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# An Investigation into Orange Fresh Sweet Potato (OFSP) as Base Complementary Food for Infants in Sierra Leone

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**Abstract**
This research work investigated the production of Orange Flesh Sweet Potato Flour (**OFSP).**
The Orange Flesh Sweet Potato was cleaned, dried and grounded into flour. Food tests and phytochemical screening of Flour and sensory evaluation of the Porridge produced for infants in the Baoma Koya Chiefdom was carried out. The Porridge prepared from the flour was tested using fifty (50) Lactating Mothers and their Infants during sensory analysis.
The results indicate that 68.9% of the weight of Flour was obtained from the harvested Orange Flesh Sweet Potatoes. Starch, proteins, glucose and fats/oils were found to be present in the Orange Flesh Sweet Potato Flour thus making the flour suitable for the preparation of food for Infants. The flour of Orange Flesh Sweet Potatoes **(OFSP)** also tested positive sterols, alkaloids, tannins, flavonoids and phenolic compounds, glycosides and saponins during phytochemical screening. The results of the sensory evaluation carried out on the Orange Flesh Sweet Potato porridge indicated higher percentages 45(90%) in favour of the colour, 42 (84.0%) in favour of the taste 25 (50%) extremely dislike the aroma and 40(80%) in favour of the texture of the product. It was recommended that a suitable flavour be added to the product to make it palatable for consumption by infants.

**Keywords:** Flour, Food Tests, Phytochemical Screening, Porridge, Flavour

## 1.0.0. Introduction
This research work was geared towards the development Orange Flesh Sweet Potato **(OFSP)** Flour as Base Complementary Food for Infants in Sierra Leone. In low-income countries like Sierra Leone, most infants are given cereal-based complementary foods (rice, maize and cassava products) prepared at the household level with no consideration of nutrient values. These foods are very high in starch content which are crucial to the development of infants and usually associated with the high prevalence of vitamin A deficiency. It has been reported that Orange Flesh Sweet Potato (OFSP) contained beta-carotene and contributes to the vitamin A requirements of infants [Francis and Jane (2014)]. Plant-based complementary foods remain the key source of nutrients in addition to breast milk for infants in lower income countries and prevents Vitamin A deficiency (VAD) prevalence [Francis et al., (2012)]. It has been reported that Vitamin A deficiency causes major health problems worldwide that leads to blindness, retarded growth, death. largely affects pre-school children, pregnant and lactating mothers in Africa [Fekadu et al., **(2014)].** Governments efforts including vitamin A supplementation, food fortification and dietary diversification, used to combat these problems are not sustainable due to their high costs.

## 2.0.0. Methodology
### 2.1.0. Study Area
This research work was carried out at Koya Chiefdom Kenema District. It shares boundaries with five chiefdoms of Kenema District namely (Nongowa Chiefdom, Dama Chiefdom, Tunkia Chiefdom, Langurama Chiefdom, Niawa Chiefdom and Small Bo Chiefdom) and two chiefdoms in the Pujehun District (Barrie Chiefdom and Makpeleh Chiefdom). The chiefdom is blessed with natural vegetation and also form part of Tiwa Island and the Gola

Rain Forest in the Kenema District.

The target community is primarily occupied by the Koa Mende people of Sierra Leone of which 90% are practicing Muslims, with a well-structured local administration for the smooth running of the chiefdom with Boama town as the chiefdom headquarter Town. Despite the other opportunities available, the sources of income of the inhabitant's ranges from farming, Gold and Diamond mining, Timber Logging, Hunting and Fishing, and whiles good number of the youth population are commercial motor bike riders.

According to the Kenema District Quarterly Nutrition Report 2022 by the District Health Management Team, the Koya chiefdom recorded high cases of malnutrition and very good percentage of people hardly afford a balance diet due to the hike in inflation and poverty.

**2.2.0. Preparation of Orange Flesh Sweet Potato (OFSP) Plant Materials**

A bag of Orange Flesh Sweet Potatoes (110 Kg) was bought from the Eastern Technical University Agricultural Farm, washed thoroughly and pealed. The tuber was grated using a grating Machine, dried under the shade and not the sun so as to protect the thermo-labile components if present from being chemically transformed. After the plant material had been dried, they were grounded using a Milling Machine to obtain the Flour.

The flour produced was stored in a plastic bag and used for the following;

- Food Tests
- Phytochemical Screening
- Production of porridge
- sensory evaluation of the product

**2.2.1. Food Tests**

This involved testing the flour produced for Glucose, starch, Proteins and Fats and Oils

**2.2.2. Test for Glucose**

**Benedict's test**: - 5mg of the OFSP Flour was put into a test tube and 20ml of water added. The mixture was boiled for two minutes and 1ml of Benedict's reagent added to the test tube. The whole mixture was boiled for 5-10 minutes on a water bath. A change in colour of the solution from blue, to green and to yellow or brick-red precipitate depending on the amount of test sample present indicates the presence of Glucose

**2.2.3 Test for Starch**

Iodine Test: 5mg of the OFSP Flour was put into a test tube and 20ml of water added. The mixture was boiled for two minutes and 2-3 drops of iodine solution were added. The formation of blue-black colour indicates the presence of starch.

**2.2.4. Test for Protein (Biuret Test)**

5mg of the OFSP flour was placed in a petri dish and few drops of 2M Sodium Hydroxide added and stirred. 2-3 drops of 1% Copper Sulphate solution added to the mixture and stirred again. The formation of violet colour after few minutes indicate the presence of proteins.

**2.2.5. Test for fats and Oils**

5mg of OFSP flour was put into a beaker and 20 ml of water added and stirred. 5 ml of Sudan III Solution was added to the mixture and boiled for few minutes and filtered when hot. The formation of red specks of residue on the filter paper indicate the presence of Fats and Oils.

The results of each of the above tests are reported in table 1 of chapter four.

**2.3.0. Phytochemical Screening**

Phytochemical screening involved testing of OFSP flour for different classes of secondary plant metabolites. The methods used for detection of the various phytochemicals include qualitative chemical tests to give general idea regarding the nature of constituents present in the different solvent extracts of the OFSP flour. (Khandelwal, 1995; Trease et el. 1978, 1989; Sazada et el. 2009; Kokate et el. 2006, 2011; Nayak, 2007).

**2.4.0. Test For Saponin Glycosides**

**Froth test:** - The OFSP flour was treated with ethanol in a small tube and shaken well. The appearance of a persistent froth on top of the mixture indicates the presence of glycosides.

**2.4.1. Tests for Sterols and Triterpenoids**

**Libermann-Burchard Test:** The OFSP flour was treated with few drops of acetic anhydride and then boiled for few minutes. The mixture was cooled and concentrated tetraoxosulphate (VI) acid added down the side of the test tube. The appearance of a brown ring at the junction of the two layers with the upper layer turning green is indicative of the presence of sterols and formation of a deep-red colour indicates the presence of triterpenoids.

**2.4.2. Tests for Tannins and Phenolic Compounds**

**Ferric chloride test:** - a small amount of the OFSP flour was shaken with water and warmed, followed by addition of 2 ml of 5% ferric chloride solution. The formation of green or blue colour indicates the presence of phenols.

**Iodine test:** - the OFSP flour was treated with dilute iodine solution. The appearance of a transient red colour indicates the presence of tannins and phenolic compounds.

**2.4.3. Test for Alkaloids**

About 0.5 mg of the OFSP flour was stirred with about 5 ml of dilute hydrochloric acid in separate beakers and filtered. The following tests were conducted on the filtrate:

Dragendroff's test: - few drops of Dragendroff's reagent (solution of potassium bismuth oxonitrate iodide) were added to the filtrate and observed. The formation of orange-yellow precipitate indicates the presence of alkaloids.

Wagner's test: -few drops of Wagner's reagent (solution of iodine in potassium iodide) was added to the filtrate and observed. The formation of reddish-brown precipitate indicates the presence of alkaloids.

**2.4.4. Tests for Flavonoids**

Shinoda's test (Magnesium Hydrochloride reduction test): - 5ml 95% ethanol were added to OFSP flour. The mixtures were then treated with 0.5g magnesium turnings and few drops of conc. HCl. The formation of pink colour indicates the presence of flavonoids.

Alkaline reagent test: -Lead acetate solution was added to a small quantity of OFSP flour and observed. The appearance of a yellow-coloured precipitate after few minutes indicates the presence of flavonoids. The results of each of the above tests are reported in Table 2.0.0.

**3.0.0. Population / Sample Size**

Due to the limited resources available for the implementation of the research work, 50 lactating mothers with their infants were selected through balloting for this research work.

**3.1.0. Sensory Analysis**

The **OFSP** flour was prepared as food and served to **50** lactating mothers and their children who that were selected

from the Baoma Koya Community in Sierra Leone for sensory evaluation in terms of the flavour, taste/mouth feel, colour and general acceptability, using a set of prepared evaluation sheet based on a five (5) point hedonic ranking scale.

The five (5)- point hedonic scale is listed below:

1= like extremely
2= like very much
3= like moderately
4= neither like nor dislike
5= dislike extremely

The Lactating mothers identified their acceptance of characteristics (colour, taste, aroma, and texture) using a score sheet. The acceptability test results were used to obtain the best formulations using the Effectiveness Index Method. The responses to the five (5)- point hedonic scales were grouped as shown below;

- Like extremely/very much/moderately (**LVK**)
- Neither like nor dislike (**NLD**)
- Dislike extremely (**DE**)

The meal was also served the 50 lactating mothers and their infants at the Baoma Koya Community Health Centre.

The results of the sensory evaluation are presented using the simple tables (Respondents and percentages).

## 4.0.0. Results and Discussions

### 4.1.0. Results

The overall aim of the study was to develop and process orange flesh sweet potato flour/powder for household consumption, which can be used as recipe for young infants in Sierra Leone. The activities carried out are as follows;

- Production of dry powdered Orange Flesh Sweet Potato powder
- Food Tests on the dry powdered Orange Flesh Sweet Potato powder
- Phytochemical screening on the dry powdered Orange Flesh Sweet Potato powder
- Preparation of porridge food from the dry powdered Orange Flesh Sweet Potato powder for infants and sensory evaluation of the product

The results of each of the above activities are presented in the following tables below:

### 4.2.0. The percentage of flour obtained from dry Orange Flesh Sweet Potato

**Mass of Orange Flesh Sweet Potato** = 110Kg

**Mass of Flour Obtained** = 75 8Kg

**Mass of the peel & unwanted Materials** = 34.2Kg

$$\text{Percentage of flour obtained} = \frac{75\text{kg}}{110\text{Kg}} \times 100 = 68.9\%$$

Hence 68.9% of the weight of Flour was obtained from the harvested Orange Flesh Sweet Potatoes.

### 4.3.0. Food Tests carried out on the Flour obtained from Orange Flesh Sweet Potato

The results of the Food tests carried out on the Flour obtained from Orange Flesh Sweet are reported in Table 1 below;

**Table 1:** Showing the Results of the Food Tests carried out on the Orange Flesh Sweet Potato Flour.

| REAGENT | Orange Flesh Sweet Potato Flour | |
|---|---|---|
| | **Observation** | **Inference** |
| Iodine Test | Blue-black colour | ++ |
| Biuret test | Violet colour | +++ |
| Benedict's Test | Brick red precipitate | +++ |
| Sudan III test | Few traces of red stains on the filter paper | + |

+ = slightly positive, +++ intensely positive, - = Negative

The above table indicates that starch, proteins, glucose and fats/oils are present in the Orange Flesh Sweet Potato Flour. This makes it suitable for the use of the Potato Flour in the preparation of food for Infants.

**Figure 1: Carrying out Food Tests**

### 4.4.0. Phytochemical screening carried out on the Orange Flesh Sweet Potato Flour

The results of phytochemical screening carried out on the Orange Flesh Sweet Potato Flour are reported in table 2 below;

**Table 2:** Showing the Results of phytochemical screening carried out on the Orange Flesh Sweet Potato Flour.

| REAGENT | Property tested | Orange Flesh Sweet Potato Flour | |
|---|---|---|---|
| | | Observation | Inference |
| **Froth Test** | Glycosides and Saponins | Persistent froth | +++ |
| **Libermann-Burchard Test** | Sterols/ Triterpenes | Upper layer turned green | +++ |
| **Ferric Chloride Test** | Tannins and Phenolic | Formation of blue colour | +++ |
| **Iodine test** | Tannins and Phenolic | Transient red colour | +++ |
| **Dragendroff's test** | Alkaloids | Orange-yellow precipitate | +++ |
| **Wagner's Test** | Alkaloids | Reddish-brown precipitate | +++ |
| **Shinoda's test** | Flavonoids | Pink colour | ++ |
| **Alkaline reagent test**. | Flavonoids | Yellow-coloured precipitate | +++ |

**Key:** + = slightly positive, +++ intensely positive, - = Negative

The flour of Orange Flesh sweet potatoes (OFSP) tested positive sterols, Alkaloids, tannins, flavonoids and phenolic compounds, glycosides and saponins as shown in Table 2

**4.5.0. Preparation of Porridge from the Flour of Orange Flesh Sweet Potato for infants and sensory evaluation of the product**

The Porridge prepared from flour of Orange Flesh Sweet Potatoes was served to 50 lactating mothers and their children for sensory evaluation in terms of the flavour, taste/mouth feel, colour and general acceptability using a set of prepared evaluation sheet based on a nine (9) point hedonic ranking scale which was grouped into three are reported below;

**Table 3:** Showing Respondent's Sensory Evaluation of the Colour of Sample Products.

| Sensory Evaluation Attribute | Porridge from the Flour the Orange Flesh Sweet Potato Flour | |
|---|---|---|
| | Respondents | Percentage |
| Like extremely/very much/moderately | 45 | 90.0 |
| Neither like nor dislike | 3 | 6.0 |
| Dislike Extremely | 2 | 4.0 |
| **TOTAL** | **50** | **100.0** |

From **Table 3**, the sensory evaluation carried out on the porridge indicated higher percentages 45(90%) in favour of the colour of the product

**Figure 2: Feeding Infants with the Product**

**Table 4:** Respondent's Sensory Evaluation of the Taste of Sample Products.

| Sensory Evaluation Attribute | Porridge from the Flour the Orange Flesh Sweet Potato Flour | |
|---|---|---|
| | Respondents | Percentage |
| Like extremely/very much/moderately | 42 | 84.0 |
| Neither like nor dislike | 6 | 12.0 |
| Dislike Extremely | 2 | 4.0 |
| **TOTAL** | **50** | **100.0** |

From **Table 4,** the sensory evaluation made on the taste of the product indicated higher percentages 42 (84.0%) in favour of the taste.

**Table 5:** Respondent's Sensory Evaluation of the Aroma of Sample.

| Sensory Evaluation Attribute | Porridge from the Flour the Orange Flesh Sweet Potato Flour | |
|---|---|---|
| | Respondents | Percentage |
| Like extremely/very much/moderately | 5 | 10.0 |
| Neither like nor dislike | 20 | 40.0 |
| Dislike Extremely | 25 | 50.0 |
| **TOTAL** | **50** | **100.0** |

From **Table 5**, the sensory evaluation made on the aroma, indicated higher percentages 25 (50%) that extremely dislike the aroma and suggested the addition of flavour to the product.

**Table 6:** Respondent's Sensory Evaluation of the Texture of Sample Products.

| Sensory Evaluation Attribute | Porridge from the Flour the Orange Flesh Sweet Potato Flour | |
|---|---|---|
| | No of Respondents | Percentage |
| Like extremely/very much/moderately | 40 | 80.0 |
| Neither like nor dislike | 8 | 16.0 |
| Dislike Extremely | 2 | 4.0 |
| **TOTAL** | **50** | **100.0** |

From **Table 6,** the sensory evaluation made on the texture of product indicated higher percentages 40(80%) in favour of the texture.

### 4.6.0. Discussions

The results of the research work, indicated that 68.9% of the weight of Flour was obtained from the harvested Orange Flesh Sweet Potatoes.

Starch, proteins, glucose and fats/oils were found to be present in the Orange Flesh Sweet Potato Flour thus making the flour suitable for the preparation of food for Infants.

The flour of Orange Flesh sweet potatoes (OFSP) also tested positive sterols, alkaloids, tannins, flavonoids and phenolic compounds, glycosides and saponins during phytochemical screening.

The results of the sensory evaluation carried out on the porridge indicated higher percentages 45(90%) in favour of the colour, 42 (84.0%) in favour of the taste 25 (50%) extremely dislike the aroma and 40(80%) in favour of the texture of the product.

## 5.0.0. Summary. Conclusions and Recommendations

### 5.1.0. Summary

This research work investigated production of Orange Flesh Sweet Potato Flour (**OFSP)** flour, Food tests, phytochemical screening of Flour and sensory evaluation of the Porridge produced for infants in the Baoma Koya Chiefdom.

The results indicated that 68.9% of the weight of dried harvested Orange Flesh Sweet Potatoes was obtained as Flour.

Starch, proteins, glucose and fats/oils were found to be present in the Orange Flesh Sweet Potato Flour thus making the flour suitable for the preparation of food for Infants. The flour also tested positive sterols, alkaloids, tannins, flavonoids and phenolic compounds, glycosides and saponins during phytochemical screening.

The results of the sensory evaluation carried out on the porridge indicated higher percentages 45(90%) in favour of the colour, 42 (84.0%) in favour of the taste 25 (50%) extremely dislike the aroma and 40(80%) in favour of the texture of the product.

### 5.2.0. Conclusion

Orange Flesh Sweet Potato has been converted into flour and for use as food for infants in Sierra Leone. The product tested positive for the major classes of food and phytochemicals thus making the flour suitable for the preparation as food for Infants.

### 5.3.0. Recommendations

It is recommended that a suitable flavour be added to the product to make it palatable for consumption by infants.

The flour produced should be sent for mineral analysis before it can be used for large scale production and Marketing.

It has been reported from literature search that the Orange Flesh sweet potatoes contain vitamin A (Francis et al., 2014), therefore the Government of Sierra Leone and Non-Governmental Organizations should support the cultivation of Orange Flesh sweet potatoes which can serve as a source of Vitamin A supplements for infants in Sierra Leone.

### 5.4.0. Sources of Funding

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### 5.5.0. Conflict of Interest

The authors have declared that no competing interests exist.

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