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Assessment of Nutrient Content and Acceptability of Soups Made from Tender Cassava Leaves

Johnson, W.O., Tijani, S., Oyewole, M.F., Abdulkadir, S.O. and Adewumi, M.A.

Abstract

Cassava is a major staple food for many people in developing countries which lots of products can be derived from. Nigeria is one of the largest producers of cassava in the world, the plant produces all year round and can be harvested over an extended period. Cassava leaves are rich source of proteins, minerals, and vitamins but unfortunately most people are not aware that its leaves can be used as soups of different varieties to serve as a compliment. Thus, the study assessed the nutrient content and acceptability of soups made from tender cassava leaves. Experimental research design was adopted for the study, three (3) research questions on the nutrient content, varieties of soups made with cassava leaves, the sensory attributes and acceptability of the soups were raised, proximate analysis was carried out on fresh tender cassava leaves, twenty (20) panelists were randomly selected for the sensory evaluation of the soups and were presented with six (6) coded samples which are CLS1-cassava leaf soup (Eforiro), CLS2-cassava leaf soup with melon, CLS3-cassava leaf soup with okra, PLS1- pumpkin leaf soup (Eforiro), PLS2-pumpkin leaf soup with melon, PLS3-pumpkin leaf soup with okra. The research questions were analyzed using descriptive and inferential statistics. The findings revealed that the fresh cassava leaves contained a higher moisture (62.31 ± 0.014) and protein (22.57 ± 0.01) content than ash (3.26 ± 0.007), fibre (2.09 ± 0.014) and carbohydrate (6.57 ± 0.057) content. Also, the sensory evaluation revealed that all the varieties of soup made from tender cassava leaves (CLS1-cassava leaf soup (Eforiro); CLS2-cassava leaf soup with melon; CLS3-cassava leaf soup with okra) were generally accepted in terms of color, mouth feel, taste and aroma whereas CLS2 was the most preferred and accepted. Furthermore, all the tested samples and their control (PLS1-pumpkin leaf soup (Eforiro); PLS2-pumpkin leaf soup with melon; PLS3-pumpkin leaf soup with okra) had a significant difference in the meals prepared from pumpkin and cassava leaves. The study concluded that cassava leaves have excellent nutritional benefits as processing and preparation methods can eliminate the toxins (cyanide) that scare individuals from its' use. Cassava leaves can contribute to the indigenous and world's food supply chain. It was therefore recommended that tender cassava leaves should be harvested and sold on the market like other green leafy vegetables and meals made from tender cassava leaves should be formally introduced and included to the menu in homes, hotels, and restaurants.

Keywords: Assessment, Cassava leaves, Soups, Nutrient content, and Acceptability.

Introduction

Cassava is a staple food for many people in developing countries (Julie, Christopher and Sherry 2009) and it is mainly grown for its roots whereas the leaves is considered mostly as by product. It can be classified as sweet (*Manihot palmata*) and bitter, (*Manihot utilissima*) in which the varieties are

generally distinguished from each other by their morphological characteristics which include leaf, stem, and tuber color, leaf shape and number of storage roots per plant (Kenneth, 2013). The plant produces all year round and can be harvested over an extended period. Although it is easily propagated by

stem cuttings, the lack of quality planting material is a major constraint to the development of a viable cassava production system. Eze and Ugwuoke (2010) reported that tuber yield of cassava is influenced by both the quality of planting material used and the agronomic practices employed. Access to high yielding cassava varieties and an improvement of the production system will result in increased economic benefits to local farmers. Like other roots and tubers, both bitter and sweet varieties of cassava contain toxin, with the bitter varieties containing larger amounts. It is one of the most drought tolerant crops that can be successfully grown on marginal soil and gives a reasonable yield where many other crops do not grow well. Cassava is a highly productive crop in terms of food calories produced over per unit land area and per unit of time, significantly higher than other staple crop (Food and Agriculture Organization; FAO, 2013). Cassava is the third-largest source of carbohydrates in the tropics, after rice and maize and it is a major staple food in the developing world, providing a basic diet for over half a billion people (FAO, 2015). It contains an extremely high proportion of starch, compared to most staples however, cassava tubers accordingly are a poor dietary source of protein and most other essential nutrients. Though an important staple, its main value is as a component of a balanced diet.

Globally, Nigeria is the world's largest producer of cassava while Thailand is the largest exporter of dried cassava (Ikuemonisan, Mafimisebi, Ajibefun and Adenegan, 2020). Nigeria currently produces about 59.5 million metric tons (MT) per annum, making Nigeria the highest cassava producer in the world, producing a third more than Brazil and almost double the production capacity of Thailand and Indonesia, however, Nigeria is not an active participant in cassava trade in the international markets because most of the cassava is targeted at the domestic food market. The production methods are primarily subsistence in nature and therefore unable to support industrial level demands (Food and Agriculture Organization, 2018).

Cassava leaves are important in some countries, for instance; in Democratic Republic of Congo, cassava leaves have greater market value than roots. For consumption, each must be prepared and cooked as appropriate. Suitably cooked and otherwise prepared the nutritional and anti-nutritional contents of each of these staples are widely different from that of raw forms and depends on the methods of preparation such as soaking, fermentation, sprouting, boiling, or baking (Adeyaba, 2014). Cassava, either sweet or bitter contains cyanide that can be toxic to human health if not properly prepared before consumption.

Cassava leaf contributes substantially to nutrient source and supply people's daily diets (Omara-Achong, Edwin-Wosu, Edu and Nkang, 2012). It is a rich source of protein, minerals, and vitamins, also the leaves contain different types of proteins comparable to soybeans: lysine, isoleucine, leucine, valine and lots of arginine, which is not common in other green leafy vegetables, but its cyanide content may limit its human consumption; this can however be addressed during processing. Pounding, soaking, and subsequently washing has been reported to be an effective method of processing cassava to ensure drastic reduction in the cyanogen while preserving essential nutrients (Ojiambo, Nawiri and Masika, 2017). Detoxified cassava leaves could serve as a safe source of nutrient depending on the cassava processing method (Latif, Zimmerman, Barati and Muller, 2019). About 100 grams of cooked cassava leaves provides about 3.7 grams of protein which is good for a green leafy vegetable.

Problem Statement

It was observed that most people are not aware that tender cassava leaves can be used as soup of different varieties to serve as an accomplishment in Nigeria dishes. Furthermore, the limited numbers of people that are aware tend to shy away from its consumption because cassava plant as whole is believed to contain toxic compound called cyanide which may be dangerous to health if not properly processed. Meanwhile

cyanide level in the leaf is low compared to its tuber and it can be drastically reduced by cooking. The essence of this study is to create more awareness of the underutilized crops made from cassava leaves and increase people's interest by exposing them to the nutritional value of the leaves and benefits derivable.

Objectives of the Study

The broad objective of the study is to assess the nutritional value of a selected underutilized soup made from tender cassava leaves.

The specific objectives are to;

1. determine the nutrient content of cassava leaves.
2. assess different varieties of soup using cassava leaves
3. determine the sensory qualities and acceptability of soups made from cassava leaves

MATERIALS AND METHOD

Materials

Fresh and succulent parts of cassava leaves were gotten directly from the farm and other ingredients like melon seed, okra, fish, meat, palm oil, pepper, salt, crayfish, stock cube and onions were purchased from the local market in Ipata, Ilorin South Local Government Area.

Preparation

The major preparation process for cassava leaves includes selection, removal from stalk, washing, pounding, boiling while for pumpkin leaves, selection, removal from stalk, washing, slicing then addition of other ingredients before final cooking.

Cassava/Pumpkin leaves soup CLS1/PLS1 (Eforiro)

Put the pounded cassava leaves in the pot with one litre of water and boil for about fifteen (15) minutes from the point it starts to boil with low heat then drain.

In large saucepan, season meat with stock cube, onions, salt, and boil until tender, to get at least 1-2 cups of stock. Remove the meat and stock to reserve.

Heat oil (palm oil) in large saucepan over medium heat, add onions and crayfish, sauté until it produces flavour for about 1-2 minutes then add pepper and simmer for two minutes.

Add the stock, meat and or fish, locust bean(optional) and cook for five(5) minutes.

Pour in the drained cassava leaves and cook for about ten minutes.

Adjust the taste with seasonings and the consistency with water or oil, cook for three minutes

Cassava/Pumpkin leaves soup with melon CLS2/PLS2

Put grounded melon into a bowl, add water proportionate to the melon, mix to form a paste then set aside

Wash, pound, and boil cassava leaves while wash and slice pumpkin leaves, drain in a colander and set aside.

Place a big pan on medium heat, add palm oil and heat for about 3 minutes (do not bleach), add reserved chopped onions allow to sauté

Add pepper mix, locust beans (optional) and stir to combine, bring to boil for 5 minutes

Add melon paste in bits in reduce heat, do not stir, cover the pot with a lid, cook for another 10 minutes

Remove the lid, and gently stir soup, melon would be lumpy, break lumps into desired size/ texture

Add cooked beef, crayfish, beef stock and stir to combine, add bouillon cubes to taste and adjust accordingly, cook for another 10 minutes

Add drained cassava leaves/pumpkin leaves, stir to mix, and cook for another 3-5minutes, take off the heat.

Cassava/Pumpkin leaves soup with okra CLS3/PLS3

Put beef in a pot and add enough water to cover the beef then bring to boil

Add salt, crayfish, chopped onions then cook the beef till tender

Pour in palm oil and cook for another 5 minutes, taste for seasoning and adjust accordingly

Add grounded red bell pepper and onions, turn heat down and allow to

simmer for another 2 minutes, stir soup well

Add well chopped okra, stir again, allow to cook for 2 minutes then add the drained cassava leaves/sliced pumpkin leaves, stir in the vegetable, and allow to cook for 1-2 minutes and turn off the heat immediately.

Serve all varieties of soup with any preferred 'swallow'. It is necessary to note that Cassava leaves do not have much flavor and absorb any flavoring that you add. So, adding spices, meats, and other vegetables enhance the flavor (Haider 2014).

Proximate Analysis

The analysis was carried out on the tender cassava leaves in the University of Ilorin chemistry laboratory using the Association of Official Analytical Chemists (A.O.A.C) 2010 method.

Determination of Moisture Content

A clean crucible was first dried in an oven for about 30 minutes, and then cooled in the desiccator. The cooled desiccator was weighed as W_1 , 2g of each sample was then introduced into the crucible and weighed as W_2 before drying. This was put in an oven set at 102-105°C for an interval of two hours and cooled in a desiccator and weighed as W_3 , this was done until constant weight was obtained, (A.O.A.C) 2010 method.

Determination of Ash Content

A clean crucible was first dried in an oven for about 30 minutes, then cooled in the desiccator. The cooled was weighed as W_1 ; 2g of each sample was then introduced into the crucible and weighed as W_2 . The crucible and its content were then transferred into the muffle furnace set at about 500 – 600°C for about four hours, the grey color observed showed that it was fully ashed. The crucible and its content were removed from the furnace and placed inside desiccator to cool, after cooling it was then weighed as W_3 (A.O.A.C) 2010 method.

Determination of Lipids Content

Lipid contents were determined using Soxhlet extractor and were done continuously using suitable solvent such as petroleum spirit (40-60°C). Two grams of each

sample was weighed into a filter paper. It was then tied up properly using a tailor thread. This was weighed again. Then tied up in a filter paper column of the Soxhlet extractor for extraction. Petroleum ether was introduced into the round bottom flask below the extraction column until it was half filled. Then more was added to it to make it up to about 300cm³. The Soxhlet extractor was then connected to a water tap source which ran around to cool the extractor. It was then immersed into a heating mantle to heat up the petroleum ether in the round bottom flask below the extractor. The petroleum ether boiled between 40 to 60°C at which it evaporated into the extracting column where the sample was, it was allowed to siphon. This was allowed to continue for about six (6) hours. It was to ensure complete extraction of the fat from the sample. After 6 hours of extraction, the set up was disconnected and the defatted sample (sample in the extracting column) was then removed and transferred into the oven and dried to a constant weight (A.O.A.C) 2010 method.

Determination of Crude Protein Content

The Micro Kjeldahl method principle was used for this analysis. This method does not include nitrogen from nitrites and nitrates, but includes nitrogen from protein, alkaloids, and nucleic acids. The organic matter was oxidized by concentrated sulphuric acids (H_2SO_4) in the presence of catalyst and the nitrogen converted to ammonium sulphate. This was then made alkaline and liberated ammonia was distilled and estimated. As a very large part of the nitrogen present in foods are derived from proteins. The crude protein was estimated by multiplying the percentage of nitrogen by an appropriate factor. This determination is because most nitrogen-containing food materials are protein, and protein on the average is approximately 16% nitrogen. Individual protein ranges from about 15 to 18% nitrogen.

2grams of sample was carefully weighed into the digestion flask containing 2grams of $CuSO_4$, 7H₂O, 10grams of $NaSO_4$ were all

added into the digesting flask containing 2grams the sample. 25cm³ of concentrated sulphuric acid was added to the mixture in the digesting flask. The flask and its contents were clamped in an inclined position and then heated gently for 15 minutes and then vigorously for further 45 minutes to digest in a fume cupboard after the mixture was clear or oxidation was complete, and a green color was obtained (color changed from black to brilliant green) and this indicated a complete digestion. The digestion flask was removed from the burner and allowed to cool. The resulting digest was then transferred into 250mls volumetric flask and diluted with distilled water and made up to the graduation mark. This method depends on the fact that when organic compound containing nitrogen is heated at 80! with concentrated sulphuric acid in the presence of a catalyst, the organic nitrogen is converted to ammonium sulphate (NH₄)₂SO₄(A.O.A.C) 2010 method.

Crude Fiber Content Determination

The crude fiber is the bulk of roughages in foods. Crude fiber determination is done at 100%. A known weight of the sample (2grams) was taken and defatted with petroleum ether for two hours, it was then boiled under reflux for exactly 30 minutes with 200cm³ of 1.25% H₂SO₄, and it was filtered and washed with distilled water until the washings were no longer acidic. The residue was boiled in a round bottom flask with 200cm³ of 1.25% NaOH for another 30 minutes.It was filtered into a previously weighed crucible and the crucible with the sample (residue) was dried in the oven at 105!. It was left in a desiccator to cool and then weighed. It was then incinerated in a muffle furnace at about 500-550! for about three hours, left to cool in s desiccator and weighed(A.O.A.C) 2010 method.

Determination of Carbohydrate Content

The total carbohydrate content of each sample was derived by difference(A.O.A.C) 2010 method.

Sensory Evaluation

The sensory evaluation of the sample was carried out by consumer's acceptance and preference using 20 panelists. A 9-point hedonic scale with 1 representing the least score (dislike extremely) and 9 the highest score (like extremely). The qualities assessed include Color, Taste, Mouthfeel, Aroma, and general acceptability. Coded samples of the same size at room temperature will be served on a white colored plate to judges in each panel.

Data Analysis

The data collected through scorecard was analyzed using descriptive statistical tools such as mean(x) and standard deviation (SD) and inferential statistics which was based on the responses gotten from the panelists. Analysis of variance (ANOVA) was used on the data gathered to determine the significant differences among the mean.

Results

Table 1 reveals the mean and standard deviation for the proximate analysis of cassava leaves, moisture content has the score of 62.31±0.014 which indicates that the moisture content is within the general moisture content range (60-90%). The ash content refers to the essential minerals found in the leaves which was between 3.25-3.26% with the score of 3.26±0.007. The fat content was 3.21±0.007 while crude protein from shows 22.57±0.01 which means that cassava leaves have high protein content. Crude fiber content shows 2.09±0.014 which ascertained that fiber content is low, this might be due the tenderness of the leaves, carbohydrate content has a score of 6.57±0.057, this is as a result high moisture content of the leaves.

Table 1: Proximate Analysis of cassava leaves

Sample	Moisture (%)	Ash (%)	Lipids (%)	Crudeprotein (%)	Fiber (%)	Carbohydrate (%)
A	62.31±0.014	3.26±0.007	3.21±0.007	22.57±0.014	2.09±0.014	6.57±0.057

Table 2 reveals sensory attributes and acceptability of cassava leaves with the control group soup made from pumpkin leaves. For Color, result shows that samples were not significantly ($p < 0.05$) different from one another except PLS1 (Pumpkin leaf soup-Eforiro) that was significantly different with the mean score ranging from 7.05-8.10 where PLS1 is more preferred than the other samples in the group. For Mouthfeel, result reveals that samples were not significantly different from each other with CLS2 (cassava leaf with melon soup) been the most preferred and mean score ranging from 7.25-7.70. For Taste, result also shows that the samples are not significantly different from one another with CLS2 (cassava leaf with

melon soup) with mean score ranging 7.10-8.05 and the most preferred in terms of taste. For Aroma, result shows that samples were not significantly ($p < 0.05$) different from one another except PLS2 (Pumpkin leaf with melon soup) that was significantly different with the mean score ranging from 7.10-7.90 where CLS2 is more preferred than the other samples in the group. For Overall Acceptability, result reveals that samples were not significantly ($p < 0.05$) different from one another except CLS2 (cassava leaf with melon soup) that was significantly different with the mean score ranging from 7.45-8.15 where CLS2 remains the sample that has the overall acceptability.

Table 2: Sensory attributes and Acceptability of Soups made from cassava leaves

Sample Codes	Colour	Mouthfeel	Taste	Aroma	Acceptability
CLS1	7.10 ^a ±1.17	7.35 ^a ±1.09	7.35 ^a ±1.27	7.55 ^a ±1.61	7.45 ^a ± 0.95
PLS1	8.10 ^b ±0.91	7.60 ^a ±0.88	7.60 ^a ±1.05	7.70 ^a ±0.98	7.85 ^a ± 0.59
CLS2	7.60 ^a ±1.10	7.70 ^a ±0.87	8.05 ^a ±0.95	7.90 ^a ±1.02	8.15 ^b ± 0.75
PLS2	7.95 ^a ±0.89	7.45 ^a ±0.83	7.80 ^a ±1.15	7.10 ^b ±1.25	7.55 ^a ± 0.89
CLS3	7.05 ^a ±1.36	7.30 ^a ±1.56	7.10 ^a ±1.80	7.25 ^a ±1.37	7.50 ^a ± 1.15
PLS3	7.65 ^a ±1.14	7.25 ^a ±1.21	7.40 ^a ±1.00	7.40 ^a ±0.88	7.75 ^a ± 1.07

Values are mean ± standard deviation of duplicate determination, means with the same superscript within the same column are not significantly different ($p > 0.05$).

Key:

CLS 1; Cassava Leaves Soup (EfoRiro),
 PLS1; Pumpkin Leaves Soup (EfoRiro)
 CLS 2; Cassava Leaves Soup with Melon
 PLS 2; Pumpkin Leaves Soup with Melon
 CLS 3; Cassava Leaves Soup with Okra.
 PLS 3; Pumpkin Leaves Soup with Okra

Discussion of Findings

The study focused on the assessment of nutrient content and acceptability of soups made from underutilized tender cassava leaves. The result of proximate analysis from table 1 shows moisture content of cassava leaves with the mean of 62.31 ± 0.014 , this indicates that moisture content of cassava leaves is within the general of moisture content range (60-90%) cassava leaves as described by (Morgan 2016 and USDA 2009). However, cassava leaves moisture content can be reduced by drying if planning

on storing for a long period of time because the food moisture content is used as indicator of its shelf life, whereby the higher the moisture content, the shorter the shelf life (Fellows 2000; Chaudri, Kothari and Panwar, 2009). Also, ash content of the cassava leaves with the mean of 3.26 ± 0.007 which is within the range (0.7-4.5) supported the findings of Julie, Christopher and Sherry 2009. The fat content was 3.21 ± 0.007 this result disagrees with the findings of (Mwanahamisi, 2017) that says that crude fat content of cassava leaves range from 3.57-3.91 which is higher than the range of the result in this study (USDA, 2009) the result of crude protein shows a mean of 22.57 ± 0.01 which means that cassava leaves have high protein content which is in line with the findings of Ayodeji, 2005 who reported that the amino acid profile of

cassava leaf is well balanced and compared to that of egg protein. Crude fibre reveals a mean of 2.09 ± 0.014 which ranges from 0.2-2.9, which can be because of the tenderness of the leaves which makes it good for consumption (Nagib and Antonio, 2005). Carbohydrate contents shows a mean score of 0.57 ± 0.057 , which is relatively low this can be due to the high moisture content of the leaves, this disagrees with the findings of Gil and Buitrago (2002), who opined that the carbohydrate in cassava leaves is twice as high than that of its roots.

Table 2 reveals sensory attributes and acceptability of cassava leaves with the control group soup made from pumpkin leaves. For Color, result shows that samples were not significantly ($p < 0.05$) different from one another except PLS1 (Pumpkin leaf soup-Eforiro) that was significantly different with the mean score ranging from 7.05-8.10 where PLS1 is more preferred than the other samples in the group. For Mouthfeel, result reveals that samples were not significantly different from each other with CLS2 (cassava leaf with melon soup) been the most preferred and mean score ranging from 7.25-7.70. For Taste, result also shows that the samples are not significantly different from one another with CLS2 (cassava leaf with melon soup) with mean score ranging 7.10-8.05 and the most preferred in terms of taste. For Aroma, result shows that samples were not significantly ($p < 0.05$) different from one another except PLS2 (Pumpkin leaf with melon soup) that was significantly different with the mean score ranging from 7.10-7.90 where CLS2 is more preferred than the other samples in the group. For Overall Acceptability, result reveals that samples were not significantly ($p < 0.05$) different from one another except CLS2 (cassava leaf with melon soup) that was significantly different with the mean score ranging from 7.45-8.15 where CLS2 remains the sample that has the overall acceptability. This finding disagrees with the Emmanuel, Chileshe, Olaniyan, Omosebi, Adegunwa, Chikoye and Maziya-dixon (2021) who reported that consumer's preference for cassava leaves was low as compared to other

leafy vegetables though they agree to consuming cassava leaf at least once a week.

Conclusion And Recommendations

One of the major reasons why cassava leaves are underutilized (because of the cyanide content that is toxic to health) has been dealt with during processing and preparation including pounding and then boiling of cassava leaves to remove cyanogenic glucose to about 97% and free cyanide are completely removed while other nutrients are retained at considerable level hence the encouragement of proper utilization of cassava leaves by consumption of soups made from it. Soups made from cassava leaves will increase the availability of numerous soups for meal consumption. In view of the findings from this research, the following recommendation were made.

1. Enlightenment should be done by Home Economists and nutritionist through seminars about the misconception of cassava leaves and proper processing and preparation methods should be taught during workshops.
2. Cassava leaves should be harvested like every other green leafy vegetable and sold in the market to curb wastage and add to the varieties of soup available for consumption.

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