The Preliminary Study of the Acceptability of Ghana Bread Made with Orange Sweet Potato Puree

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Abstract

High prevalence of vitamin A deficiency (VAD) among women and children in Ghana prompted search for measures to combat the disease. “Ghana Bread” is known for its moistness, fine texture and consumed daily by most Ghanaians. This study accessed the acceptability of orange sweet potato bread as a food-based fortification measure for combating vitamin A deficiency in Ghana. Volunteers (192) from three regions of Ghana evaluated the acceptability of the “Ghana Bread” processed with 30% orange sweet potato puree, using a 7-point Hedonic Scale for color, sweetness, texture and overall acceptability; and analyzed with SPSS computer software version 16 for the descriptive and correlation “r” analysis of the variables.

The mean age of the population ranged from 20-42 years with the youngest subjects located in the Greater Accra region, and the oldest in the Volta region. The overall acceptability rating of the bread ranged from, 5.77-6.77 (82-97%) with the highest (6.77, 97%) from the Greater Accra region and the lowest (5.77) from the Northern region. A correlation analysis of the variables indicated gender, age, texture and overall acceptability to be significant (P<0.05). The rating for texture was the lowest (3.87), and is indicative of a need for locally processed sweet potato puree. Sweetness had the highest correlation with overall acceptability (0.0314, P<0.01). The mean rating of the bread 6.25 (89%) from all regions seems to indicate that the bread made with 30% OS is indicative of likeness, and could increase the intake of vitamin A when such bread is consumed in Ghana.

ABBREVIATIONS
OS: Orange Sweet potato; OSP: Orange Sweet potato Puree

INTRODUCTION

There is high prevalence of vitamin A deficiency (VAD) in most lower-middle income countries of the world such as Ghana, especially among children less than five years of age[1] and women of childbearing age [2,3]. Many organizations working to improve the health indices of people have advocated fortification of foods [4], food-based dietary diversification or supplementation [2] among other measures, to alleviate this form of micronutrient deficiency. Due to the high cost of administering vitamin A supplements in the form of capsules, which are not sustainable by some governments, nutrition programs are now considering the use of food-based strategies [3]. It is also estimated that between 250,000 and 500,000 children become blind every year, with 70% of them dying within 12 months [5], and combating vitamin A deficiency of populations in lower-middle income countries is a key component of reducing child mortality and morbidity that would help to achieve the fourth Millennium Development Goal [3,5].

The orange sweet potato (Ipomoea batatas [L.] Lam.) Cultivar is recognized as one of nature’s unsurpassed sources of Beta-carotene, among other health benefits [6], and the content could be as high as 6495 ug/100 g [7]. The Beta-carotene, a pro-vitamin A compound, increased with increasing percentage of sweet potato added to whole wheat flour in bread making [8]; and the amount naturally contained in the orange sweet potato is more than adequate to meet the vitamin A needs of children less than five years [6].

Tuskegee University is one of the leading institutions in the United States promoting the cultivation of the orange

sweet potato [9]. For the past 20 years, Tuskegee University researchers, in collaboration with partners in Ghana, West Africa, have been promoting the orange sweet potato as a "one-stop shop" for obtaining beta-carotene or the vitamin A micronutrient from a locally available crop. To achieve this goal, Tuskegee and Ghanaian researchers have been promoting the production, processing and marketing of the orange sweet potato [10]. In order to avoid the failure rate of crops introduced to farmers without any baseline study on its end use, this study was undertaken. An end-use outlet for enhancing the demand for the farmer’s produce encourages cultivation of the crop [11].

Bread is widely consumed by Ghanaians daily, and is a major staple food taking the highest cash expenditure within the food sub-group [12]. Food fortification is said to be more effective when staples are used as vehicles [4]. Low et al. (2007) reported an increase in vitamin A intake with consumption of orange sweet potato with a concomitant increase in serum retinol concentrations in young children in rural Mozambique. Kidane and Abegaz (2013) processed bread with 30% orange sweet potato flour and reported that it could meet the daily needs of children 3-6 years of age. It was reported that firmness (least softness) of bread increased as levels of sweet potato flour increased from 50-65% substitutions [9], and the best bread by volume was substituted with 50% sweet potato flour. Hence a lower level became necessary to use a 30% orange sweet potato substitution to make Ghana bread that would be soft. Aniedu and Agugo (2010) recommended a composite of potato and wheat flour of 10-30 % for acceptable bread. However, a previous study utilizing orange sweet potato flour to make the Ghana bread found it not to be as moist as the traditional Ghana bread (Data not shown). Hence, the need to process a Ghana bread and evaluate its acceptability when processed with sweet potato puree. This would encourage the promotion of the orange sweet potato cultivars by farmers, as well as provide a food-based fortification program that can help combat the high prevalence of VAD in Ghana, and most lower-middle income countries with such problems.

MATERIALS AND METHODS

Sample area, sample population and study design

A Pilot study carried out in the Greater Accra region of Ghana, designed to test the acceptability of “Ghana Bread” processed with varied additions of sweet potato puree at 10%, 20% and 30% levels, found the bread with the highest percentage (30%) addition of the puree most acceptable. Hence, the bread made with 30% puree was replicated and the acceptability tested among 192 volunteers in three regions of Ghana: Greater Accra, Northern and Volta Regions. Those in the Volta Region had the oldest people, with a mean age of 20.12 years, the population in the Greater Accra Region, constituting 13.5% of the population, was the youngest, with a mean age of 20-42 years. The mean age range for the study population to be 20-42 years. The results of the study are put in Tables 1-3. Table 1 shows the mean age range for the study population to be 20-42 years. The population in the Greater Accra Region, constituting 13.5% of the population, was the youngest, with a mean age of 20.12 years, when compared with those in the Northern and Volta Regions. Those in the Volta Region had the oldest people, with a mean age of 30-40 years [13].

A 7-point Hedonic scale of: 7=like extremely; 6=like very much; 5=like slightly; 4=neither like nor dislike; 3=dislike slightly; 2=dislike very much and 1=dislike extremely, was used to measure the sensory attributes of color, sweetness, texture and overall acceptability of the bread. The like/dislike moderately of a widely used “9-point Hedonic” scale [15] was not included. Hence a positive rating for this study would represent ≥4 instead of ≥5 [15].

Description of materials used for the study

A standard recipe of Ghana bread was used for the study (Figure 1). Typically, Ghanaians eat four kinds of bread: tea bread, buns bread, sugar bread and butter bread. For the purpose of this study, butter bread was chosen due to its overall popularity and universal consumption. The participating bakers were instructed to use their traditional recipes in every aspect, except that a proportion of sweet potato puree was introduced in varied amounts of 10%, 20% or 30% for the pilot study, while maintaining the overall consistency of the traditional Ghana bread. The puree used was a commercially available one (Bruce’s Sweet potato Puree by Bruce Foods Corporation, USA). The bread made with 30% orange sweet potato puree had the highest acceptability rating for the pilot study and hence was produced and used for the sensory evaluation reported in this study.

Statistical analysis

The data were subjected to statistical analysis using SPSS version 16. The descriptive analyses of age, gender and regions were used to stratify the sample population and ANOVA was used to evaluate difference in means. Pearson correlation (r) was used to identify likely population for product acceptability.

RESULTS AND DISCUSSION

The results of the study are put in Tables 1-3. Table 1 shows the mean age range for the study population to be 20-42 years. The population in the Greater Accra Region, constituting 13.5% of the population, was the youngest, with a mean age of 20.12 years, when compared with those in the Northern and Volta Regions. Those in the Volta Region had the oldest people, with a mean age of 30-40 years [13].

![Flowchart for processing “Ghana Bread” made with orange sweet potato puree.](image-url)
Table 1: Frequency Distribution of Population by Region and Mean Age.

<table>
<thead>
<tr>
<th>S/N</th>
<th>Region</th>
<th>N (%)</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Greater Accra</td>
<td>26 (13.54)</td>
<td>20.12</td>
</tr>
<tr>
<td>2</td>
<td>Northern Region</td>
<td>92 (47.92)</td>
<td>35.43</td>
</tr>
<tr>
<td>3</td>
<td>Volta Region</td>
<td>74 (38.54)</td>
<td>42.45</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>192 (100.00)</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Sensory Evaluation of Orange Sweet potato (OSP) Puree Bread (PB) by Regions.

<table>
<thead>
<tr>
<th>Region</th>
<th>N</th>
<th>Color</th>
<th>Sweetness</th>
<th>Texture</th>
<th>Overall Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater Accra</td>
<td>26</td>
<td>4.32</td>
<td>4.12</td>
<td>4.12</td>
<td>6.77</td>
</tr>
<tr>
<td>Northern Region</td>
<td>92</td>
<td>4.41</td>
<td>3.95</td>
<td>3.84</td>
<td>5.77</td>
</tr>
<tr>
<td>Volta Region</td>
<td>74</td>
<td>4.31</td>
<td>4.05</td>
<td>3.82</td>
<td>6.65</td>
</tr>
<tr>
<td>Total</td>
<td>192</td>
<td>4.36</td>
<td>4.01</td>
<td>3.87</td>
<td>6.25</td>
</tr>
</tbody>
</table>

* values are mean values for the sensory attributes

Table 3: Matrix of Significantly Correlated Gender and Age with Sensory Attributes in each Region*.

<table>
<thead>
<tr>
<th>Region</th>
<th>N Gender</th>
<th>Age</th>
<th>Color</th>
<th>Sweetness</th>
<th>Texture</th>
<th>Overall Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater Accra</td>
<td>26</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>t</td>
<td>1</td>
<td>4</td>
<td>-0.435 (p&lt;0.026)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>-0.46</td>
<td>(p&lt;0.018)</td>
<td>1</td>
<td>-0.391 (p&lt;0.048)</td>
</tr>
<tr>
<td>Northern 92</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>-0.260</td>
<td>(p&lt;0.046)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.230 (p&lt;0.029)</td>
</tr>
<tr>
<td>Volta 74</td>
<td>1</td>
<td>1</td>
<td></td>
<td>0.246</td>
<td>(p&lt;0.035)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.244 (p&lt;0.036)</td>
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<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.314 (p&lt;0.006)</td>
</tr>
</tbody>
</table>

* are correlation "r" values. Code: 1=Gender (1M, 2F), 2=Age, 3=Color, 4=Sweetness, 5=texture, 6=Overall Acceptability

of 42.45 years, and made up 38.54% of the study population. The Northern Region made up 47.92% of the population with a mean age of 35.43 years.

Table 2 shows that the population in the Greater Accra Region has the greatest preference, with the highest overall rating (6.77) or 97% likeness for the bread. Those in the Volta or Northern Regions had 6.65 and 5.77 rating or 95% and 82% likeness for the bread, respectively. Those in the Volta and Northern Regions seem to prefer an improvement in the texture than those in the Accra Region as indicated by a similar lower rating (3.82-3.84) of about 55%. The color was rated the highest 4.41 (63%) by those in the Northern Region as opposed to a rating of 4.31 and 4.32, respectively, about 62% by those in the Volta and Greater Accra Regions. The population in the Greater Accra Region rated the product from like very much to like extremely, while those in the Northern Region seemed to like the product slightly. However, the average rating of 6.25 (89%) obtained for the product is high, and could be an indication that the bread made with 30% orange sweet potato puree will be accepted, with ratings between like very much and like extremely. The rating for texture was the lowest (3.87), and is indicative of a need for improvement.

Table 3 shows that in the Greater Accra Region, gender is negatively and significantly correlated with the sensory attribute texture (r=-0.435, P<0.05); and age is negatively and significantly correlated with sweetness and overall acceptability (r=-0.46 and -0.391, respectively, P<0.05). Males rated the product higher for texture than females. Similarly in the Northern Region, the younger people seem to like the product more on the basis of its sweetness and those that gave a lower overall acceptability rating for the product ranked it higher for sweetness.

In the Volta Region, the older the population, the higher the acceptability rating of the product; and the higher the rating, the more likely the higher rating was due to sweetness. Females rated the texture of the product higher than males in this region. In all, texture has a gender bias in the Greater Accra and Volta Regions, and is the sensory attribute with the lowest overall rating.
The high acceptability rating of 6.25 obtained for the “Ghana Bread” made with 30% orange sweet potato puree is suggestive of the acceptability of the product in the country if introduced, and is supportive of the work of Asiedu and Agugo (2010) which found 30% composite flour of sweet potato and wheat acceptable. A 9-point hedonic rating score ≥ 5 (equivalent to ≥ 4 in this study) is indicative of product liking by consumers (Peryam and Pilgrim, 1957). This is especially true of the Greater Accra Region with a younger population. A similar study using orange sweet potato and locally available wheat reported that the bread enriched with 30% orange sweet potato flour can contribute 83.3 and 74.2% of vitamin A to 3 and 4-6 years old children’s daily requirement, respectively (Kidane and Abagaz, 2013) and could be assumed to increase vitamin A status if the Ghana bread processed with orange sweet potato puree is consumed. The acceptance and subsequent consumption of this food could be a food-based approach to increasing vitamin A intake being advocated as a long-term measure for combating vitamin A deficiency disease (UNICEF, 2007).

Texture was rated the least acceptable attribute, and Greene and Bovell-Benjamin (2004), using 50-65% sweet potato substitution for whole wheat in making the bread, found the bread volume at 50% substitution to be the best, but indicated that the higher the percentage sweet potato substitution, the firmer (less soft) the bread, suggesting that the texture of the Ghana Bread might not be improved with a higher amount of puree. Also a previous study (Dansby and Bovell-Benjamin, 2003) found a 75% substitution well-liked and accepted, for making ready-to-eat sweet potato breakfast cereal, and seems to indicate the use of such high sweet potato substitution for making less soft products.

The significant gender influence on the texture of the bread, especially for females, is important due to the fact that females in the age range for childbearing have high prevalence for vitamin A deficiency (UNICEF, 1990; 2007) and their dislike of the bread could mean low consumption. Also, the use of a non-local (from the United States) commercial sweet potato puree in processing the bread could have contributed to the displeasure in texture, requiring the use of locally made sweet potato puree.

CONCLUSION
This study indicates the acceptance of a “Ghana Bread” to which 30% orange sweet potato puree is added. Although there was high acceptability of the product, the fact that texture was rated the lowest in all of the regions, is concern for more studies, especially its gender implication and the use of a commercial orange sweet potato puree. The chemical and cost-benefit analyses of the orange sweet potato puree fortified bread are also needed to ascertain its efficacy in combating VAD in Ghana.

ACKNOWLEDGEMENTS
The authors sincerely extend their heartfelt appreciation to Dr. Conrad Bonsi for his professional thorough review and critique of this manuscript. They thank the George Washington Carver Agricultural Experiment Station, Tuskegee University, Alabama, the Center for Scientific and Industrial Research (CSIR) and, most importantly, the Savannah Agriculture Research Institute (SARI), Ghana for their support. We express our utmost appreciation to Zenabu Yahya and her family of bakers in Tamale for their assistance and creativity. Finally, we commend the sweet potato bread baker in Bawku, Sister Afia, the local house mothers of the SOS Children’s Village, Tamale, and the small business owners and sweet potato farmers in the Volta and Tamale Regions, Ghana, West Africa.

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