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# DEVELOPMENT OF UNIQUE RECIPES FROM LIMA BEANS, ITS NUTRIENT COMPOSITION AND ORGANOLEPTIC PROPERTIES OF DEVELOPED PRODUCTS

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**ABSTRACT:** *The purpose of this research was to develop queen's cakes from dehulled and undehulled lima bean, porridge and pudding using lima bean as a means of diversify the utilization of lima bean. To achieve this, three specific objectives were formulated. The study adopted an experimental research design. Three research questions guided the study. Three cooking methods were used for preparation queen's cakes, porridge and pudding (moimoi). The cooking methods includes; baking, boiling and steaming Proximate composition of the food products were determined (moisture content, ash content, fat content, protein content, fibre and carbohydrate). The flour samples were also subjected to sensory evaluation. A nine-point hedonic scale was used. Results were analyzed statistically by the analysis of variance and differences between means separated. Results for the proximate composition showed that, sample. Sample BLB had the highest moisture content and this may reduce the shelf life of the food product. There was no significant difference in the ash content of all the samples. Sample NLE had the highest protein content compared to other samples. Result for fat revealed that, sample NLE had the highest value for fibre. Sample DLB had the highest value for carbohydrate. Result for sensory evaluation revealed that, sample DLB, BLB and SLB had equal preference for colour. However, sample NLE had the least value for colour. Result for taste, texture and aroma followed this pattern because, significantly the samples do not differ. However, sample SLB was highest in aroma. Based on the finding of this study it was recommended that for improved protein and fibre intake, undehulled lima bean should be encouraged. Baking method of cooking is recommended for shelf life extension of lima bean products; Lima bean should be dehulled before utilization for improved sensory properties and food products developed from lima bean can be very useful in food product development. Further research work should be geared towards developing more food products using lima bean.*

**ABSTRACT:** Unique Recipe, Lima Beans, Nutrient Composition, Developed Products

## INTRODUCTION

Protein malnutrition is one of the major nutritional problems in the developing countries, Nigeria inclusive. The specific health disorders like kwashiorkor prevalent in the children due to protein deficiency, whereas in adults, it results in poor health and reduced work capacity. Inadequate protein consumption is regarded as the main cause of poor nutrition among individuals in Nigeria. Poor Nutrition involving protein remains a major health challenge (Ajayi, Funmi Adewumi & Sunday, 2012). This problem originated from insufficient supply caused by high price of animal proteins, which are highly favored to those of plant sources.

There are basically two sources of protein they are animal and plant; provision of adequate animal proteins is difficult due to high cost and changing consumer's attitudes towards animal-based proteins. Consumers are more conscious in the food selection due to increasing awareness about nutritional dependent illness. An alternative for improving protein intake of households is to supplement for diet with plant proteins with reference to legumes. Legumes are inexpensive source of proteins with high nutritional profile.

Lima bean (Phaseolus lunatus) like many other legumes is a rich source of plant protein which compares favorably with other legumes. Lima beans are leguminous plants that are grown for their edible seeds. Lima bean of the Family of Fabaceae is one of such underutilized legumes with high nutritional potential. The common names include- butter bean, sieva bean, sugar bean, madagascar bean, haba bean, burma bean. They vary in size, shape and colour. The seed are generally cream or green in colour (Iheanacho, 2010). There are two main types of lima beans; Bush lima beans and pole lima beans. Lima bean is a tropical and subtropical legume cultivated for its edible seeds. There are wild and cultivated types. The perennial form is an indeterminate, vigorous, climbing and trailing plant, up to 2-6 m tall, with auxiliary flowering only. It has swollen and fleshy roots up to 2 m long. Annual lima bean is a pseudo-determinate, bushy plant, 0.3-0.9 m tall with both terminal and axillary flowering. It has thin roots. There are wild and cultivated type *phaseolus lunatu* generally referred to as *Phaseolus lunatus* var. *silvester* Baudet and *Phaseolus lunatus* var. *Lunatus*. Lima bean is an N-fixing legume that sheds its leaves copiously and is thus valuable for restoring soil fertility (Ajayi, et al, 2012).

**Statement of the Problem**

Malnutrition associated to inadequate protein consumption is still prevalent in developing countries Nigeria inclusive. This is for the fact that, most of the staple foods consumed by households are highly carbohydrate based and animal protein which is the source of protein preferred by many is expensive and unaffordable. Legumes are known to be a cheap source of protein. However, legumes, though available, are under-utilized, particularly Lima beans. Lima bean is one of the legumes that are under-utilized in Nigeria. This is for the fact that, information on Lima beans has not been popularly documented and the issue of hard to cook seeds as complained by consumers. Hence the need to seek for ways of cooking Lima beans with less fuel consumption. Lima beans are generally cultivated for their edible seeds. Lima beans like other legumes are important source of protein, carbohydrate and dietary fibres but low in fat. It also contains thiamin, riboflavin, niacin and vitamin $B_6$ which are co enzymes for protein, carbohydrate and fat metabolism. Lima beans contain some anti-nutrients including trypsin inhibitors, phytic acid, haematoglutinns, oxalate, tannins and cyanide which interfere with absorption and utilization of important minerals such as calcium, iron, zinc and magnesium (Olanipekun *et al*, 2017).

**Purpose of the Study**

The main purpose of this research is the development of unique recipes from lima bean, while assessing its nutrient composition and organoleptic properties of developed products. Specifically, the study;

1. Developed unique recipe for baked, boiled and steamed lima beans.
2. Determined the nutrient compositions of the food products.
3. Determined the organoleptic evaluation of the products produced.

**Research Questions**

The research questions that guided this study are stated as follows:

1. what are the recipes for baked, boiled and steamed lima beans?
2. what are their nutrient compositions?
3. what are their levels of acceptability (organoleptic properties)?

**Hypotheses**

The following null hypotheses were tested at .05 level of significance

1. There will be no significant difference in the recipe development of baked, boiled and steamed lima beans.
2. There will be no significant difference in the nutrient composition of baked, boiled and steamed lima beans.
3. There will be no significant difference in the organoleptic evaluation of baked, boiled and steamed lima beans.

## METHODOLOGY

**Design of the study**

The study adopted experimental research design. An experimental research design is a blueprint of the procedure that enables the researcher to test a hypothesis by reaching valid conclusions about relationships between independent and dependent variables.

**Materials**

Lima bean seeds were purchased from Mile 3 Market in Port Harcourt Rivers State, Nigeria. Other laboratory materials and chemicals such as; measuring cylinder centrifuge tube, porcelain crucible, soxhlet extraction, desiccator, Kjedahl flask, beaker, whatman, filter paper, distilled water among others were collected from the analytical laboratory of Food Science and Technology, Rivers State University, Port Harcourt.

**Processing of Raw Materials**

- **Procedure for Preparation of Lima Bean Paste (Steamed lima bean pudding)**

Lima bean seeds were sorted, and cleaned soaked in 100 ml of tap water for 2 hours, pre-soaked seeds were then dehulled, washed and addition of ingredients, wet milled and lima bean paste obtained was packaged in a plastic container until used.

- **Procedure for Preparation of Lima Bean Flour (baked queen's cake)**

Lima bean seeds were cleaned and sorted, soaked, dehulled, washed, dried and dry milled using a commercial mill and sieved through a 500mm British standard sieve (model Bs 410,

Endecotts Ltd, London, UK). The flour obtained was then stored in an air-tight plastic container at room temperature $37^0$c until used.

- **Procedure for Preparation of Undehulled Lima Bean Flour (baked queen's cake)**

Lima bean seeds were cleaned and sorted and dry milled using commercial mills and sieved through a 500mm British standard sieve (model Bs 410, Endecotts Ltd, London, UK). The flour obtained was then stored in an air-tight plastic container at room temperature $37^0$c until used.

- **Procedure for Preparation for Boiled Lima Bean (boiled lima bean)**

Lima bean seeds were cleaned, sorted, washed in tap water and boiled in a stainless-steel pot.

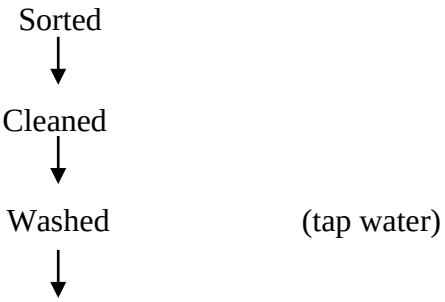


**Figure 1: Flow Chart for Preparation of Boiled Lima Bean (Source; Berry, et al 2016**)

**Sample Formulation**

One sample was formulated for baked, boiled and steamed lima bean products each of the products. 100 percent Lima beam was used for all the products.

**Flour Blends for the Production of Chin-Chin**

| | Samples % | | | |
|---|---|---|---|---|
| | **BLB** | **DLB** | **SLB** | **NLE** |
| Baked lima bean | 100 | - | - | |
| Boiled lima bean | - | 100 | - | |
| Steamed lima bean | - | - | 100 | |
| Baked undehulled lima bean | - | - | - | 100 |

*BLB: (100% - Baked lima bean), DLB: (100% Boiled lima bean), SLB: (100% Steamed lima bean) and NLE; (Undehulled lima bean queens' cake).*

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**Proximate Composition of the Products (queens' cake, bean pudding and boiled bean)**

The proximate composition is the term usually used in the field of food and means the six components of moisture, crude protein, crude fat carbohydrate, crude fibre, crude ash etc., which are expressed as the content (%) in food respectively. The proximate composition was done after the production of the food products.

**Moisture Content of the Products**

The method of A. O. A. C. (2006) was used. Five grams of each sample was weighed in duplicate into already weighed and dried aluminum dish. The sample was dried to constant weight in an air oven at $105^0$C for 2 hours.

$$\text{Moisture content (\%)} = \frac{M1 - M2 \; x \; 100}{M1 - M0}$$

Where;

MO = Weight of Aluminum dish

M1 = Weight of fresh sample + dish

M2 = Weight of dried sample + dish

**Ash Content of the products**

AOAC (2006) method was used in the determination of the ash content. The food products were weighed into a previously ignited and cooled porcelain crucible with the lid. The crucible and sample were heated on a heating mantle in a fume cupboard until smoking ceases. The crucible and the content were then transferred to a muffle furnace and allowed to ash for three hours at $500^0$C. At the end of ashing the crucible with its content was removed from the furnace and cooled in a desiccator, and weighed again. The percentage ash content of the sample was calculated as follows:

$$\text{Ash (\%)} = \frac{Weight\ of\ ash \; x \; 100}{Weight\ of\ sample}$$

**Crude fat Content of the Products**

The crude fat was determined using the Soxhlet extraction method .5g of dried sample was weighed, wrapped in a Whatman number 1 filter paper and was extracted in the extraction unit for 3 hours using petroleum ether as solvent. At the end of the extraction process, the ether was evaporated and the weight of the extract+ flask taken. The difference in weight of the extraction flask before and after extraction was recorded as the amount of fat or ether extract.

$$\text{(\%) crude fat} = \frac{\text{wt of ether extract x 100}}{\text{wt of sample}}$$

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**Crude Protein of the Products**

Determination of the crude protein content of the food products was done using the method of the A.O.A.C (2006). 1g of the sample was weighed into a 100ml Kjedahl flask. One and a half tablet of Kjedahl catalyst and 10ml of Nitrogen-free concentrated sulphuric acid will be added. The mixture was heated slowly for digestion on a digester set at $420^0$c under a fume cupboard. The sample digest was allowed to cool and then transferred into a 100ml volumetric flask and made to volume with distilled water.10ml of the digest was introduced into 100ml Kjedahl distillation flask and 10ml of 45% NaOH was added. The ammonia liberated was steam distilled into a 5ml of the boric acid indicator in a conical flask using a Nitrogen distillation unit, the distillate was back titrated against O.1NHcl to give the nitrogen content of the sample. A blank determination will also be carried out and subtracted from the sample reading and the %N was calculated thus:

$$\text{N (\%)} = \frac{(\text{Titre} - \text{Blank}) \times \text{Normality of acid} \times 1.4}{\text{Weight of sample}}$$

The percentage crude protein content of the stiff porridge was calculated as follows:

$$\text{\% crude protein} = \text{\% N} \times 6.25$$

**Total Carbohydrate Content of the Products**

This was determined by difference (100-%moisture-%ash-%fat-%protein-%crude fibre)

**Crude Fibre of the Products**

2g of the moisture-free sample was extracted for three hours with petroleum ether using a Soxhlet apparatus. The fat-free material was placed in a 200ml beaker and 50ml of 1.25% w/v sulphuric acid was added and covered with a watch glass. The content of the beaker was heated gently on a hot plate for 30 minutes (acid hydrolysis). At the end of the acid hydrolysis, the content of the beaker was filtered under vacuum through a Buchner funnel fitted with filter paper (Whatman No. 40) and washed with boiling water until the washings will no longer acid to litmus. The residue was washed back into the beaker with 1.25% NaOH and boiled for 30 minutes covered with a watch glass. The resulting insoluble material was transferred to dried pre-weighed ash less filter paper and washed thoroughly first with hot water until the washing is no longer alkaline to litmus and then with 15ml of Ethanol (95%) by volume and was dried at $105^0$C to a constant weight for one hour. The filter paper and content were incinerated to ash at $500^0$C for 1 hr. The ash was then cooled and weighed. The weight of the ash was subtracted from the increase of weight on the paper due to the insoluble material and the difference reported as fibre.

$$\text{Crude fibre (\%)} = \frac{Wt\ of\ fibre}{Wt\ of\ sample}\ x\ 100$$

**Sensory Evaluation**

A panelist of 31 consisting of staff and students chosen from the department of Home Economics, Ignatius Ajuru University of Education were used for the sensory evaluation of

the food products. The panelists were asked to assess the samples based on the following attributes: colour, texture, taste, flavour and general acceptability. A 9 – point hedonic scale was used to score the samples as follows:

1. = dislike extremely
2. = dislike very much
3. = dislike moderately
4. = dislike slightly
5. = neither like no dislike
6. = like slightly
7. = like moderately
8. = like very much
9. = like extremely

**Statistical Analysis**

Results were analyzed statistically by the analysis of variance and differences between means separated.

**Results for Proximate Composition of all the Samples are Explained Below:**

The proximate composition of Lima queen's cakes, porridge and pudding are presented in Table 2. Values for moisture content ranged from 33.37in sample NLE to 66.13% in sample BLB. Ash content ranged from1.66 in sample NLE to 2.53% in sample SLB with values for fat ranging from7.13 in sample BLB to18.23% in sample DLB. Protein ranged from 6.19 in sample SLB to 9.38% in sample NLE. Crude fibre that ranges from 5.76 in sample BLB to 9.45% in sample NLE. Carbohydrate ranged from 11.56 in sample BLB to32.86% in sample32.86a DLB.

**Table 1: Proximate Composition of Lima Bean Queens Cakes, Porridge and Pudding Samples**

| | Moisture Content (%) | Ash (%) | Fat (%) | Crude Protein (%) | Carbohydrate (%) | Crude Fibre |
|---|---|---|---|---|---|---|
| DLB (100% boiled lima bean) | 35.14$^{c}$ | 2.16a | 18.23a | 7.28b | 32.86a | 4.33d |
| BLB (100% dehulled lima bean queens' cake) | 66.13a | 1.91a | 7.13b | 7.52b | 11.56c | 5.76c |
| SLB (100% lima bean pudding) | 56.96$^{b}$ | 2.53a | 8.32b | 6.19c | 19.55bc | 6.46b |
| NLE (100% undehulled lima bean queens' cake) | 33.37c | 1.66a | 17.37a | 9.38a | 28.53ab | 9.45a |

*Means with the same superscript on a column are not significantly difference at ($P < 0.05$)*
*BLB: (100% - Baked lima bean), DLB: (100% Boiled lima bean), SLB: (100% Steamed lima bean) and NLE; (Undehulled lima bean queens' cake).*

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**Sensory Evaluation**

**Results of Sensory Evaluation of all the Samples are Explained below**

Table 1 showed the mean score for dehulled and undehulled lima bean queen's cakes, porridge lima bean and lima bean pudding prepared from 100 lima beans. Colour ranged from 6. 35 in sample NLE to 8.61 in sample SLB. However, sample BLB and DLB have equal preference for colour. Sample NLB had had the least score for colour. Sensory score for taste ranged from 6.00 in sample NLB to 8.19 in sample SLB and was most preferred. Mean score for texture ranged from 6.29 in sample NLB to 8.45 in sample SLB. However, sample BLB and DLB have equal preference for texture. Mean rating for aroma ranged from 6.67 in sample NLB to 8.09 in sample 8.09 samples BLB and DLB have equal preference for aroma.

**Table 2: Sensory Evaluation of Queens Cakes, Pudding and Porridge Samples**

| | BLB | SLB | DLB | NLB |
|---|---|---|---|---|
| Colour | $7.8B^{a}$ | $8.61^{a}$ | $7.74^{b}$ | $6.35^{c}$ |
| Taste | $8.22^{a}$ | $8.61^{a}$ | $4.80^{a}$ | $3.4^{b}$ |
| Texture | $7.84^{a}$ | $8.45^{a}$ | $7.90^{a}$ | $6.29^{b}$ |
| Aroma | $7.45^{a}$ | $8.09^{a}$ | $7.38^{a}$ | $6.67^{b}$ |

*Means with the same superscript on a row are not significantly difference at ($P \leq 0.05$)*
*BLB: (100% - Baked lima bean), DLB: (100% Boiled lima bean), SLB: (100% Steamed lima bean) and NLE; (Undehulled lima bean queens' cake).*

**DISCUSSION OF FINDINGS**

**Proximate Composition**

Table 1 shows result for queen's cakes, porridge and pudding made from 100% lima bean. It was observed that there were significant differences among the samples. Sample BLB differed significantly ($P < 0.05$) from sample DLB, SLB and NLE in moisture content it could be as a result of the cooking method used. The food had direct contact with the boiling water. Sample SLB also had high value of moisture content because of the steam that was used for the cooking

Moisture content according to Ehimen, *et al* (2017) is an important parameter which significantly affects the shelf life of food product. It therefore means that, lima bean queen's cake will have longer shelf life than lima bean pudding and porridge.

Result for ash showed, sample DLB, BLB and SLB were not significantly different ($P > 0.05$) in ash content but differed significantly ($P < 0.05$) from samples NLE having the least value for ash content. Since the ash content of a sample is a reflection of the minerals it contains therefore, lima bean seeds are expected to be rich in mineral. Agu and Aluyah (2017) reported a high mineral content in maize -cowpea seed blends. The same result presented itself as observed by Osuji and Anyaiwe (2015). The high value of fat in sample NLB and DLB could also be attributed to the margarine added while creaming fat and sugar for the

production of the queen's cakes. Fats are essential in diet as they increase the palatability of foods by absorbing and retaining their flavours (Sara, 2018).

Sample NLE had the highest value for protein content. NLB is undehulled lima bean queens' cake, the sample differed significantly (P <0.05) from all the samples. However, sample DLB and BLB were not significantly (P >0.05) different. This result in an accordance with Elegbede et al (2014) that when legume are rich in protein. This result in accordance with the view Okaka, (2005) that lima bean seed contains a significant amount of protein. Sample NLE differed significantly from all the samples. This may be attributed to the undehulled lima bean, the coat of lima bean seeds has some levels of fibre. Lima bean should be processed undehulled for improved fibre intake. Result for carbohydrate varied between 11.56 in sample BLB to 32.86% in sample DLB. Sample DLB differed significantly P<0.05 from all the samples with regards to carbohydrate. This may be attributed to addition of sugar in the queen's cakes.

**Sensory Evaluation**

Results for the sensory evaluation are shown in Tables 2, for all the attributes investigated i.e colour, taste texture, and aroma.

Table 2 showed the mean sensory scores for lima bean queen's cakes, lime bean pudding and lima bean porridge. Results for sensory evaluation of the samples revealed that sample SLB was most preferred and significantly different (P <0.05) from the other samples. Sample BLB and DLB were not significantly different (P>0.05) but, differed significantly from sample NLB with the least rating for colour. The cooking method used influenced the choice made by panelists in this case. Appearance of food is usually the first sign of edibility (Iwe and Egwuekwu, 2010). Steaming method of cooking was reported to improve sensory quality of food especially bean pudding. The result showed that steamed sample was most preferred due to the cooking method applied. It was as a result of the product not been in direct contact with the boiling water. This result was in line with the observation by Akusu and Kinn-Kabari (2012), who pointed out that steaming method of cooking bean pudding, enhances the colour preference of food product. Sample BLB which is baked queen's cake and NLB also had good rating scores. However, sample NLB undehulled Lima bean queens' cake was least preferred by the panelists. It therefore means that, lima bean should be dehulled before utilization in snacks production.

Sensory evaluation result for taste, showed that sample SLB was most desirable with the highest value 8.61 followed by sample BLB with 8.22. The result is in accordance with the observation of Berry, et al (2016), who reported high rating value for steamed bean pudding compared to dry heat-treated bean pudding.

For texture, sample SLB had higher value (8.61). Statistically, sample SLB, BLB and DLB were not significantly different (P>0.05). But differed significantly (P<0.05) from sample NLB. Texture of food depends a lot on the starch content (Iwe & Egwuekwu, 2010). This implies steamed Lima pudding retained all the food nutrients including carbohydrate than the other samples since there was no direct contact between the food and the boiling water. Also leaching compared to boiling cooking method. Sample NLB was rated least because of the rough texture since the lima bean was not dehulled and was least preferred. Results for aroma followed the same pattern. Sample SLB was most preferred. However, not significantly

different at (P>0.05) from sample BLB and DLB, but differed significantly (P< 0.05) from sample NLB.

## CONCLUSION

The chemical analysis of queen's cakes, porridge and pudding made from lima bean showed a significant nutritional influence on the samples. Sample BLB had the highest moisture content and this may reduce the shelf life of the food product. There was no significant difference in the ash content of all the samples. Sample NLE had the highest protein content compared to other samples. Result for fat revealed that, sample NLE had the highest value for fibre. Sample DLB had the highest value for carbohydrate. Result for sensory evaluation revealed that, sample DLB, BLB and SLB had equal preference for colour. However, sample NLE had the least value for colour. Result for taste, texture and aroma followed this pattern because, significantly the samples do not differ. However, sample SLB was highest in aroma.

## RECOMMENDATIONS

Based on the findings of this study and the problems encountered, it is therefore recommended that:

1. Food products developed from lima bean can be very useful in food product development
2. For improved protein and fibre intake, undehulled lima bean should be encouraged.
3. Baking method of cooking is recommended for shelf life extension of lima bean products
4. Lima bean should be dehulled before utilization for improved sensory properties.

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