wheat flour and it is a delicacy amongst the children because of its sweet taste, ready to eat convenience and low cost [1]. The product 'Madiga' is a type of bread that is much dense in nature, unlike the normal bread which is soft. Madiga which is commonly baked in local bakeries and it is commonly eaten by rural dwellers and now embraced by urban settlers in the south-south region of Nigeria, more especially in the Niger Delta. Madiga, is produced and sold in the open market in a generic state without label, nutritional tag and brand number. The baking of madiga bread started in the 1980s precisely by Chief Madiga (founder) in Enekorogha community in Burutu Local Government Area of Delta State, Nigeria.

Bread is a dietary staple diet for the world's population [2,3]. Bread products are well accepted worldwide because of the low cost, ease of preparation, versatility, sensory attributes and nutritional properties. Bread in human nutrition is not only a source of energy, but also a supplier of irreplaceable nutrients for the human body. It provides little fat, but high quantities of starch and dietary fibre as well as cereal protein. Apart from that, bread contains the B group vitamins and minerals which are mostly magnesium, calcium and iron [4]. The simplest bread can be created by basic formula dough which includes flour, water, leavening agent (yeast or chemicals) and sodium chloride [5]. Other ingredients such as fat, emulsifiers, sugars and dough conditioner may be added to improve the dough and bread quality. Each ingredient has its own function in bread and if slightly changed will alter final bread quality. Therefore, a proper balance of ingredients needs to be obtained to produce high-quality bread. The major or mandatory ingredients in bread making are flour, water and yeast [6,7]. The flour should have good amylase activity, the moisture content should be less than 14% and the colour or appearance should be satisfactory [8]. Due to the high cost, geographical scarcity and high demand of wheat flour, efforts are being directed toward the provision of alternative source of flour. Cocoyam flour has also been used as a good substitute for wheat flour in bread making [9]. According to Idowu et al. [10], the possibility of using starchy staples for bread making depends on the physical and chemical properties of the product. Efforts has been made to promote the use of composite flour from locally grown crops and high protein composite seeds are replaced in a portion of wheat for use in bread, thereby decreasing the demand for imported wheat and promoting the production of protein enriched bread. On the light of this, cocoyam, cassava, taro and other tubers crops have been found to be an alternative source of major raw materials for bread making [8]. Nigeria and most developing countries are largest importer of American red winter wheat [11,12,13]. This implies that these countries are totally dependent on foreign country for their bread production. Due to increasing population, urbanization and also change in food habits, consumption of leaven bread has increased tremendously in developing countries in recent years [14]. It is however relatively expensive being made from wheat which is as a result of climatic reasons does not grow well in tropical regions and therefore has to be imported [13]. Although, wheat flour is the indispensable in leavened bakery products, flours and meals from many other grains are frequently used as ingredients for the purpose of enhancing flavor or color and improving the nutritional aspect [15]. The predominance of wheat flour for baking of leaven breads due to the properties of its elastic gluten protein, which helps in producing a relatively large loaf volume with a regular finely crumb structure. If the wheat flour used in bread making is to be substituted with flour produced from other crops, they must be milled to acceptable baking quality. However, such products cannot compare favorably with wheat flour and therefore can only be referred to as non-wheat bread- or named after their flour sources [16]. However, in tropical countries, wheat production is limited and importation of wheat flour to meet local demand is a necessity [8]. Tanzania imports over 90% of its annual wheat demand of about 360,000 tons per year from countries like Australia, Canada, and

Russia among others which costs substantial amount of foreign exchange. Studies on the use of various oilseeds, legumes and high protein seeds in bread making have been reported [17,18]. These studies showed that 2 to 10% non-wheat flour can be used in breads without undesirable changes in bread characteristics and sensory attributes of breads.

Madiga bread is high in carbohydrate, measuring about 60% to 70% [1], which indicates that the product needs to be enhanced with protein supplements in order to meet the nutritional needs of consumers. Composite flours have great advantages to developing countries because wheat imports can be reduced and alleviate the use of locally grown grains [19]. Indeed, research studies have been conducted with the intention of promoting the use of composite flours, in which flour from locally grown crops and high protein seeds replace a portion of wheat flour for use in bread, thereby decreasing the demand for imported wheat and producing protein enriched bread [8]. Some of these studies include: Production of bread from composite flour of cassava and wheat flour [15], Substitution of wheat flour with taro flour in bread making [20], Substitution of pumpkin flour in wheat bread [21] and production of bread from tiger nut-wheat composite flour [22]. All these ingredients will impart characteristics color, texture and nutritive value which may be favorable in bakery products, recipes and other food products. Therefore, in order to obtain a better nutritional quality of the product, fluted pumpkin (*Telfaria occidentalis* Hook) seed flour blends which have a very high value of protein of about 52% gives a better alternative. Fluted Pumpkin (*Telfairia occidentalis* Hook F), a tropical cucurbit [23,24] is grown in Nigeria as a source of leafy vegetable, and for its oil bearing seeds. Common names for this plant in Nigeria include 'ugu', and fluted gourd. *Tefairia occidentalis* grows in many countries of West Africa, but cultivated mainly in Nigeria where it is used primarily in soups and herbal medicines. It is said to be indigenous to southern Nigeria [25]. The fruit pulp is not edible, but the seeds are rich in fat and protein, and can therefore be used in nutrient fortification, to enhance a well-balanced diet. Giami et al. [26] reported that fluted pumpkin seed contained 14.5% carbohydrate, 27% protein and 54% fat. Pumpkin seed flour have been used for nutritional enrichment and for maintaining the rheological and sensory properties of confectionery products [27]. Pumpkin seed flour, unlike wheat, is rich in fibre (47.9%, dry mass) and thus, enhances intestinal functions and produce the feeling of satiety that is essential in body weight control [28]. It has potential for use as a functional agent in many formulated foods [23,29]. Thus, use of Fluted pumpkin seed flour as wheat flour substitute in Madiga bread production has great potential to bridge the nutritional gap as might be presented in wheat. High carbohydrate content and low protein potential of Madiga bread is a cause for serious concern due to the higher consumption of this indigenous brand among the locals, especially children in the Niger delta region of Nigeria. Need to enhance the nutrient potential of this local bread engendered the objective of this work; production of local Madiga bread, enriched with defatted fluted pumpkin seed flour and evaluating its nutrient composition and sensory properties.

2. MATERIALS AND METHODS

Fluted pumpkin seed was purchased from an open market in Yenegoa, Bayelsa State., Wheat flour, sugar, salt, margarine and yeast used for this study were purchased from confectionery store in Yenegoa Bayelsa State, Nigeria and transported in air tight high density polyethylene bag. The chemicals used were of analytical grade manufactured by British Drug House, London and purchased from a chemical store in Port Harcourt.

2.1 Defatting of Fluted Pumpkin Seed Flour

Fluted pumpkin seed was dehulled, cleaned and oven dried at 60°C for 24h [26] in a hot air oven (model QUB 305010G, Gallenkamp, UK), milled using a laboratory mill (model MXAC2105, Panasonic, Japan). The flour was defatted using the method described by Rosenthal [30], with slight modification. The milled seed flour was made into paste by adding warm and cold water intermittently. The paste was placed in boiling water and allowed to boil for 6 hours. Oil floating to the surface and kept to stand overnight in the refrigerator. To allow for oil crystallization making it easier to be skimmed off the mixture. Defatted pumpkin flour was dried in a hot air oven to 12 – 13% moisture content, sieved to fine particles.

2.2 Flour Blending and 'Madiga' production

Six blends were prepared by mixing wheat flour and defatted fluted pumpkin seed flour in the proportions of; 100:0, 90:10, 80:20, 70:30, 60:40

and 50:50, which were represented as samples A, B, C, D, E and F, respectively (Table 1).

Madiga bread was produced using the method of Idolo [1], with slight modifications, as shown in Fig. 1. The flour blends (100 g wheat/fluted pumpkin seed flour) were mixed properly with yeast (1 g), sugar (10 g), baking margarine (6 g), salt (2 g) and water (45 g) in a mixing bowl for 5 min, to obtain a consistent dough. The dough was milled by kneading vigorously for 10 – 15min, to obtain smooth dough. The dough was placed in fat-greased pans, covered and allowed to proof for 30 – 45 min. The proved dough was oven baked for 30 min at 180°C – 190°C. Removed from oven and placed on cooling racks to cool before packaging.

2.3 Proximate Composition

Proximate composition of the Madiga bread was performed via: Percentage Protein content, fat content, ash content, crude fibre, moisture content and carbohydrate content, using standard methods [31].

2.4 Energy Value

Energy value (kcal per 100 g) was estimated using the Atwater conversion factor [32]. Energy (kcal per 100 g) = [9 × Lipids% + 4 × Proteins% + 4 × Carbohydrates%]

2.5 Sensory Evaluation

Sensory evaluation was performed on the madiga using the method of [33]. The Madiga samples were evaluated by selected untrained panelists on the 5point Hedonic scale. The team consisted of 20 randomly selected tasters, made up of students and literate business owners in Madiga-eaten communities in Yenegoa, Bayelsa State. Evaluation was on most preferred quality attribute for each treatment levels with respect to colour (light brown to dark brown), taste (little bitter to very sweet), texture (extremely hard to slightly hard), and overall acceptability. All evaluations were conducted at room temperature on the same day. Necessary precautions were taken to prevent carry-over flavour during the tasting by ensuring that panelists rinsed their mouth with water after each stage of sensory evaluation.

2.6 Statistical Analysis

All the analyses were carried out in duplicate. Data obtained were subjected to Analysis of Variance (ANOVA); differences between means were evaluated using Turkey's multiple comparison tests with 95% confidence level. The statistical package in Minitab software version 16 was used.

3. RESULTS AND DISCUSSION

3.1 Nutrient Composition of "Madiga" Produced from Wheat and Defatted Fluted Pumpkin Seed Flour Blends

Proximate composition presents the nutrient content of food with respect to moisture, ash, fat, crude fibre, protein and carbohydrate content [34]. From the result, as shown in Table 2, sample A gave significantly (P<0.05) lower moisture 16.60%, while significantly (P<0.05) higher moisture of 32.48% was shown in sample B (Madiga enriched with 10% fluted pumpkin seed flour). Lower moisture of 11.91% was earlier reported by [35] for 100% wheat flour bread. However, Idolo [1] reported a higher moisture of 28.00% for Madiga produced with 100% wheat flour, different in moisture content is

Table 1. Production blends for wheat/defatted fluted pumpkin seed flour

	Ingredient						
Samples	**WF (g)**	**DFPSF (g)**	**Sugar (g)**	**Margarine (g)**	**Salt (g)**	**H_2O (g)**	**Yeast (g)**
A	100	0	10	6	2	45	1
B	90	10	10	6	2	45	1
C	80	20	10	6	2	45	1
D	70	30	10	6	2	45	1
E	60	40	10	6	2	45	1
F	50	50	10	6	2	45	1

Key: A = 100% wheat flour (control)
B = 90% wheat + 10% fluted pumpkin seed flour; C = 80% wheat + 20% fluted pumpkin seed flour
D = 70% wheat + 30% fluted pumpkin seed flour;E = 60% wheat + 40% fluted pumpkin seed flour
F = 50% wheat + 50% fluted pumpkin seed flour; WF= wheat flour
DFPSF= defatted fluted pumpkin seed flour

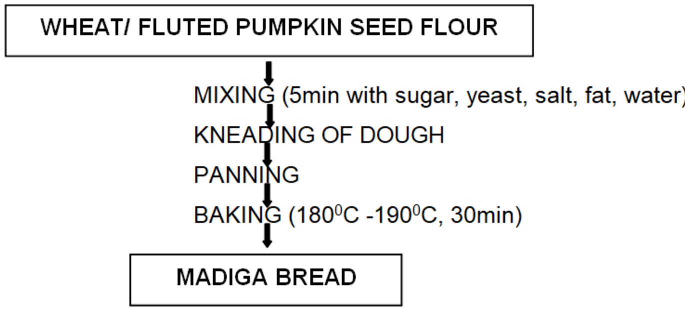

Fig. 1. Flow diagram for production of madiga from composite flour

probably due to different in baking temperature and time. There was no significant difference (P>0.05) in the moisture content of samples C, D and E. Low moisture content is a better indicator of product potential to have longer shelf life [36]. The higher the moisture contents of food the lower the shelf life stability [37].

Sample A gave significantly (P<0.05) lower Ash content (1.20%) than those of the enriched Madiga, indicating that producing Madiga with composite flour of wheat/fluted pumpkin seed greatly enhances its mineral content, as the ash content of food is simply a measure of its mineral content [38,39]. Significantly higher Ash values of 2.55%, 2.44% and 2.39% were seen in samples E, F and D, respectively. Higher ash content ranging from 3.78% - 4.23% was reported earlier by [40], for composite bread produced with blends of wheat, soybean and cassava flour.

Percentage fat content ranged from 0.2% - 2.47%. with the control given significantly (P<0.05) higher fat content of 2.47% followed by sample E (40% enriched Madiga). Higher fat content of the control Madiga is due to the use of defatted fluted pumpkin seed flour (DFPSF). Defatting is done to enhance protein content [41]. There was no significant different (P>0.05) in the fat content of samples A and B. Low fat content in a dry product will help in increasing the shelf life of the sample by decreasing the chances of rancidity and also contribute to low energy value of the food product while high fat product will have high energy value [42].

The protein content of all the enriched Madiga samples were significantly (P<0.05) higher than that of the control, with percentage crude protein of 6.79%. This value was lower than 8.444% protein reported by Idolo [1] and 11.07% reported by Giami and Bekebain [23]. Madiga enriched with 50% DFPSF) (sample F) gave significantly higher protein content of 9.36% followed by sample E (8.93%) and sample C (7.61%). The result showed that DFPSF) substitution in wheat flour improved the protein content of 'Madiga' bread. This is as a result of reported high protein content of fluted pumpkin seed flour, about 27% [26]. Protein is a major nutrient needed as building blocks for the body, necessary for growth and for the repair of damaged tissues [43].

Crude fiber content ranged from 0.91% – 1.82%, with sample C (madiga enriched with 20% DFPSF)) given significantly (P<0.05) higher value of 1.82% followed by samples D and F. these values were lower than 9.01% reported earlier by Giami et al. [26] and 0.04% - 0.13% reported by Idolo [1] for Madiga produced from wheat flour in composite with sweet potato flour. The crude fibre content of the control was significantly (P<0.05) lower (0.91%). Dietary fiber is the undigested part of the food product that helps to keep our digestive system healthy against diseases like cancer, diabetics etcetera. High crude fiber slows down the release of glucose into the blood and decreases inter-colonic pressure hence reducing the risk of colon cancer [44].

Carbohydrate content ranged from 54.80 – 74.31%, with the control local Madiga given significantly (P<0.05) higher carbohydrate content of 74.31%. This value was lower than 58.95% reported by Idolo [1] for wheat flour Madiga, and also higher than 50.45% reported by Giami et al. [26] for wheat bread. The carbohydrate content of samples B and F were also not significantly different. Increased fiber and the lower carbohydrate content of enriched Madiga possess several health benefits, as it will aid digestion in the colon and reduce constipation often associated with products from refined grain flours [45,46].

3.2 Energy Value of "Madiga" Produced from Wheat and Defatted Fluted Pumpkin Seed Flour Blends

The result of the energy value of Madiga samples produced from wheat/fluted pumpkin composite flour (Fig. 2) showed that there was a progressive decrease in energy content with increasing substitution of DFPSF. The energy value ranged from 258.62 kcal/100g – 326.165 kcal/100 g. with the control sample showing significantly (P<0.05) higher energy value than those of Madiga produced from wheat in composite with DFPSF, at different levels of substitution. Reduction in energy value results from the use of DFPSF, which is aimed at enhancing the protein and mineral potential of the enriched Madiga. Energy value was estimated from the contributions of protein, fat and carbohydrate, taking into account the digestibility of each and their heat of combustion [26].

The energy value of samples B, C, D, E and F in kcal/100g were respectively 258.62, 284.16, 296.07, 296.96 and 278.81. Sample B showed significantly (P<0.05) lower energy value (258.62kcal/100g). According to US Nutritional Recommendation (values per 100 g) of white bread consumption for Adults, it is given that it should provide 270 kcal (1110 kJ), 8 g protein, 3 fats, 51 g carbohydrate [47] keeping fluted pumpkin enriched Madiga bread at an advantaged position.

3.3 Sensory Properties of Madiga Produced from Wheat and Defatted Fluted Pumpkin Seed Flour Blends

Result for sensory properties of Madiga bread produced from wheat and defatted fluted pumpkin seed flour blends is shown in Table 3. Sensory quality is the most important dimension of quality evaluation of bread [48]. Sensory evaluation is generally based on texture and flavor related perspectives and appearance that assist to find out product acceptability [49]. The ability to assess food commodity is based on human senses including color, flavor, texture, taste and overall acceptability [50]. Descriptive sensory analysis of the Madiga showed score for taste ranging from 2.95 – 4.70 with sample B (10% enriched Madiga) and sample C (20% enriched Madiga) receiving significantly (P<0.05) higher value of 4.70 and 4.05, respectively, keeping these samples in the 'sweet' to 'very sweet' range. The differences observed in the taste scores of samples E, D and A (control) were not statistically significant (P>0.05), these samples fell within the descriptive range of 'not sweet' to 'fairly sweet'. Sample F was assessed as 'little bitter' with significantly (P<0.05) low taste score of 1.45. Colour score ranged from 1.55 – 3.70, with samples F and E given significantly (P<0.05) higher values of 3.70 and 3.30, respectively, placing them within the colour range of 'chocolate to 'cocoa brown'. There was however, no significant difference (P>0.05) in the colour scores of samples E and D and those of samples D and C. Sample B and the control (A)

Table 2. Proximate composition of "Madiga" produced from wheat and defatted fluted pumpkin seed flour blends

Sample	Moisture (%)	Ash (%)	Fat (%)	Protein (%)	Crude fibre (%)	Carbohydrate (%)
A	16.60^{d}±0.099	1.20^{c}±0.007	0.20^{d}±0.007	6.79^{f}±0.000	0.91^{f}±0.000	74.31^{a}±0.085
B	32.48^{a}±0.537	1.94^{b}±0.219	0.40^{d}±0.001	7.12^{e}±0.000	1.42^{e}±0.000	56.65^{c}±0.757
C	26.50^{bc}±0.163	2.14^{ab}±0.057	1.19^{c}±0.279	7.18^{d}±0.000	1.82^{a}±0.007	61.18^{b}±0.505
D	24.23^{c}±1.761	2.39^{a}±0.014	1.89^{b}±0.141	7.61^{c}±0.000	1.73^{b}±0.014	62.16^{b}±1.648
E	24.70^{c}±0.354	2.55^{a}±0.078	2.38^{ab}±0.014	8.93^{b}±0.014	1.49^{d}±0.000	59.96^{b}±0.304
F	29.26^{b}±0.085	2.44^{a}±0.071	2.47^{a}±0.134	9.36^{a}±0.014	1.68^{c}±0.014	54.80^{c}±0.120

Values are mean ± standard deviation of duplicate samples
Mean values bearing different superscripts in the column differ significantly (P<0.05)
Key: A = 100% wheat flour (control)
B = 90% wheat + 10% fluted pumpkin seed flour
C = 80% wheat + 20% fluted pumpkin seed flour
D = 70% wheat + 30% fluted pumpkin seed flour
E = 60% wheat + 40% fluted pumpkin seed flour
F = 50% wheat + 50% fluted pumpkin seed flour

received significantly (P<0.05) lower score of 1.55, placing them within the descriptive colour range of 'light brown' to 'gold brown'. Texture grades ranged from 2.20 – 4.85, with sample B and C receiving significantly (P<0.05) higher scores of 4.85 and 4.35, respectively, placing them in texture range of 'hard' to 'slightly hard'. Samples D, E and F received texture scores of 3.60, 2.55 and 2.20, respectively, placing them in the descriptive texture range of 'very hard' to 'very, very hard'. Samples C and B received significantly (P<0.05) higher overall acceptability and were scored 3.85 and 3.70, respectively. These values were however, not significantly difference (P>0.05) from 3.33 and 2.93 as scored in samples D and E, respectively. Idolo [1] in his earlier work on the Sensory and Nutritional Quality of Madiga Produced from Composite Flour of Wheat and Sweet Potato, also observed that there was no significant difference (p<0.05) in the sensory attributes of texture, flavor/aroma, taste and overall acceptability between the Madiga samples at all levels of substitution.

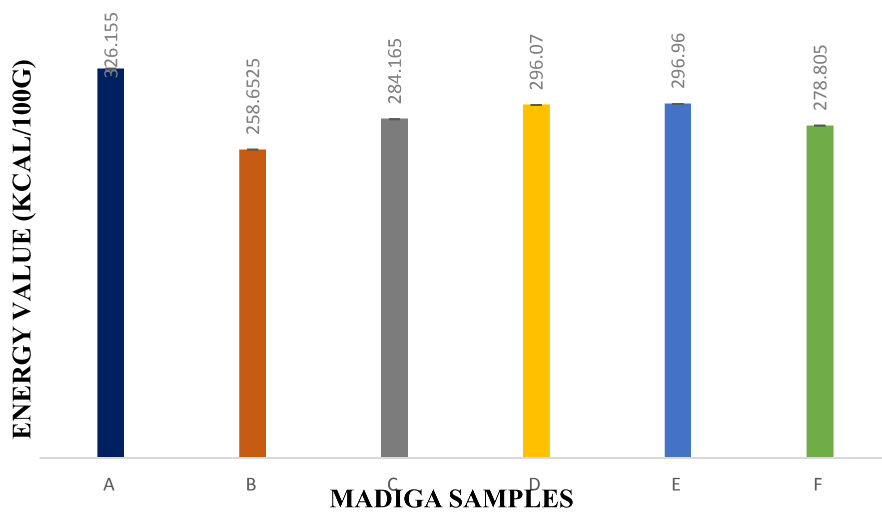

Fig. 2. Energy value of "Madiga" produced from wheat and defatted fluted pumpkin seed flour blends

Key: A = 100% wheat flour (control)
B = 90% wheat + 10% fluted pumpkin seed flour
C = 80% wheat + 20% fluted pumpkin seed flour
D = 70% wheat + 30% fluted pumpkin seed flour
E = 60% wheat + 40% fluted pumpkin seed flour
F = 50% wheat + 50% fluted pumpkin seed flour

Table 3. Sensory properties of madiga produced from wheat and defatted fluted pumpkin seed flour blends

Samples	Taste	Colour	Texture	Overall acceptability
A	3.05^{cd}±0.605	1.55^{d}±0.759	4.00^{bc}±0.918	2.87^{bc}±0.661
B	4.70^{a}±0.470	1.55^{d}±1.234	4.85^{a}±0.366	3.70^{a}±0.506
C	4.05^{ab}±0.510	2.40^{c}±0.883	4.30^{ab}±0.470	3.58^{a}±0.431
D	3.70^{bc}±0.470	2.70^{bc}±0.733	3.60^{c}±0.503	3.33^{ab}±0.390
E	2.95^{d}±0.099	3.30^{ab}±0.657	2.55^{d}±0.686	2.93^{b}±0.547
F	1.45^{e}±0.999	3.70^{a}±0.979	2.20^{d}±0.696	2.45^{c}±0.575

Values are mean ± standard deviation of twenty responses
Mean values bearing different superscripts in the column differ significantly (P<0.05)
Key: A = 100% wheat flour (control)
B = 90% wheat + 10% fluted pumpkin seed flour
C = 80% wheat + 20% fluted pumpkin seed flour
D = 70% wheat + 30% fluted pumpkin seed flour
E = 60% wheat + 40% fluted pumpkin seed flour
F = 50% wheat + 50% fluted pumpkin seed flour

4. CONCLUSION

The work indicated that producing Madiga with composite flour of wheat/fluted pumpkin seed greatly enhances its mineral content. Significantly higher Ash values of 2.55%, 2.44% and 2.39% were seen in samples E, F and D, respectively. The protein content of all the enriched Madiga samples were significantly (P<0.05) higher than that of the control (sample A; 100% wheat flour Madiga). Madiga enriched with 50% fluted pumpkin seed flour (sample F) gave significantly higher protein content of 9.36% followed by sample E (8.93%). Increased fibre and the lower carbohydrate content of enriched Madiga possess several health benefits, as it will aid digestion in the colon and reduce constipation often associated with products from refined grain flours. Madiga produced with 10% and 20% substitution of defatted fluted pumpkin seed flour, received significantly higher consumer preference for taste, texture and overall acceptability, with scores of 4.70, 4.85, 3.70 and 4.05, 4.30, 3.58 for samples B and C, respective. Substitution of wheat flour with 10%, 20% and 30% defatted fluted pumpkin seed flour is shown to be effective in producing nutritionally enriched Madiga bread.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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