

Sensory Evaluation of Diversified Sweet Potato Drinks among Consumers: Implication for Malnutrition Reduction in Nigeria

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Abstract—Diversification of the processing of crops is a very important way of reducing food insecurity, perishability of most perishable crops and generates varieties. Sweet potato has been diversified in various ways by researchers through processing into different forms for consumption. The study considered diversifying the crop into different drinks by combining it with different high nutrient acceptable cereal. There was significant relationship between the educational background of the respondents and level of acceptability of the sweet potato drinks ($\chi^2 = 1.033$ and $P = 0.05$). Interestingly, significant relationship existed between the most preferred sweet potato drink by the respondents and level of acceptability of the sweet potato drinks ($r = 0.394$, $P = 0.031$). The high level of acceptability of the drinks will lead to enhanced production of the crops required for the drinks that would assist in income generation and alleviating food and nutrition insecurity.

Keyword—Diversification, Malnutrition, Sensory Evaluation, Sweet Potato.

I. INTRODUCTION

HUMAN beings need food for growth and proper functioning of the body metabolism to be active in performing their daily activities through consumption of nutritious food. Nutrition is a central component of the Millennium Development Goals. An improvement in nutrition will help meet these goals and more importantly lead to development, enhanced labor force, poverty reduction and economic growth of the country. The diversification of the diet to increase the consumption of more nutrient including Iron, vitamin A and other micronutrients on a daily basis is a practical, long term measure to eliminate and prevent micronutrient deficiencies [1]. Increase in food production, processing and accessibility are important to achieve improvement in nutrition.

The problem of food and nutrition security in Nigeria has not been adequately and critically analyzed despite various approaches at addressing the challenge [2].

Although the critical factors or considerations for food security are that food must be of high quality, safe, nutritious, available all-year-round and easily accessible [3]. The issue of hunger and poverty is prevalent in the country and the increase in population is a threat to food security as the available food is not enough to serve the increasing

population. Child malnutrition, the single most important index for accessing any nation's welfare, is on the increase [4]. There is also increase in infant and maternal mortality which correlate positively. Micronutrient deficiency in Nigeria is mostly suffered by the vulnerable groups. Experts estimate that 2 billion people, mostly in poorer countries, suffer from micronutrient deficiency [5], also known as hidden hunger. This occurs as a result of deficiency in vital micronutrients such as vitamin A, zinc, and iron in the diet, which gets worse as the prices of food increase thereby making people switch from costly nutrient rich food to nutrient poor staple foods. UNICEF said that a deficiency in vitamin A affects over 100 million small children in the world and causes blindness [6]. Hence there's need to produce foods that are rich in micronutrients which will be available throughout the year and in sufficient quantities. Agriculture, if improved upon, can serve as a good way to secure food for people to consume all year round and generate income for people especially the poor. There is a high demand of sweet potato internationally which implies that if there is expansion of sweet potato production in Nigeria, there will be enough to supply to the market both locally and internationally. The exportation of the crop to other countries will serve as a source of foreign exchange. Dietary diversification will help strengthen small scale industries by making them ensure more production of related crops, increased rate of turn-over, food security and provide variety of micronutrient-rich food. It will also produce more markets, create jobs and reduce seasonal fluctuations. Dietary diversification helps to reduce the intake of selected nutrients like fat, refined sugar and salt [7]. It also gives consumers the opportunity to make their own choices of food, especially in utilization of different blends of fruits [8]. Many countries have identified dietary diversification as a major food security and nutrition policy theme or as an indicator for international initiatives such as poverty reduction strategy [9].

Sweet potato (*Ipomoea batatas*) is an important subsistent food security crop that can be diversified into various products. It is a slender, perennial, herbaceous vine which belongs to the *Convolvulaceae* family. It is a short seasonal crop which reliably provides food on marginal and degraded land with little labor and few or no input outside the farm [10]. It is a good nutritional crop which is very easy to cultivate and also has a good taste [11]. Besides simple starches, sweet potatoes are rich in complex carbohydrates, dietary fiber, beta carotene (vitamin A equivalent nutrient),

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vitamin C, and vitamin B6 [12]. Sweet potato is an essential dietary food required by people especially in the rural areas as they may be at risk of vitamin A deficiency. The nutritional value of sweet potato (especially high levels of vitamin A) offers an added benefit to processed products [13], [14]. Sweet potato plays an important role in food security, for example, the dried chips can be stored for consumption during the hungry period when some vital crops are in short supply or not available [15]. Sweet potato blends well with vegetables, spices and flavorings, producing delicious dishes of all types [16]. Growing sweet potato has a great potential for generating employment opportunities and alleviating poverty [17]. The vitamin A content in sweet potato is yet to be appreciated by consumers and farmers [11]. The bulkiness and perishability of sweet potato storage is a major barrier to the wider utilization of the crop [14]. A possible means of approach to this problem is to diversify the use of sweet potato. Sweet potato roots are being utilized for various products but there is need to further diversify the processing of the roots into more products. Some of the products produced from the processing of sweet potato include fermented sweet potato drink by [18] and sweet potato cocktail by [19]. This further diversification of the products of sweet potato in this study is an attempt to complement other people's efforts and improve nutrition by mixing sweet potato with different crops. It is also an attempt to improve food security and income generation in Nigeria.

Zobo drink is being produced and marketed which is embraced by consumers but most people add sugar (which can lead to diabetes) [8]. Therefore, the sugar in sweet potato (which is not bad) will add sweet taste to the combination of sweet potato and zobo leaves. The mixture of millet and sweet potato (kunu) is in existence but some people do not like it because the color is not bright. Therefore the study seeks to add zobo to the drink, making a combination of sweet potato, millet and zobo so as to brighten the color and enrich the drink with more nutrients. The effect of food on our senses is neither simple nor totally understood. The complexity of our senses is affected by a vast number of factors including nature and presentation of the specific food matrix, age, gender, background and sensory sensitivity of the consumer, even the condition under which the test is carried out.

Despite these limitations, the area of sensory evaluation is used to establish the acceptability of the potential new product or the effectiveness of a modification to a new product [20].

Based on the stated problems, the following questions guided this research:

- 1) What are the selected personal characteristics of the respondents?
- 2) Do the respondents consume sweet potato and how often do they consume it?
- 3) Have the respondents previously consumed any drink produced from sweet potato?
- 4) What percentage of sweet potato paste or flour should be added to the mixture of sweet potato and zobo?

- 5) What percentage of sweet potato paste or flour should be added to the mixture of sweet potato, zobo and millet?
- 6) What is the level of acceptability (sensory evaluation) of the sweet potato drinks?
- 7) Which of the sweet potato drinks is the most preferred by the respondents?
- 8) What is the estimated total nutrient of the sweet potato drinks?

The general objective of the study is to determine the level of acceptability through sensory evaluation of diversified sweet potato drinks among consumers in Offa, Kwara State.

A. Hypotheses of the Study

This study investigated the following null hypotheses:

- 1) There is no significant relationship between the selected personal characteristics of the respondents in the study area and level of acceptability of the sweet potato drinks.
- 2) There is no significant relationship between how often the respondents consume sweet potato and level of acceptability of the sweet potato drinks.
- 3) There is no significant relationship between the previous consumption of any drink produced from sweet potato and level of acceptability of the sweet potato drinks.
- 4) There is no significant relationship between the most preferred sweet potato drink by the respondents and level of acceptability of the sweet potato drinks.

II. MATERIAL AND METHOD

A. Study Area

The area of study is Offa Local Government Area in Kwara State. The Local government was created in 1991 and has its headquarters at Offa town. It was founded by Olalomi Oluakin, a prince, the son of Oranmiyan, who was the first son of Oduduwa. It is a traditional settlement of yorubas in the savannah area. It shares boundary with Oyun, Asa and Irepodun Local Government Areas. It is 56km away from the State Capital (Ilorin). It lies along the railroad and at the intersection of roads from Ilorin town, Lafiagi and Ikirun. Offa Local Government Area is one of the smallest Local Government Area in Kwara State in terms of geographical landmass. It is located on longitude $4^{\circ} 54'$ West and Latitude $8^{\circ} 10'$ North. Offa Local Government Area shares a boundary with Ipee to the East, Ikotun and Igbonna to the West, Ijagbo to the North and Erin-Ile to the South. It covers an area of about 14922 square kilometres and has a population of 89,674 [21].

B. Research Design

Research design is the strategy, plan and structure of conducting a research project [22]. The need for research design stems from a sceptical approach to research and a view that scientific knowledge must always be provisional [23]. The essence of research design in this study is to be able to provide answers to research questions unambiguously. The

steps involved in carrying out this study include: i. Experiment, ii. Data collection

C. The Experiment

In the course of the study, experiments were carried out to produce four different sweet potato drinks which took place in the Home Economics Laboratory of the Department of Agricultural Extension and Rural Development in University of Ibadan. The results obtained from the experiments were used to collect data from the respondents. The reasons for the experiments were to obtain the right methods and measurements for preparing the drinks. Four experiments were carried out for each of drinks using different measurements and the best was selected from each of them. The experiments that were carried out include:

1. Experiment 1: (Sweet potato paste and Zobo flour drink)

Measurements of sweet potato paste for the four experiments that were carried out include: 100g, 200g, 400g and 500g. The best mixture that was selected was that of 500g of sweet potato paste. The ingredients used and the procedure for the selected drink includes: 500g of sweet potato root, 25g of ground zobo leaves and half teaspoon of ginger flour.

Procedure:

Five hundred grams (500g) of sweet potato root was measured, washed, peeled, cut into small pieces, washed and ground into paste. Two (2) dessertspoonfuls (25g) of zobo flour were put into a pot with addition of half teaspoon of ginger flour and 1 liter of water was added to it. It was stirred and boiled for about 10 minutes. The sweet potato paste was poured into a bowl and the boiled zobo was poured into it and covered for 20 minutes to cool. It was then sieved, poured into a bottle and put in the refrigerator to cool.

2. Experiment 2: (Sweet potato flour and zobo flour drink)

The measurements of sweet potato flour for the four experiments that were carried out include: 2 spoons, 4 spoons, 6 spoons and 8 spoons (all are dessertspoonfuls). The best mixture that was selected was that of 4 dessertspoonfuls of sweet potato flour. The ingredients used and the procedure for the selected drink includes: **Ingredients:** 75g (4 dessertspoonfuls) of sweet potato flour, 25g (2 dessertspoonfuls) of ground zobo leaves and half teaspoon of ginger flour. Even though dessertspoon was used for the measurement of the quantity, they have different weights. Sweet potato flour was obtained by peeling some sweet potato roots, which were washed, cut into small pieces, sundried for three days and then blended. Zobo flour was obtained by drying the zobo leaves after which they were blended.

Procedure:

Two (2) dessertspoonfuls (25g) of zobo flour were put in a pot and 1 liter of water was poured into it, half teaspoon of ginger flour was added to it and stirred. It was then boiled for about 10 minutes, poured into a bowl with addition of 4 dessertspoonfuls (75g) of sweet potato flour and stirred. The

drink was covered in order to allow the heat to cook the sweet potato and to add taste to it. When the mixture had cooled, it was sieved in order to separate the chaff from the drink. The drink was then poured into a bottle and put in a refrigerator to chill.

3. Experiment 3: (Millet paste, sweet potato paste and zobo flour drink)

Measurements of sweet potato paste for the four experiments that were carried out include: 100g, 200g, 400g and 500g. The best mixture that was selected was that of 500g of sweet potato paste. The ingredients used and the procedure for the selected drink includes: 100g of millet seeds, 500g of sweet potato root, 12.5g of ground zobo leaves and half teaspoon of ginger flour.

Procedure:

Half cup (100g) of millet seeds was soaked in a bowl of water over the night and ground into paste in the morning. Five hundred grams (500g) of sweet potato root was measured, washed, peeled, cut into small pieces, washed and ground into paste. The sweet potato paste was poured into a bowl; half teaspoon of ginger flour was added to it and stirred. The millet paste was poured into a pot and small quantity of very hot water was poured into it while it was stirred. It was then put on the fire with constant stirring for about 2 minutes and poured into the mixture of sweet potato paste and ginger in the bowl. It was covered for some minutes to cool and sieved to remove the chaff, then poured back into the pot with an addition of 1 dessertspoonful of zobo flour. It was stirred for 2 minutes on the fire, covered to cool for some minutes, sieved again, poured into a bottle and put in the refrigerator to cool.

4. Experiment 4: (Millet flour, sweet potato flour and zobo flour drink)

Measurements of sweet potato flour for the four experiments that were carried out include: 2 spoons, 4 spoons, 6 spoons and 8 spoons (all are dessertspoonfuls). The best mixture that was selected was that of 6 dessertspoonfuls of sweet potato flour. The ingredients used and the procedure for the selected drink includes: 50g (2 dessertspoonfuls) of millet flour, 100g (6 dessertspoonfuls) of sweet potato flour, 12.5g (1 dessertspoonful) of ground zobo leaves and half teaspoon of ginger flour.

Procedure:

Six (6) dessertspoonfuls (100g) of sweet potato flour were put into a bowl, half teaspoon of ginger flour was put into it then little water was added and stirred to make it a paste. Two (2) dessertspoonfuls (50g) of millet flour were put into a pot and little water was added and stirred to also make it a paste. Small quantity of very hot water was poured into the millet in the pot while it was stirred. It was then put on the fire and stirred for 2 minutes so as to thicken it. It was now poured into the bowl that contains the mixture of sweet potato and ginger. It was stirred and covered for some minutes for it to

cool and to allow the sweet potato to give it a sweet taste. It was then sieved and poured into the pot again, 1 dessertspoonful (12.5g) of zobo was added to it and was stirred while boiling on the fire for about 2 minutes. It was covered again to cool, sieved again, poured into a bottle and put in a refrigerator to cool. The drinks that were given to the respondents to consume were prepared in the location where the sensory evaluation was carried out in the study area. It was necessary to prepare the drinks in their presence because people will not want to consume anything they don't know how it was prepared especially when the person that prepared it is a stranger. The target population of the study includes all consumers of sweet potato in Offa Local Government Area, Kwara State.

D. Sampling Procedure and Sample Size

This study adopted a multistage sampling technique. Offa Local Government Area was purposively selected for this study because the major crop produced in the area is sweet potato and it is one of the major sweet potato growing areas in Nigeria. It is made up of about seventeen communities which include: Emiola, Osunte, Idi-Ogun, Olalomi, Atari, Owode, Igbo-Ora, Oke-Agun, Popo, Oritamerin, Ejiwumi, Idi-Agbon, Omo-Owo, General, Atan-Oba, Itafa and Ite-erin. All these communities are involved in sweet potato production. Three communities were randomly selected to represent the communities in the Local Government Area. The reason for random sampling in selecting the community was to ensure that the communities were selected in such a way that every community had an equal chance of being selected. Systematic Sampling method was used to select the respondents and this sampling technique helped in compiling the frame during the course of the sampling. Ten (10) consumers were selected from each of the 3 randomly selected communities in the Local Government Area making a total of thirty (30) respondents.

E. Method of data Collection

The primary data was collected with the use of structured questionnaire based on the research questions, objectives and hypotheses developed for the study. The sensory evaluation was carried out with the use of central location method and a 5 point scale was used to test for the acceptance of the sweet potato drinks.

F. Data Analysis

The data collected was analyzed with the use of both descriptive and inferential statistics. Frequency count and percentage distribution were used to analyze the selected personal characteristics of the respondents and other variables.

III. RESULTS AND DISCUSSION

The study revealed that the ages of the majority (60%) of the respondents were between 20 and 39 years which suggest that they are in their active years. The educational background of the respondents revealed that most (76.7%) of the

respondents have attained a higher level of education in tertiary institution and many (60%) of them were students. The study also revealed that all (100%) the respondents consume sweet potato. More than half (60%) of the respondents consume sweet potato yearly and most (80%) of them have never consumed any drink produced from sweet potato while few (20%) of them have previously consumed a drink produced from sweet potato. Also, the finding of the sensory evaluation carried out revealed that for drink 1 (sweet potato paste and zobo flour), more than half (56.7%) of the respondents moderately accepted the color while less than half (43.3%) of them highly accepted it, most (80%) of them moderately accepted the taste while few (20%) of them highly accepted it and majority (90%) accepted the flavor while very few (10%) highly accepted it. For the overall acceptability of drink 1, there was high acceptability of the drink by more than half (53.3%) of the respondents while there was low acceptability of the drink by less than half (46.7%) of them. For drink 2 (sweet potato flour and zobo flour), the color was moderately accepted by more than half (53.3%) of the respondents while it was highly accepted by less than half (46.7%) of them, majority (66.7%) of them moderately accepted the taste while few (33.3%) of them highly accepted it and Most (83.3%) of them moderately accepted the flavor while very few (16.7%) highly accepted it. For the overall acceptability of drink 2, majority (73.3%) of the respondents had high acceptance of the drink while few (26.7%) of them had low acceptance of it. For drink 3 (sweet potato paste, millet paste, and zobo flour), majority (63.3%) of the respondents moderately accepted the color while few (36.7%) highly accepted it, more than half (53.3%) of them moderately accepted the taste while less than half (46.7%) of them highly accepted it and more than half (53.3%) moderately accepted the flavor while less than half (46.7%) highly accepted it. For the overall acceptability of drink 3, majority (73.3%) of the respondents of the respondents had high acceptance of the drink while few (26.7%) had low acceptance of it. For drink 4 (sweet potato flour, millet flour and zobo flour), very few (6.7%) of them did not accept the color, majority (56.7%) moderately accepted it and few (36.7%) highly accepted it. The taste of drink 2 was moderately accepted by more than half (60%) of the respondents and highly accepted by less than half (40%) of them. The flavor of drink 4 was not accepted by very few (6.7%) of the respondents, moderately accepted by most (60%) of them and highly accepted by few (33.3%) of them. For the overall acceptability of drink 4, more than half (53.3%) of the respondents had high acceptability of the drink while less than half (46.7%) had low acceptability of the drink. The respondents were asked to select the drink which they preferred most among the four drinks they tasted and the findings showed that drink 3 (sweet potato paste, millet paste and zobo flour) was the most preferred as majority (60%) of the respondents preferred it, followed by drink 4 (sweet potato flour, millet flour and zobo flour) which was preferred by less than half (33.3%) of them, drink 1 (sweet potato paste and zobo flour) was preferred by few (13.3%) of

them and drink 2 (sweet potato flour and zobo flour) was preferred by few (13.3%) of them.

A. The Estimated Total Nutrient of the Drinks

The content of some selected nutrients (protein, ash, fat, fiber, Vitamin A and Vitamin C) of each of the crops which were used for the drinks. The crops include sweet potato, zobo and millet. The nutrient content of the drinks were calculated by adding the nutrient content of each of the crops required for each drink. There is no significant relationship between the age of the respondents and acceptability of the sweet potato drinks since $P > 0.05$ ($r = 0.038$ and $P = 0.840$). This implies that age does not affect the acceptability of the sweet potato drinks by the respondents. Also there is no significant relationship between the sex of the respondents and level of acceptability of the sweet potato drinks since $P > 0.05$ ($\chi^2 = 0.455$ and $P = 0.500$). This implies that sex does not have any effect on the acceptability of the sweet potato drinks by the respondents. Interestingly, there is no significant relationship between the marital status of the respondents and level of acceptability of the sweet potato drinks since $P > 0.05$ ($\chi^2 = 2.705$ and $P = 0.259$). This implies that marital status does not affect the acceptability of the sweet potato drinks by the respondents. Expectedly, There is no significant relationship between the religion of the respondents and level of acceptability of the sweet potato drinks since $P > 0.05$ ($\chi^2 = 1.023$ and $P = 0.312$). This implies that religion has no effect on the acceptability of the sweet potato drinks by the respondents. Also, there is significant relationship between the educational level of the respondents and level of acceptability of the sweet potato drinks since $P \leq 0.05$ ($\chi^2 = 1.033$ and $P = 0.05$). Therefore the null hypothesis is rejected and the alternative hypothesis is accepted. This implies that education has a role to play in the acceptability of the sweet potato drinks as people with higher education tend to have higher acceptability of the sweet potato drinks. It is also revealed that there is no significant relationship between the occupation of the respondents and level of acceptability of the sweet potato drinks since $P > 0.05$ ($\chi^2 = 1.620$ and $P = 0.899$). The implication is that occupation has nothing to do with the acceptability of the sweet potato drinks by the respondents. There is no significant relationship between the frequency of consumption of sweet potato by the respondents and level of acceptability of sweet potato drinks since $P > 0.05$ ($\chi^2 = 4.884$ and $P = 0.180$). Therefore the null hypothesis is accepted which implies that the frequency of the consumption of sweet potato by the respondents does not have any effect on the acceptability of the sweet potato drinks. The result revealed that there is a significant relationship between the most preferred sweet potato drink by the respondents and level of acceptability of the sweet potato drinks since $P \leq 0.05$ ($r = 0.394$ and $P = 0.031$). This implies that the most preferred drink by the people is likely to be the best of the drinks and will be the most accepted than the other drinks. This is justified by the fact that the most preferred drink was found to be the most accepted from the result of the analysis.

IV. CONCLUSION

All the respondents in the study area consume sweet potato though majority of them do not consume it regularly. The level of acceptability of all the drinks was high and the most acceptable blend was identified which will be used for diffusion. The value that has been added to sweet potato processing will enable farmers utilizes the crop better, generate income and provide employment opportunities. This will help reduce poverty, improve food nutrition and food security in the country.

V. RECOMMENDATIONS

Based on the findings of this study, the following recommendations are being made:

1. The most acceptable drinks can be recommended for people to consume more especially those who do not like sugary things and for reduction in the use of raw sugar in such drinks.
2. Drink 3 (sweet potato paste, millet paste and zobo flour) and 4 (sweet potato flour, millet flour and zobo flour) can be recommended for sale in the market since the colour is brighter than 'kunu' which some people do not consume because of the dull colour.
3. Farmer's should be enlightened on the essence of combining the crops so that they will be encouraged to produce them.

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