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# Sensory and Nutritional Quality of Madiga Produced from Composite Flour of Wheat and Sweet Potato

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**Abstract:** Madiga is a local bread product produced from wheat flour consumed by the people of the Niger Delta regions of Southern Nigeria. The use of sweet potato flour substitution in wheat flour at 0%, 15%, 20% and 25% each for the production of Madiga was investigated. Proximate analysis of the sample showed that there was a slight decrease in the protein and fat content with increasing sweet potato supplementation. On the other hand, the ash and crude fibre content increased with higher sweet potato supplementation. Carbohydrate contents ranged from 57.75-59.26%. Nutritional analysis of the Madiga samples showed an increase in the energy, Vitamin A, $B_6$ C and magnesium contents as sweet potato flour substitution increased with the 25% supplementation having the highest values of 1023 kcal/100 g, 3.241 ug/100 g, 0.383 mg/100 g, 6.85 mg/100 g and 28 mg/100 g respectively. The results of sensory evaluation of the Madiga samples showed that no significant differences were observed between whole wheat Madiga and the sweet potato supplemented Madiga in sensory attributes of aroma, texture, taste and overall acceptability ($p<0.05$). In terms of Madiga colour, the 25% sweet potato supplemented Madiga sample had the highest scores. The findings from this work show that wheat substitution with sweet potato flour up to 25% can be adopted for improved nutritional quality and reduced cost in the production of Madiga.

**Key words:** Sweet potato, wheat/sweet potato composite flour, nutritional quality, Madiga, sensory evaluation

## 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. In recent years, breads and other bakery products have been produced using composite flours. These flours are advantageous to developing countries because wheat imports can be reduced and alleviate the use of locally grown grains (Hugo *et al*., 2003). 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 (Giami *et al*., 2004). Some of these studies include: Production of bread from composite flour of cassava and wheat flour (Shittu *et al*., 2006), Substitution of wheat flour with taro flour in bread making (Ammar *et al*., 2009); Substitution of pumpkin flour in wheat bread (See Ean Fang, 2008) and production of bread from tiger nut-wheat composite flour (Ade-Omowaye *et al*., 2008). All these ingredients will impart characteristics color, texture and nutritive value which may be favorable in bakery products, recipes and other food products. Sweet potato is one of the world's important food crops and an important staple in the Niger Delta regions of Nigeria. It is a low input crop and is used as vegetable, a desert, a source of starch and animal feed (Odebode, 2004). Among the world's major food crops, sweet potato produces the highest amount of edible energy per hectare per day (Horton and Fano, 1985). Though, it is an important food in many enclaves in Nigeria its full potential is yet to be exploited inspite of its nutritive and agronomic characteristics (Woolfe, 1992) and according to Ofori *et al*. (2009), the development of appealing processed products from sweet potatoes will therefore play a major role in raising awareness on the potential of the crop.

Sweet potato flour can serve as of nutrients (carbohydrates, beta-carotene (provitamin A), minerals (Ca, P, Fe and K) and can add natural sweetness, color, flavour and dietary fiber to processed food products (Woolfe, 1992; Ulm, 1988). Consequently, the objective of this work was to produce Madiga from composite flour of wheat-sweet potato and to evaluate the nutritional content and sensory qualities to determine the acceptability of the Madiga product.

## MATERIALS AND METHODS

Sweet potato tubers were purchased from Ogbeogonogo Market at Asaba, Delta State. They were processed into flour using the technique described by Singh *et al*. (2008) in their work. The sweet potatoes were peeled and cut into thin slices manually. Slices were directly immersed into 1% NaCl solution and then immersed in solution containing Potassium

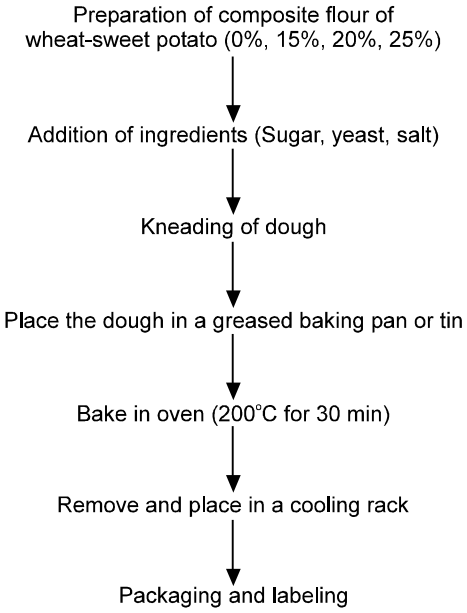


Fig. 1: Flow chart showing the production of Madiga from composite flour

metabisulphite (1%) and citric acid (0.5%) for 30 minutes. Drying of sweet potato slices was done on perforated trays in a tray dryer at 55°C till 7.8% moisture content and then stored in air tight container till further use. The dried chips were milled into flour using the laboratory grinder and passed through 80 mesh sieve to obtain flour of uniform size. The flour was then packed in air tight container and stored under refrigeration condition till further use.

**Blend formulation:** Four blends were prepared by mixing with wheat flour with sweet potato in the proportions of 100:0, 85:15, 80:20 and 75:25.

**Baking process:** The process for the production of Madiga is shown in Fig. 1. The baking was done in a local bakery in Warri, Delta State Nigeria, where the product is normally produced. The baking formula used is as described by Ihekoronye (1999) with slight modifications. All ingredients were mixed in a kenwood mixer. The dough was then place in a greased pan and baking was don2e in an oven at 200°C for 30 min.

**Proximate analysis of the Madiga sample:** The method recommended by AOAC (2003) was used to determine the ash, crude protein, crude fibre, ether extract, moisture content and carbohydrate (by difference).

**Nutritional analysis of Madiga sample:** Produced Madiga was analyzed for various nutrients such as vitamins, minerals and energy. Mineral analysis was done using the Atomic Absorption Spectrophotometer as described by AOAC (2003). Energy content was also measured using the Bomb Calorimeter (AOAC, 1990). The Vitamin A, $B_6$ and C were determined using the AOAC (2005) procedure.

**Sensory evaluation:** The sensory attributes, including colour, texture, aroma/flavour, taste and overall acceptability, were evaluated by a semi trained 20-member panel, using a 7-point Hedonic scale with 1 representing the least score (dislike extremely) and 7the highest score (like extremely). Analysis of Variance (ANOVA) was performed on the data gathered to determine differences, while the least significant test was used to detect significant differences among the means (Ihekoronye and Ngoddy, 1985).

Table 1: Proximate analysis of sweet potato supplemented and whole wheat Madiga samples

| Parameter/Madiga Sample | 0% | 15% | 20% | 25% |
|---|---|---|---|---|
| Crude protein | 8.44 | 8.23 | 7.80 | 7.57 |
| Crude fibre | 0.04 | 0.08 | 0.12 | 0.13 |
| Ash % | 2.60 | 2.90 | 3.00 | 3.00 |
| Ether extract % | 1.97 | 1.90 | 1.89 | 1.83 |
| Moisture % | 28.00 | 29.14 | 28.31 | 28.21 |
| Carbohydrate % | 58.95 | 57.75 | 58.88 | 59.26 |

## RESULTS AND DISCUSSION

The result of the proximate analysis is presented in Table 1. The results obtained for the protein and ether extract were quite similar in all the Madiga samples, with the whole wheat Madiga sample having the highest values of 8.44% and 1.97% respectively. Generally cereals and tubers are poor sources of protein and consumption of food items from these sources should be accompanied with other protein sources. On the other hand, crude fibre content increased progressively with higher proportion of sweet potato flour content. In general dietary fibre helps lowers the risk of constipation, diverticulosis and colon and rectal cancer. The same trend was recorded in the ash content of the Madiga samples with the whole wheat Madiga sample having the least value of 2.6% implying that the inorganic nutrients in the composite Madiga product is richer than wheat Madiga. It can be concluded that incorporation of sweet potato flour in the process of Madiga could enhance the mineral intake of consumers of the product, as ash is indicative of the amount of minerals contained in any food sample. The carbohydrate content in all samples ranged from 57.75-59.26%. According to Enwere (1998), of all the solid nutrients in roots and tubers, carbohydrate predominates. Carbohydrate supplies quick source of metabolisable energy and assists in fat metabolism. The result of the Nutritional analysis of Madiga samples presented in Table 2 showed that there was a progressive increase in energy content with increasing sweet potato flour content.

Table 2: Nutritional content of sweet potato supplemented and whole wheat Madiga samples

| Wheat-sweet Potato Madiga | Energy kcal/100 g | Magnesium mg/100 g | Copper mg/100 g | Calcium mg/100 g | Vit. A Ug/100 g | Vit.$B_6$ mg/100 g | Vit. C mg/100 g |
|---|---|---|---|---|---|---|---|
| 0% | 743 | 26 | 0.19 | 21 | 2.405 | 0.245 | 2.65 |
| 15% | 874 | 28 | 0.18 | 19 | 2.693 | 0.274 | 4.71 |
| 20% | 992 | 28 | 0.16 | 18 | 3.141 | 0.323 | 6.13 |
| 25% | 1023 | 28 | 0.14 | 17 | 3.241 | 0.383 | 6.85 |

Energy is very important in the human body; it is required for every physical activity. Deficiency in calories is as much a cause of malnutrition as protein deficiency (Defoliart, 1992), hence the need for energy. There was an overall 40% increase in the energy content between the whole wheat Madiga and the 25% sweet potato-wheat Madiga. Therefore incorporating sweet potato into the product will go a long way to reduce the malnutrition problem among the people in Nigeria. Furthermore, there was also a slight increase in the magnesium content of the Madiga bread with the 25% sweet potato recording the highest value. Magnesium is needed to maintain normal muscle and nerve function, to keep the heart rhythm steady, to support a healthy immune blood and to regulate blood sugar level. Saris *et al.* (2000). The vitamin A, $B_6$ and C content increased in proportion with the sweet potato added. The vitamin A content increased from 2.405 ug/100 g of whole wheat Madiga to 3.241 ug/100 g of 25% sweet potato flour supplemented Madiga representing a 35% increase in Vitamin A. Vitamin A is an essential nutrient required for maintaining immune function, playing an important role in the regulation of cell-mediated immunity and in humoral antibody responses Stephensen (2001). It also helps in the maintenance of healthy teeth, skeletal and soft tissue, mucous membranes and skin. It is also known as retinol because it produces the pigment in the retina of the eye. Most foods that are rich in Vitamin A, except sweet potato, have the limitations of being too expensive for African consumers, seasonally available or are unpalatable to young children. Furthermore, Kapinga *et al.* (2001), opined that 100 g of sweet potato can provide enough beta-carotene to produce from 0-100% of the suggested daily vitamin A requirement (350 ug) per day for infants and young children). Similarly, the Vitamin $B_6$ content also followed the same trend as Vitamin A with the 25% sweet potato-wheat supplemented Madiga recording the highest values. According to Merrill and Henderson (1987), Vitamin $B_6$ acts as a cofactor for enzymes involved in such diverse processes as macromolecular metabolism, immune competence and hormone function, The vitamin C content increased from 2.65 mg/100 g in the whole wheat Madiga to 6.85 mg/100 g in the 25% sweet potato-wheat supplemented Madiga. Vitamin C helps to maintain collagen, healthy gums and is known to enhance the availability and absorption of iron from non-heme iron sources (Naidu, 2003). The result of the sensory analysis carried out on the Madiga samples is presented in Table 3. The mean sensory scores obtained for the whole wheat Madiga and sweet potato supplemented Madiga ranged between 4.60 and 6.50. 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. In terms of color, the 25% sweet potato wheat Madiga sample had highest scores owing to the appealing golden brown colour imparted by the sweet potato. The implication of this is that sweet potato flour substitution in Madiga would yield general consumer acceptance.

Table 3: Hedonic sensory mean scores for sweet potato supplemented and whole wheat Madiga samples

| Attribute/Madiga Sample | 0% | 15% | 20% | 25% |
|---|---|---|---|---|
| Color | $4.75^{b}$ | $5.00^{ab}$ | $5.20^{ab}$ | $6.50^{a}$ |
| Texture | $4.78^{a}$ | $4.60^{a}$ | $5.05^{a}$ | $5.60^{a}$ |
| Flavor/aroma | $5.26^{a}$ | $5.20^{a}$ | $4.90^{a}$ | $5.20^{a}$ |
| Taste | $5.58^{a}$ | $5.70^{a}$ | $5.10^{a}$ | $4.75^{a}$ |
| Overall acceptability | $5.53^{a}$ | $5.50^{a}$ | $5.35^{a}$ | $5.40^{a}$ |

Means with the same superscript in a row are not significantly different ($p<0.05$)

**Conclusion:** Madiga produced with sweet potato substitution up to 25% were nutritionally superior to that of whole wheat Madiga. Madiga of good nutritional and sensory qualities could be produced from up to 25% sweet potato substitution in wheat flour. This will accrue in great savings in the scarce resources of a developing country like Nigeria, where wheat cultivation does not thrive for climatic reasons. Furthermore, potato farmers in the region could benefit economical if the use of this staple is encouraged in Madiga production.

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