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Recipe Development and Sensory Evaluation of Cassava-Based Puddings

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Abstract

This study evaluated the sensory attributes of cassava-based puddings. Cassava-based puddings in the ratio 60:40 and 70:30 of cassava and cowpea flour as well as the control (100% cowpea flour) were prepared and subjected to sensory and proximate evaluation using standard procedures. Data were analysed using descriptive statistics and analysis of variance (ANOVA) at 0.05 level of significance. The puddings had appreciable proximate values. The colour and flavour of the two cassava-based puddings were significantly ($p<0.05$) lower than the control. Taste, texture and general acceptability, showed no significant difference ($p>0.05$) between the control and the cassava-based pudding in the ratio of 60:40. Since cassava-based pudding in the ratio of 60:40 compared favourably with the control, it could be accepted at household level.

Key words: Cassava-based Pudding, Proximate, Sensory Evaluation, Recipe

Introduction

Cassava(*Manihot esculenta*) is a woody shrub native to South America of the spurge family (United States Department of Agriculture (USDA), 2014). Nigeria is the world's largest producer of cassava. However, based on the statistics , Thailand is the largest exporting country of dried cassava, with a total of 77% of world export in 2005 (FAO, 2011). It is extensively cultivated as an annual crop in tropical and subtropical regions for its edible starchy tuberous root, a major source of carbohydrates. The cassava root is long and tapered, with a firm, homogeneous flesh encased in a detachable rind, about 1 mm thick, rough and brown on the outside. A woody vascular bundle runs along the root's axis. The flesh can be chalk-white or yellowish. Cassava roots are very rich in starch and contain significant amounts of calcium (50 mg/100g), phosphorus (40 mg/ 100g) and vitamin C (25 mg/100g). However, they are poor in protein and other nutrients (Food and Agriculture Organization (FAO), 2011).

Cassava is the third largest source of food carbohydrates in the tropics, after rice and maize(FAO, 2011). Cassava is a major staple food in the developing

world, providing a basic diet for over half a billion people. It is one of the most drought-tolerant crops, capable of growing on marginal soils (FAO, 2014). Cassava plays a particularly important role in agriculture in developing countries, especially in sub-Saharan Africa, because it does well on poor soils and with low rainfall, and also because it is a perennial crop that can be harvested as required. Its wide harvesting window allows it to act as a famine reserve and is invaluable in managing labor schedules. It offers flexibility to resource-poor farmers because it serves as either subsistence or cash crop.

A great variety of cassava-based dishes are consumed in the regions where cassava (*Manihot esculenta*) is cultivated, and they include many national or ethnic specialties (Fredrick, 2008). In Nigeria and Sierra Leone, cassava is commonly prepared as *eba* or *garri*. The cassava is grated, pressed, fermented and roasted, then mixed with boiling water to form a thick paste. In West Africa the cassava root is pounded, mixed with boiling water to form a thick paste and cooked like eba. In Ghana, among all root crops and even all food crops, cassava is the most favored by Ghanaian consumers. It can also be processed into *agbelima* by lactic acid fermentation (Namwalizi & Rhoda, 2006). Cassava flour can also be made into a staple food with a consistency like polenta or mashed potatoes which is called fufu.

Cassava has the lowest protein/energy ratio (P:E) compared with any staple crop. Stephenson *et al.* (2010) found that cassava intake is inversely correlated with protein intake and that populations that consume large amounts of cassava may well be at risk for inadequate dietary protein intake. Another condition that may result from cassava dependency includes kwashiorkor among children following weaning because of an imbalance of protein relative to calorie intake. This association identifies cassava consumers as a vulnerable population that may require interventions to improve nutrition (Stephenson *et al*., 2010)

Studies have shown that cassava is the most commonly consumed food in South-eastern Nigeria. (FAO/IFAD, 2011; Ene-Obong *et al.,* 2013). It is consumed mainly as fufu/garri with soup and as tapioca salad (Davidson *et al*., 2017). Heavy reliance on cassava leads to less dietary diversity. In south-eastern Nigeria where cassava is commonly consumed, household meals could therefore get quite monotonous and the monotonous nature of traditional diet has been attributed to the driving force behind nutrition transition. Development of new cassava based recipes with improved protein content could fight not only malnutritionbut also nutrition transition in a cassava dependent population.

Cowpea pudding is one of the most popular Nigerian dishes. It an important dietary staple in west African nations because of its high protein (Ogundele *et al*., 2014). It can be consumed alone or as part of the main meal. Puddings of high panelist acceptability have been produced from blends of cowpea and other food items

such as African yam bean (Nwosu *et al*., 2014), pigeon pea (Akajiaku *et al*., 2014) and soy bean (Ogundele *et al*., 2015). There is however a dearth of information on puddings made with blends of cowpea and cassava flour even though they have great potential in food formulation system.

Objectives of the study: The main objectives of the study were to carry out sensory evaluation and determine the proximate composition of cassava based puddings.

The objectives of this study were to:

1. evaluate the sensory qualities of cassava based puddings
2. determine the proximate composition of cassava based puddings

Research questions: The following research questions guided the study

1. What are the sensory qualities of cassava based puddings?
2. What is the proximate composition of cassava based puddings?

Materials and methods

Study design: The study adopted a quasi-experimental design. This is empirical study used to estimate the causal impact of an intervention without random assignment. Quasi experimental research shares similarities with the traditional experimental design or randomized controlled trial but it specifically lacks the element of random assignment.

Materials procurement: Ingredients (cowpea, cassava flour, palm oil, dry pepper, crayfish, salt, maggi and onion) that were used for the preparation of the cassava-based pudding and the control were purchased from retailers at Ogige market in Nsukka, L.G.A.

Processing of cowpea and cassava flour: The cowpea and cassava were processed into flour using the flow chart below.

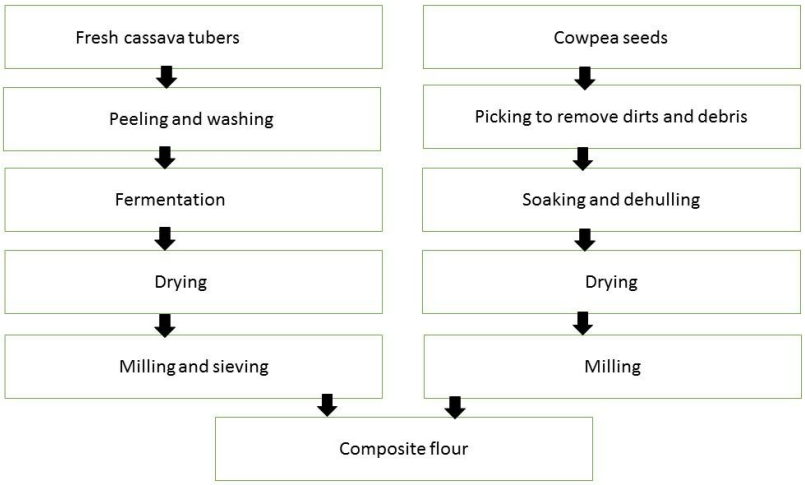

Fig 1. Flow chart for cassava and cowpea composite flour processing

Production of the puddings: Cassava and cowpea composite in the ratio of 60:40 and 70:30 (cassava and cowpea flour) were used to prepare cassava based pudding as outline below. Pudding prepared with only cowpea flour served as the control.

1Recipe name: **Cassava based puddings**

Ingredient	**60:40**	**70:30**
Cassava	60	70
Cowpea	40	30
Salt	4.7	4.8
Maggi	4	4
Dry pepper (ground)	2.5	2.5
Onion	25	25
Crayfish (ground)	2.7	2.7
Palm oil	36	36
Water	250	250

Method of preparation

1. Mix the flours thoroughly
2. Add water gradually to form paste (mix thoroughly while adding the water)
3. Add the oil and mix thoroughly
4. Add the onion, maggi and salt and mix properly
5. Scoop the desired quantity into a prepared foil and steam
6. Allow to steam for 60 minutes
7. Serve hot

2 Recipe name: **Cowpea pudding (control)**

Ingredient	
Cowpea	100
Salt	4.7
Maggi	4
Dry pepper (ground)	2.5
Onion	25
Crayfish (ground)	2.7
Palm oil	36
Water	250

Method of preparation

1. Put the flour in a mixing bowl
2. Add water gradually to form paste (mix thoroughly while adding the water)
3. Add the oil and mix thoroughly
4. Add the onion, maggi and salt and mix properly
5. Scoop the desired quantity into a prepared foil and steam
6. Allow to steam for 60 minutes
7. Serve hot

Methods of data collection: Data was collected using sensory evaluation and chemical analysis

Instrument for data collection: A nine-point hedonic scale, where nine was the highest score and one the lowest score was used to evaluate the pudding. The nine-point hedonic scale was used to test for flavor, color, taste, texture and general acceptability.

***Selection of panelists*:** A panel of 20 persons (both male and female) was selected randomly from the final year class of Home science, Nutrition and Dietetics to determine the sensory attributes of the products. The sensory evaluation was conducted in the diet therapy laboratory. The laboratory was well ventilated with windows opened for proper ventilation and lighting. Each of the panelists was comfortably seated and the environment was free from distractions.

***Data collection procedure*:** The products were presented to each of the panelist as coded in the hedonic scale. The products were coded as follows: Cp - control (i.e. 100% cowpea), Cp_1 -cassava and cowpea in the ratio of 60:40 and Cp_2 - cassava and cowpea in the ratio of 70:30. Each panelist was given a disposable serving bowl with spoon and a cup of water to rinse the mouth to avoid carry over effect. An ambient room temperature was maintained throughout the testing session. The puddings were evaluated by the panelist (20) for flavor, texture, color, taste and general acceptability. The sensory evaluation hedonic scoring forms with the codes of the products were placed near the products and each judge collected and filledone accordingly. The forms were collected from the judges at the end of the evaluation for statistical analysis.

Chemical (Proximate) analysis

Determination of moisture, fibre, ash, fat, protein and carbohydrate were based on the official methods of analysis described by the association of Official Analytical Chemist (A.O.A.C., 18th edition, 2005). All analysis was carried out in duplicate. Moisture was determined using the air oven method. Crude protein was determined by Kjeldahl procedure. Fat content was determined using Soxhlet solvent extraction method. Crude fibre was determined by heating the samples under reflux. Ash was determined by incineration of samples in a muffle furnace at 550^0C for six hours. Carbohydrate was calculated by difference 100-(moisture + protein + fat + ash + crude fibre).

Statistical analysis

The data generated from the study was statistically analyzed using SPSS (Statistical product for Service Solution) Version 20. Analysis of variance (ANOVA) was alsodone and Duncan's multiple range test was used to group and compare the means. Significance was accepted ($p \leq 0.05$).

Result

Sensory evaluation of the puddings

Table 1: Organoleptic attributes of the puddings

Samples	Colour	Flavour	Taste	Texture	General Acceptability
Cp	8.15 ± 0.88^a	7.55 ± 1.00^a	6.70 ± 1.87^a	7.15 ± 1.27^a	6.60 ± 1.96^a
Cp_1	7.10 ± 1.80^b	6.55 ± 2.16^b	5.85 ± 2.58^a	5.95 ± 2.78^a	5.10 ± 2.29^a
Cp_2	6.85 ± 1.81^b	5.25 ± 2.02^b	4.75 ± 2.20^b	4.65 ± 2.68^b	3.30 ± 1.49^b

Mean values of different superscripts in the same row were significant at ($p < 0.05$).
Cp (control) = 100g of cowpea
Cp_1 = 60:40% of cassava and cowpea flour
CP_2 = 70:30% of cassava and cowpea flour.

Table 1 revealed that the values for colour and flavour of the pudding ranged from 6.85-8.15 and 5.25-7.55 respectively while taste, texture and

general acceptability scores were within the range of 4.74-6.70, 4.65-7.15 and 3.30-6.60. The colour and flavour of the two cassava-based puddings were significantly ($p<0.05$) lower than the control. For taste, texture and general acceptability, there was no significant difference ($P>0.05$) between the control and the cassava-based pudding with the 60:40 ratio. The value of cassava-based pudding with the ratio of 70:30 was statistically lower for all the parameters examine.

Proximate analysis of the puddings

Table 2: Proximate composition of the puddings (%)

Samples	Protein	Carbohydrate	Moisture	Ash	Fat	Fibre
Cp	3.26±0.21^a	54.98±2.28^a	32.45±0.35^a	0.08±0.01^a	11.50±0.71^a	0.25±0.01^a
Cp_1	2.37±0.36^a	55.71±1.94^a	33.18±6.51^a	0.08±0.01^a	9.00±0.71^a	0.18±0.02^b
Cp_2	2.72±0.15^b	62.31±4.28^b	25.70±3.68^b	0.08±0.02^a	7.00±0.71^b	0.21±0.02^a

Mean values with different superscripts in the same row are significantly different ($p < 0.05$)
Cp (control) = 100g of cowpeaCp_1 = 60:40% of cassava and cowpea flour
Cp_2 = 70:30% of cassava and cowpeaflour

Table 2 revealed that the protein content of the puddings ranged from 2.37-3.26%, being highest in the control (3.26%) and lowest in the pudding in the ratio of 60:40 (2.37%). Carbohydrate and moisture values ranged between 54.98-62.31 and 25.70-33.18% respectively. fat and fibre composition ranged from 7.00-11.50 and 0.18-0.25 respectively. Ash values were similar in all the pudding (0.08%). With the exception of fibre values, the control and cassava based pudding in the ratio of 60:40 had statistically similar proximate composition ($p>0.05$).

Discussion

Sensory evaluation of the puddings

In terms of colorthe rate of acceptability of the puddings varied according to increase in the level of cowpea flour, the control which had 100% cowpea flour was the most accepted, followed by the cassava-based pudding in the ratio of 60:40 and lastly cassava-based pudding in the ratio of 70:30, this is in line with the study carried out on cowpea pudding by Funmi, (2013) which revealed that cowpea pudding with 100% cowpea flour had better acceptance in terms of color. The control had better flavor than the two cassava-based puddings. Similar finding was gotten in the study of Ibiyemi & Adebowale, (2013) on the sensory attributes of cocoyam and cowpea pudding. it was found that the pudding with 40% cowpea flour had better flavor compared to the pudding with 30% cowpea flour, this is in accordance with the findings of this study, the cassava-based pudding with 40% cowpea flour had better flavor compared to the cassava-based pudding with 30% cowpea flour. This could be because the strong cassava flavor might have masked the cowpea flavor which the panelists were already familiar with. It

is not surprising that the cassava-based pudding in the ratio of 70:30 had poorer attribute than the one in the ratio of 60:40 since more cowpea was used in the later. The taste of the control and the cassava-based pudding in the ratio of 60:40 was similar while that of the control and cassava-based pudding in the ratio 70:30 were different. This is in accordance with the study of Sanni, (2013) on cowpea pudding. He found out that the taste of cowpea pudding varied with increase in the percentage of cowpea flour, this explains the similarity in the taste of the control and cassava-based pudding with 40% cowpea flour and the differences in the cassava-based pudding with 30% cowpea flour. Similarity in the taste of the control and cassava-based pudding in the ratio of 60:40 could be because the percentage of cowpea (40%) in the pudding is significant enough to give similar taste to that of the control (cowpea pudding). The observed differences in the taste of the control and the cassava-based pudding in the ratio of 70:30, could be attributed to the judge's familiarity with the taste of the control (cowpea pudding), and it could also be because the percentage of the cowpea (30%) was insignificant. This is also supported by the study of Olapode *et al.* (2005), who discovered that the acceptance of the taste of the cowpea pudding by the judges could be affected by familiarity. The texture of the control and cassava-based pudding in the ratio of 60:40 was more accepted than that of the cassava-based pudding in the ratio of 70:30 was least accepted. This agrees with the study of Onabanjo & Afolabi, (2010) who discovered that the texture of yam and cowpea pudding varied with increase in substitution of cowpea flour. For general acceptability, there was no significant difference($p>0.05$) between the control and cassava based pudding in the ratio of 60:40 (cassava and cowpea). This finding disagrees with that of Nwosu *et al.*(2014) who only observed good comparison in the substitution level of up to 60:40 (cowpea and African yam bean). The result of this study is however in line with the finding of Akajiaku *et al.* (2014) who found high acceptability level at up to 60% substitution of cowpea with pigeon pea. In general, the cassava-based pudding with the ratio of 70:30 had statistically lower values than the control for all the parameters examined implying that this cassava-based pudding with such a ratio may not be accepted if prepared in the household. Though cowpea pudding (control) had better colour and flavor, its taste, texture and general acceptability compared very well with cassava-based pudding in the ratio of 60:40. This also means that cassava-based pudding with the ratio of 60:40 will be comfortably accepted at the household level.

Proximate composition of the puddings

The protein content of the control was higher than that of the two cassava-based puddings. This is expected because according to FAO, 2011 cowpea is a legume and has higher protein content than cassava (a tuber). The study on cocoyam and cowpea pudding by Funmi(2013) revealed that the

inclusion of cowpea flour increased the protein content of all the samples, this is line with this study, because the protein content of the cassava-based puddings increased with increase in cowpea flour. The proteins in the cowpea flour complemented those of cassava flour thus improving the protein content of the puddings. Proteins are useful in the body for growth, maintenance and repair of body tissues. The carbohydrate content of the samples varied according to increase in the level of cassava flour, the cassava-based pudding in the ratio of 70:30 had the highest level of carbohydrate (62.31%) while the control (100% cowpea) had the lowest carbohydrate content (54.98%). This was expected because cassava is a major source of carbohydrate (FAO, 2011). Chen *et al. (*2000) reported similar increase in the carbohydrate content of cocoyam-based pudding substituted with cowpea flour. Carbohydrate is a source of energy and it supports other metabolic activities within the body. It was observed that the moisture content of the cassava-based pudding with the ratio of 70:30 was the lowest, this could be because it had the lowest ratio of cowpea (30%) which is the protein source. This is in line with the study reported by Sanful *et al.* (2010) and Ihekoronye & Ngoddy,(2000) that proteins have high absorption capacity. The percentage ash which is an indicator of the mineral content of the puddings, was low (0.08%) in all the puddings, this is lower compared to the findings of Olaoye *et al.*(2006) and Sanful *et al.*(2010) who got 1.17% and 2.41 respectively as the ash content of cowpea pudding (moi-moi). The fat content of the samples also varied according to increase in cowpea substitution, the control (100% cowpea) had the highest fat content followed by the cassava-based pudding with 40% cowpea and cassava-based pudding with 30% cowpea had the lowest fat content. This is not surprising because according to Deshpande &Damodaran, (2000) cowpea is higher in fat than cassava. Fat is needed for support of certain metabolic activities within the body of living organisms and equally a source of energy. The fibre content of the puddings including the control were low, this is similar to the study of George & Pamplona-Roger (2003). They reported that the fibre content in whole cowpea flour is higher than dehulled cowpea flour which was used in this study to prepare the puddings, thus accounting for the low fibre content in the puddings. When there is low fibre in food it can cause faeces to be hard, dry and concentrated, thus obliging the intestine to make enormous effort to eliminate them (George & Pamplano-Roger, 2003).

Conclusion

This study helped in the development of cassava-based puddings using 60:40 and 70:30 ratios of cassava and cowpea flour. The study has shown that cassava-based pudding with the ratio of 60:40 had better sensory attributes than cassava-based pudding with the ratio of 70:30. Cassava-based pudding in the ratio of 60:40 compared favourably with the control in terms of proximate values and sensory attributes and could

therefore be accepted at household level.

Recommendations

1. In order to fight against nutrition transition, Home Economists should develop more nutritious and palatable cassava based dishes.
2. Since food related behavior is difficult to change, nutrition education should focus on the need for home makers to incorporate the new cassava based dishes into the family menu.
3. The government should economically empower house wives so as to increase their purchasing power and reduce food insecurity as the house hold level

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