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Research Article

Sensory Evaluation and Feasibility Report of Plantain Sandwich for Nigerian Market

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Abstract: Protein-energy malnutrition is a common nutritional disorder in developing countries and constitutes a major public health problem in young children and elderly people. This project is aimed at evaluating the acceptability of plantain-peanut sandwich and roasted at different temperatures. A plantain-peanut sandwich consists of minced protein stuffed into a carbohydrate source made into a roll as a food product. The plantain was roasted at two different temperatures than later enriched with 5%, 10% and 15% peanut butter. The crude protein and crude fibre contents of the plantain samples roasted at 200^{o}C and 240^{o}C showed no significant difference ($P>0.05$) while the ash, fat and carbohydrate contents showed that there was a significant difference ($P<0.05$). The results of the proximate composition showed that there was a significant difference ($P<0.05$) at the two different roasting temperatures of 200^{o}C and 240^{o}C when enriched at 5%, 10% and 15% levels with peanut butter. This pattern of significant increase was also observed with the amino acid profiles at the two different roasting temperature levels. The sensory evaluation record shows that the mean scores for the appearance, taste, colour, aroma, mouthfeel and overall acceptability of the enriched roasted samples varied, but the plantain roasted at 240^{o}C enriched with 15% peanut butter had the highest acceptability level. A feasibility study was carried out to investigate the possibility of producing and marketing a plantain-peanut sandwich. The study revealed that a starting point of 60 packs at 4 fingers per pack sold at 600 Naira per day gave an estimated turnover of 9 million Naira per annum. A breakeven point analysis revealed that a price break even point of 19.14% is feasible while a product breakeven of 18.04% of the estimated annual sales of 15,000 packs is also feasible.

Keywords: Plantain, Peanut Butter, Roasting, Enrichment, Sensory Evaluation, Feasibility Study, Breakeven Point.

1. Introduction

1.1 Plantain

Nigeria is faced with the problem of malnutrition due to deficiency of protein and calories. The protein-calories sources of vegetable origin have been proposed as a solution to this problem. In Nigeria and many African countries, plantains (*Musa paradisiaca*) are used as an inexpensive source of calories (Akubor *et al*., 2003). It is an important starchy staple and commercial crop in the West and Central Africa, where fifty percent of the world's plantain crop is produced (Swennen, 1990). Cassava, Plantain, and sweet potato are among the major starchy crops which are used in many tropical countries (FAO, 1990). According to FAO (2009), over 2.3 million metric tons of plantains are produced in Nigeria annually. However, about 35 to 60% post-harvest losses had been reported and attributed to lack of storage facilities and inappropriate technologies for food processing.

Plantain is a popular dietary staple due to its versatility and good nutritional value. It is starchy, less sweet variety of banana that can be used either ripe or unripe; they are an invaluable source of carbohydrate, comparable in nutritive value to yam or potato and are used as a variant on the usual staple foods. It is consumed mainly in Nigeria as snacks in the form of chips, boli, dodo ikire.

Plantains are members of the banana family. They are a starchy, low in sugar variety that is cooked before serving as it is unsuitable raw. It is used in many savory dishes somewhat like a potato would be used and is very popular in Western Africa and the Caribbean countries. It is usually fried or baked. Plantains are

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native to India and are growing more widely in tropical climates. Plantains are sometimes referred to like the pasta and potatoes of the Caribbean. Sold in the fresh produce section of the supermarket, they usually resemble green bananas but ripe plantains may be black in colour. This vegetable-banana can be eaten and tastes different at every stage of development. The interior colour of the fruit will remain creamy, yellowish or light pink. When the peel is green to yellow, the flavour of the flesh is bland and its texture is starchy. As the peel changes to brown or black, it has a sweeter flavour and more of a banana aroma but still, keeps a firm shape when cooked.

The plantain averages about 65% moisture content and the banana averages about 83% moisture content. Since hydrolysis, the process by which starches are converted to sugars, acts fastest in the fruit of higher moisture content it converts starches to sugars faster in bananas than it does in plantains. A banana is ready to eat when the skin is yellow whereas a plantain is not ready to eat "out of hand" until hydrolysis has progressed to the point where the skin is almost black. Plantains grow best in areas with constant warm temperatures and protection from strong winds. They have been grown in scattered locations throughout Florida since the 16th century.

The consumption of plantain has risen tremendously in Nigeria in recent years because of the rapidly increasing urbanization and the great demand for easy and convenient foods by the non-farming urban populations. Besides being the staple for many people in more humid regions, plantain is a delicacy and favoured snack for people even in other ecologies.

1.2 Groundnut

Groundnut (*Arachis hypogea*) is a true pulse, a member of the Leguminosae family that has gained recognition as both snack and a healthy food. Groundnut is a small annual herb growing up to a foot above the ground. It is thought to have originated in the Central Americas and from where it spread to the rest of the world through Spanish explorers. Today, the nuts are widely cultivated oilseeds and have established as a prime commercial crop in China, India, African nations, and the United States of America.

Groundnut is a rich source of fat ranging from 36 to 54% (Asibu, 2008). Groundnuts and groundnut butter are energy-rich and nutritious foods, providing a valuable supply of a wide range of vitamins, minerals and dietary fibre (Jennette, 2003).

Groundnuts (*Arachis hypogea*) have various uses: - adds to good nutritional value, as soup thickener and when cooked, roasted, dried or fried serve as snacks. Sometimes, a paste used as margarine or butter. More so, there are less expensive, widely distributed easily cultivated, consumed and sold by the masses.

Peanut-containing foods have high consumer acceptance because of their unique roasted peanut flavour. Peanuts are continually applied for the preparation of new and improved food products (Woodroof, 1983). A large proportion of peanut production in the world is destined for domestic foods such as peanut butter, snack products, confections and roasting peanut products, showing positive results in relation to consumer acceptance and sensory and chemical stability (Ahmed and Young, 1982; Mestrallet *et al*., 2004; Nepote *et al*., 2006 a,b; Nepote *et al*., 2008). The rest of the peanut production is utilized as an edible oil source of high quality (Ahmed and Young, 1982). Peanuts contain high percentages of oil (45-54%) and protein (Savage and Keenan, 1994; Grosso *et al*., 2002).

Due to their high oil content, peanuts are rich in energy, but are susceptible to developing rancidity and off flavors through lipid oxidation because of their composition rich in unsaturated fatty acid (approximately 80%), with 40-50% and 30-40% of the oil being oleic and linoleic acids, respectively (Frankel, 2005).

Groundnut, *Arachis hypogea* L. also known as peanut or earthnut is a native to a region in eastern South America (Weiss, 1983). It is grown as an annual crop principally for its edible oil and protein-rich kernels seeds, borne in pods which develop and mature below the soil surface. The groundnuts, an herbaceous plant of which there are varieties, common in the United States, grow up to 30-46cm high does not spread. Runner varieties, the most common in West Africa are shorter and run along the ground for 30-60cm (Asiedu, 1992). Peanut *(Arachis hypogea* L.*)* is now grown worldwide in the tropic and temperate zones primarily as an oilseed crop (Bansal *et al*., 1993). Peanut seeds make an important contribution to the diet in many countries. The fatty acid composition of the endogenous fats ranges from 22 to 30%. And the average oil content may reach 50% (Pancholy *et al*., 1978; Oerise *et al*., 1974). These play an important role in determining shelf life, nutrition, and flavour of peanuts seeds.

Groundnut provides an inexpensive source of high-quality dietary protein and oil. The vast food preparations incorporating groundnut to improve the protein level have helped in no small way in reducing malnutrition in the Developing Countries (Asibuo *et al*., 2008).

Worldwide, protein deficiency is the most common form of malnutrition. In parts of Asia, Africa, and Latin America, protein deficiency occurs in millions of children (Sommer, A., 1989) and groundnut is an important source of protein for the people of those regions. They are rich in many important nutrients that can help the human body stay healthy and enable to combat a variety of disease and health conditions.

In Nigeria, children suffer from kwashiorkor, due to protein deficiency, whose symptoms includes reduced energy levels, reduced immune system

functioning, hair loss, fatigue, constipation, reduced blood pressure, mental problems, skin rashes, weight loss, diarrhoea, kwashiorkor and reduced ability to fight infectious diseases, ultimately leading to premature death.

1.3 The Need for the Development of a Plantain-Peanut Sandwich

A plantain-peanut burger is a protein source minced and stuffed into a carbohydrate source made into a roll as a food product. The plantain-peanut mix diet could be used to balance the protein-calorie composition in the diet. This is because plantains have high carbohydrate content while peanuts are rich in proteins. Groundnut is a rich source of energy due to its high oil and a protein content which helps prevent malnutrition.

Although, peanuts are high in proteins but do not contain all the essential amino acids. Peanuts lack the essential amino acid, L-methionine but contain high levels of the other essential amino acids, including L-lysine which is deficient in plantains. The Recommended Dietary Allowance (RDA) for protein is 0.8g/kg body weight for adults set by the Institute of medicine and is based on the consumption of good quality protein, (USDHHS, 2010) such as low-fat dairy, lean meat, eggs, soy, and nuts. The quality of proteins depends on its ability to provide nitrogen to meet the amino acid requirements necessary for growth, maintenance, and repair which in turn are determined by two factors- the protein digestibility and its amino acid profile.

Also, plantain is one of the main dietary starch sources and is a good source of pro-vitamin A, carotenoid which can provide up to half the human daily requirement from a single fruit (Davey *et al*., 2009).

2. Materials and Methods

2.1 Materials

Matured unripe plantain (*Musa paradisiaca*) and peanut (*Arachis hypogea*) was obtained from the Sango market in Ogun state and were processed in the food processing laboratory of the food science and technology laboratory of the University.

2.2 Methods

2.2.1 Preparation of boli (roasted plantain)

The plantain was washed, peeled and weighed before roasting in the oven. After roasting, the boli is weighed and cooled (Fig. 1).

2.2.2 Preparation of peanut butter

The groundnut was washed, sorted and de-shelled. The cleaned groundnut is soaked in 5% brine for 30 minutes, the brine is drained and oven dried and roasted at 80^{o}C for 5 days. After roasting, the husk is removed and the groundnut is milled to produce peanut butter (Fig. 2).

Fig. 1. Flowchart for boli production.

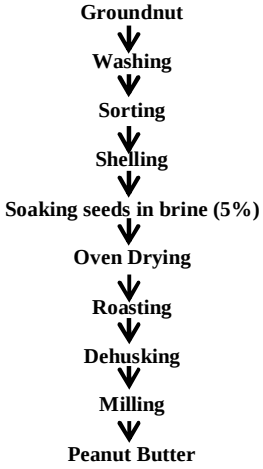

Fig. 2. Flowchart of peanut butter production.

2.2.3 Plantain-peanut mix (burger) production

The roasted plantain is weighed then 5%, 10% or 15% proportion of peanut butter is added to the roasted plantain. The plantain-peanut mix is then packaged and stored (Fig. 3).

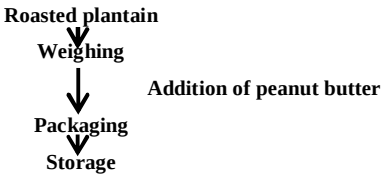

Fig. 3. Flow diagram for the production of plantain-peanut mix.

2.3 Proximate Analysis

2.3.1 Moisture content determination

The moisture content was determined using the procedure described in AOAC, (1990) was used. The moisture content was determined by weighing 5g of the sample into the aluminum moisture can after the weight of the can have been gotten. The sample was dried in an oven for 3 hours to a constant weight at 105^{o}C.

$$\text{Moisture Content} = \frac{\text{weight of can with sample} - \text{weight of empty can}}{\text{Weight of sample}} \times 100$$

2.3.2 Ash content determination

3g of the plantain and peanut butter samples was weighed into a pre-weighed crucible and then placed in a muffle furnace to ash at 600^{o}C for 3 hours and then the ash content was calculated.

$$\text{Ash content} = \frac{(\text{weight of crucible + ash}) - \text{weight of empty crucible}}{\text{Weight of sample}} \times 100$$

2.3.3 Fat content determination

Crude fat was extracted in a Soxhlet extractor with petroleum ether and quantified gravimetrically. 1g of the sample was weighed into an extraction thimble and then stopped with grease-free cotton. Before the operation commenced, the extraction cans were dried, cooled and weighed. The thimble was placed in an extraction chamber and 80ml of petroleum ether was to the extraction can to extract the fat. The extraction was carried out at 135^{o}C for 1 hour 15 minutes, after which the fat collected in the extraction cans. The cans were dried in the oven, cooled in a desiccator and the weights were taken.

$$\text{Crude fat} = \frac{(\text{weight of can + fat}) - \text{weight of empty can}}{\text{Weight of sample}} \times 100$$

2.3.4 Crude protein

The protein content was determined using a Foss Tecator^{TM} protein digester and KJELTEC 2200 distillation apparatus (Kjeldahl method) according to the procedure of AOAC, (1990). Concentrated H_2SO_4 and 2 tablets of catalyst were put into a Kjeldahl digestion flask containing 5g of the sample. The flask was placed in the digester in a fume cupboard and switched on and digestion was done for 45 minutes to obtain a clear colorless solution. The digestion was distilled with 4% boric acid, 20% sodium hydroxide solutions were automatically metered into it in the KJECTEC 2200 distillation equipment until distillation was complete. The distillate was then filtered with 0.1M HCl until a violet color formation indicating the endpoint. A blank was run under the same condition as with the sample. Total nitrogen content was then calculated according to the formula:

$$\text{Crude protein} = \frac{(\text{titre (of sample)-blank}) \times 0.01 \times 14.07 \times 6.25}{10 \times \text{Weight of sample}}$$

2.3.5 Crude fibre

2g of the sample was transferred to 1-litre conical flask. 100ml of sulfuric acid (0.255M) was heated to boiling and then introduced into the conical flask containing the sample. The contents were then boiled for 30 minutes and ensuring that the level of acid was maintained by the addition of distilled water. After 30 minutes, the contents were then filtered through a muslin cloth held in a funnel. The residue was then transferred into a conical flask. 100ml of sodium hydroxide (0.313M) was then brought to boil and then introduced into the conical flask containing the sample. The contents were boiled for 30 minutes and ensuring that the level of the acid was maintained by the addition of distilled water. After 30 minutes, the contents were filtered through a muslin cloth held in a funnel. The residue was rinsed thoroughly into an already dried crucible and ashed at 600^{o}C.

$$\text{Crude fibre} = \frac{\text{final weight of crucible} - \text{initial weight of crucible}}{\text{Weight of sample}} \times 100$$

2.3.6 Mineral Content Composition

The dry ashing procedure was used for the mineral content determination. 5g of each sample were accurately weighed into porcelain crucibles and prewashed. The pre-ashed samples were thereafter ashed in the muffle furnace at 600^{o}C till the ash was white for about 2 hours. After ashing, the crucibles were transferred into the desiccator to cool and then re-weighed. Each sample was quantitatively transferred into volumetric flasks by carefully washing the crucibles having the samples with 30ml of 0.1M H_2SO_4 through a filter paper.

The solutions were diluted to volume with deionized water and were used for individual mineral determination using the appropriate standards and blank. The content of the minerals; magnesium, iron, and copper, were determined with the Atomic Absorption Spectrophotometer (Buck Scientific, Model 210).

The percentage mineral content was calculated as follows:

Calculation:

$$\%\ \text{Mineral Element Concentration} = \frac{\text{meter reading} \times \text{slope} \times \text{dilution factor}}{1000}$$

2.3.7 Amino Acid Profile

The analysis of the amino acids was done using WATERS 616/626 LC High-Performance Liquid Chromatography (HPLC) instrument.

Amino acid analysis is a method for estimating the concentration of each individual amino acid present in a given protein or peptide samples.

The sample preparation and determination were carried out in the following stages;

2.3.7.1 Stage (1) Hydrolysis;
2.3.7.2 Stage (2) Derivatisation;
2.3.7.3 Stage (3) Separation of the derivatised amino acids;
2.3.7.4 Stage (4) Data interpretation and calculations.

2.3.7.1 Stage (1) Hydrolysis of the samples: 0.5g of the sample was weighed into the sterile furnace hydrolysis tube; 5nmols Norleucine was added to the sample and then dried under a vacuum.

The tube was again placed in a vial containing 10.05N HCL with a small quantity of phenol, thereby

hydrolyzing the protein by the HCL vapours under vacuum. This stage of hydrolysis of the samples lasted for between 20-30 hours at 108^0C grade, containing ethylenediaminetetraacetic acid (EDTA). The EDTA chelates HPLC amino acid analyzer bottles for further analytical operations.

2.3.7.2 Stage (2) Derivatisation: The hydrolyzed samples were derivatised automatically using the water 616/626 HPLC by reacting the five amino acid, under basic situations with phenyl isothiocyanate (i.e. PITC) to get phenyl thiocarbamoyl (PTC) amino acid derivatives. The duration for this is 45 minutes per sample, as calibrated on the instrument.

These standards (0.0, 0.5, 1.0, 1.5, 2.0umol) were used to generate a calibration file that was to determine the amino acid content of the samples. After the derivatisation, a methanol solution (1.5N) containing the PTC-amino acid was transferred to narrow bore water 616/626 HPLC system for separation.

2.3.7.3 Stage (3) the HPLC separation and Quantization: The separation and quantization of the PTC-amino acids were done on a reverse phase 18 silica column and the PTC chromo phone were automatically and digitally detected at the wavelength of 245nm.

The elution of the whole amino acids in the samples took 30 minutes. The buffer system used for separation was 140mm sodium acetate, pH 5.50 as buffer A and 80% acetonitrile as buffer B.

The program was run using a gradient of buffer A and buffer B concentration and ending with a 55% buffer B concentration at the end of the gradient.

2.3.7.4 Stage (4) Data interpretation and calculations: The intensity of the chromatography peak areas were automatically and digitally identified and quantified using a Dionex Chromeleon data analysis system which is attached to the waters 616/626 HPLC system.

The calibration curve or file prepared from the average values of the retention times (in minutes) and areas (in Au) at the amino acids in 5 standard runs was used.

Since a known amount of each amino acid in the loaded into the HPLC, a response factor (Au/pmol) was calculated by the software that was interphase with the HPLC. This response factor was used to calculate the amount of each of the amino acid (in pmols) in the sample and displayed on the system digitally. The amount of each amino acid in the sample is finally calculated by the software by dividing the intensity of the intensity of the peak area of each (corrected for the differing molar absorptive of the various amino acids) by the internal standard (i.e. Pierce) in the chromatogram and multiplying this by the total amount of internal standard added to the original sample.

After the Picomole by the intensity of the height of each amino acid has been ascertained by the software, the data, the digital chromatography software extrapolate back to 5nmoles of the internal standard (Norleucine), and displays for the total amount that was pipetted into the hydrolysis tube at the beginning of the analysis as below;

Calculations:

mg/ml (in Extract) = Dilution factor x peak height intensity
mg/ml (in samples) = ug/ml in extract x sample volume/wt. of sample.

2.4 Sensory Evaluation

The multiple comparison tests was used, 6 samples of the roasted plantain enriched with different proportions of peanut butter were served to 10 semi-trained panelists who were familiar with the sensory attributes. A 9-point hedonic scale was designed to measure the degree of preference of the samples. The samples were presented in identical containers, coded with 3-digit random numbers served simultaneously to ease the possibility of the panelists to re-evaluate a sample.

The categories were converted to numerical scores ranging from 1 to 9, with 1 as the lowest and 9 as the highest level of preference (Iwe, 2002).

2.5 Statistical Analysis

Data obtained were subjected to analysis of variance (ANOVA). Means were separated using Duncan multiple range tests (SPSS 16.0).

3. Results and Discussion

3.1 Proximate Composition of Peanut Butter and Plantain Roasted at Different Temperatures

The results obtained from the proximate analysis in Table 1 showed a significant difference ($P>0.05$) between the ash, fat and carbohydrate content of the plantains roasted at 200^oC and 240^oC and no significant difference ($P<0.05$) between the protein and crude fibre content. However, the difference between the peanut butter in terms of protein content, fat and carbohydrate content and the roasted plantain at different temperatures of roasting were highly significant even at the 1% level ($P<0.01$). The protein component of peanut butter at 27.3% on dry weight basis as compared with the protein components of plantain roasted at 200^oC and 240^oC which is 2.37% and 2.41% respectively. Hence, that is the reason behind the enhancement of the plantain to produce "plantain-peanut burger or plantain-peanut sandwich" which is described as a protein source (peanut butter) minced and stuffed into a carbohydrate source made into a roll as a food product. There was also a significant difference ($P<0.05$) in the crude fibre and carbohydrate content between the peanut butter and plantain samples roasted at 200^oC and 240^oC.

Table 1. Proximate Composition of Peanut Butter and Plantain Roasted at Different Temperatures on Dry Weight Basis. [Values within the same row with different superscript letters are significantly different from each other (p<0.05)].

	Peanut butter (%)	200°C Plantain (%)	240°C Plantain (%)
Ash	2.78 ± 0.04[a]	3.01 ± 0.01[b]	3.14 ± 0.02[c]
crude fibre	3.36 ± 0.01[b]	2.56 ± 0.01[a]	2.59 ± 0.05[a]
Fat	42.9 ± 0.05[c]	2.19 ± 0.02[b]	1.9 ± 0.13[a]
crude protein	27.3 ± 0.10[b]	2.37 ± 0.01[a]	2.41 ± 0.01[a]
carbohydrates	23.55 ± 0.10[a]	89.85 ± 0.07[b]	89.94 ± 0.09[c]

Legend: 200°C P: Plantain Roasted At 200°C; 240°C P: Plantain Roasted At 240°C; 5% Pb: Enrichment With 5% Peanut Butter; 10% Pb: Enrichment With 10% Peanut Butter; 5% Pb: Enrichment With 15% Peanut Butter.

3.2 Proximate Composition of Roasted Plantain at Different Temperatures Enriched With Different Proportions of Peanut Butter

The result in Table 2 showed the enhanced plantain burger roasted at different temperatures of 200°C and 240°C showed an appreciable increase in protein and fat components as the level of enhancement increases as compared to Abioye *et al*., (2011) where the protein and fat contents increased with increasing level of soy flour substitution indicating nutrients enhancement with soy flour substitution ranging from 2.54% and 0.45% (0% soy flour substitution) to 8.40% and 7.05% (40% soy flour substitution) respectively (Abioye *et al*., 2011). The significant increase in the fat and protein content is obviously due to the significant quantity of protein and fat in peanut butter. There is a significant decrease ($P<0.05$) in the carbohydrate content as the content of the peanut butter increases, which is similar to research by Adelakun *et al*., (2005), the physical, compositional and sensory characteristics of soybean substitution in the production of Kokoro, the protein and fat contents increased while the carbohydrate content decreased as the proportion of the soybean flour mixture was increased. There is a significant increase in the ash content of the roasted plantain at 200°C and 240°C as the proportion of the peanut butter increased.

Table 2. Proximate Composition of Roasted Plantain at Different Temperatures Enriched with Different Proportions of Peanut Butter on Dry Weight Basis [Values Within the Same Row with Different Superscript Letters are Significantly Different From Each Other (P<0.05)].

	200°C P + 5%PB	200°C P + 10%PB	200°C P + 15%PB	240°C P + 5%PB	240°C P + 10%PB	240°C P + 15%PB
Ash	3.91 ± 0.05[d]	3.56 ± 0.01[d]	4.72 ± 0.02[e]	1.84 ± 0.02[a]	3.08 ± 0.02[c]	3.02 ± 0.02[b]
crude fibre	4.56 ± 0.02[d]	3.81 ± 0.02[c]	3.43 ± 0.02[b]	3.98 ± 0.01[c]	3.57 ± 0.01[b]	3.19 ± 0.02[a]
Fat	20.44 ± 0.03[a]	24.92 ± 0.08[c]	29.57 ± 0.08[e]	20.64 ± 0.50[b]	26.47 ± 0.55[d]	30.30 ± 0.76[f]
crude protein	4.77 ± 0.29[a]	6.39 ± 0.06[b]	7.99 ± 0.10[c]	5.01 ± 0.05[a]	6.70 ± 0.09[b]	8.09 ± 0.04[c]
Carbohydrate	66.30 ± 0.35[b]	61.30 ± 0.33[c]	54.27 ± 0.31[a]	68.50 ± 0.36[d]	60.17 ± 0.50[c]	55.38 ± 0.33[c]

Legend: 200°C P: Plantain Roasted At 200°C; 240°C P: Plantain Roasted At 240°C; 5% Pb: Enrichment With 5% Peanut Butter; 10% Pb: Enrichment With 10% Peanut Butter; 15% Pb: Enrichment With 15% Peanut Butter.

3.3 Essential Amino Acid Profile of Peanut Butter, Roasted Plantain at Different Temperatures and at a Different Enrichment Level

The result in Table 3 shows the amino acid profile of peanut butter, and plantain roasted at 200°C and 240°C respectively. For the peanut butter, threonine had the highest percentage among the essential amino acid having 3.2%, this amino acid is needed to create other amino acids that aid the production of collagen and it is also important for antibody production (Travis, 2014) followed by lysine (2.37%). In the plantain samples roasted at 200°C and 240°C, there was a decrease in most of the essential amino acids except leucine and arginine. Lysine is the most vulnerable to stress of all the amino acids, because of the epsilon group which could easily be knocked off during processing (Malomo *et al*, 2012).

The result in Table 4 shows the essential amino acid profile of plantain roasted at 200°C enriched with different 5%, 10% and 15% peanut butter. There is an appreciable increase in the percentage of the essential amino acids as the proportion of peanut butter increases. Also in the substitution of soybean with poundo yam, the amino acid of poundo yam increased with increasing enrichment levels (Malomo *et al*., 2012).

Table 3. Essential Amino Acid Profile of Roasted Plantain at Different Temperatures.

Amino Acids	Peanut butter	200°C plantain	240°C plantain
Threonine	3.20	2.03	1.85
Leucine	0.84	0.06	0.49
Isoleucine	0.41	1.06	0.90
Lysine	2.37	1.00	0.77
Methionine	0.77	0.49	0.45
Phenylalanine	0.85	1.46	1.10
Tyrosine	1.39	1.45	0.70
Valine	0.28	0.45	0.10
Arginine	0.74	0.13	0.99
Histidine	1.07	1.02	0.44

Legend: 200°C P: Plantain Roasted At 200°C; 240°C P: Plantain Roasted At 240°C; 5% Pb: Enrichment With 5% Peanut Butter; 10% Pb: Enrichment With 10% Peanut Butter; 15% Pb: Enrichment With 15% Peanut Butter.

The result in Table 5 shows the essential amino acid profile of plantain roasted at 240°C enriched with 5%, 10% and 15% peanut butter, there is also an increase in the percentage of essential amino acids as the proportion of peanut butter increases.

Table 4. Essential Amino acid profile of 200°C roasted plantain enriched with different proportions of Peanut butter.

Amino Acid	200°C P + 5% PB	200°C P + 10% PB	200°C + 15% PB
Threonine	2.06	2.14	2.20
Leucine	0.09	0.13	0.18
Isoleucine	0.95	0.97	1.01
Lysine	1.06	1.12	1.19
Methionine	0.51	0.52	0.53
Phenylalanine	1.34	1.35	1.32
Tyrosine	0.48	0.52	0.58
Valine	0.13	0.14	0.15
Arginine	0.98	0.99	1.01
Histidine	0.33	0.37	0.41

Legend: 200°C P: Plantain Roasted At 200°C; 240°C P: Plantain Roasted At 240°C; 5% Pb: Enrichment With 5% Peanut Butter; 10% Pb: Enrichment With 10% Peanut Butter; 15% Pb: Enrichment With 15% Peanut Butter.

Table 5. Essential Amino acid profile of 240°C roasted plantain enriched with different proportions of Peanut butter.

Amino Acid	240°C P + 5% PB	240°C P + 10% PB	240°C P + 15% PB
Threonine	2.00	2.03	2.11
Leucine	0.53	0.55	0.89
Isoleucine	0.82	0.85	0.87
Lysine	0.85	0.93	1.00
Methionine	0.46	0.47	0.49
Phenylalanine	1.06	1.07	1.08
Tyrosine	0.40	0.45	0.50
Valine	0.79	0.81	0.84
Arginine	0.93	0.94	0.97
Histidine	0.47	0.49	0.53

Legend: 200°C P: Plantain Roasted At 200°C; 240°C P: Plantain Roasted At 240°C; 5% Pb: Enrichment With 5% Peanut Butter; 10% Pb: Enrichment With 10% Peanut Butter; 15% Pb: Enrichment With 15% Peanut Butter.

3.4 Mineral Content of Peanut Butter and Plantain Roasted at Different Temperatures

The mineral content of peanut butter and plantain roasted at 200°C and 240°C is shown in Table 6.

Table 6. Mineral Content of Peanut Butter and Roasted Plantain at Different Temperatures.

SAMPLE	Magnesium mg/100g	Iron mg/100g	Copper mg/100g
Peanut Butter	101.00^{b}	2.40^{b}	0.71^{a}
200°C plantain	47.20^{a}	2.19^{a}	1.40^{b}
240°C plantain	47.20^{a}	2.22^{a}	1.50^{b}

Legend: 200°C P: Plantain Roasted At 200°C; 240°C P: Plantain Roasted At 240°C; 5% Pb: Enrichment With 5% Peanut Butter; 10% Pb: Enrichment With 10% Peanut Butter; 15% Pb: Enrichment With 15% Peanut Butter.

The result showed a significant difference ($P<0.05$) between peanut butter and plantain roasted at 200°C and 240°C in the magnesium content, the magnesium content of peanut butter is higher than the magnesium content in the plantain roasted at 200°C and 240°C. Also in the iron and copper content of peanut butter, 200°C roasted plantain, and 240°C roasted plantain.

In Table 7, there was a significant difference ($P<0.05$) in the magnesium, iron and copper content of 200°C roasted plantain enriched with 5%, 10% and 15% proportions of peanut butter.

In Table 8, there was a significant difference ($P<0.05$) in the magnesium, iron and copper content of 240°C roasted plantain enriched with 5%, 10% and 15% proportions of peanut butter.

Table 7. Mineral Content of Roasted Plantain at 200°C Enriched With Different Proportions of Peanut Butter.

SAMPLE	Magnesium mg/100g	Iron mg/100g	Copper mg/100g
200°CP+5%PB	47.55^{a}	2.19^{a}	1.41^{a}
200°CP+10%PB	48.09^{b}	2.25^{b}	1.45^{b}
200°CP+15%PB	48.85^{c}	2.55^{c}	1.51^{c}

Legend: 200°C P: Plantain Roasted At 200°C; 240°C P: Plantain Roasted At 240°C; 5% Pb: Enrichment With 5% Peanut Butter; 10% Pb: Enrichment With 10% Peanut Butter; 15% Pb: Enrichment With 15% Peanut Butter.

Table 8. Mineral Content of Roasted Plantain at 240°c Enriched With Different Proportions of Peanut Butter.

SAMPLE	Magnesium mg/100g	iron mg/100g	copper mg/100g
240°CP+5%PB	47.23^{a}	2.24^{a}	1.46^{a}
240°CP+10%PB	47.53^{b}	2.29^{b}	1.5^{b}
240°CP+15%PB	48.35^{c}	2.7^{c}	1.57^{c}

Legend: 200°C P: Plantain Roasted At 200°C; 240°C P: Plantain Roasted At 240°C; 5% Pb: Enrichment With 5% Peanut Butter; 10% Pb: Enrichment With 10% Peanut Butter; 15% Pb: Enrichment With 15% Peanut Butter.

Fortification with soy flour is advantageous due to the increased nutritional value (higher mineral and protein content) (Morteza *et al.*, 2008). This also applies to fortification or enrichment with peanut butter or any plant protein.

3.5 Sensory Evaluation of Roasted Plantain at Different Temperatures Enriched With Different Proportions of Groundnut

The result for sensory evaluation is represented in Table 9.

This result was evaluated in terms of appearance, colour, taste, aroma, mouth feels and overall acceptability. The appearance of plantain roasted at 240^{o}C and enriched with 15% peanut butter was significantly different ($P<0.05$) from the other roasted plantain samples, but the plantain roasted at 200^{o}C enriched with 15% peanut butter was the least liked by the panelists. The taste of the 240^{o}C roasted plantain enriched with 15% peanut butter was the most liked and was significantly different ($P<0.05$) from the 200^{o}C plantain enriched with 15% peanut butter was the least liked. The aroma of the 240^{o}C roasted plantain enriched with 10% peanut butter was the most preferred choice by the panelists and it was significantly different from 200^{o}C roasted plantain enriched with 5% peanut butter. The colour of the plantain samples roasted at 240^{o}C enriched with different proportions of peanut butter was significantly different at the 5% level from the plantain samples roasted at 200^{o}C enriched with different proportions of peanut butter. There was a significant difference ($P<0.05$) in the mouthfeel of the roasted plantain samples, but the least liked by the panelists was the 200^{o}C roasted plantain enriched with 15% peanut butter. There was a significant difference ($P<0.05$) in the overall acceptability between plantain roasted at 240^{o}C enriched with 15% peanut butter and the roasted plantain samples, but the least liked by the panelists was the 200^{o}C roasted plantain enriched with 15% peanut butter.

3.6 Marketability

According to the choice of the panelists, the 240^{o}C plantain enriched with 15% peanuts was preferred. Therefore more of the samples be produced and conveyed to the market for further market analysis. A product concept testing questionnaire was prepared alongside the sensory evaluation and a majority of the panelists agreed that the proposed price (N150) was moderate.

3.7 Feasibility Study

3.7.1 Executive Summary

This report is designed to explain in an elaborate and more detailed manner the step by step process of starting up a boli and groundnut company which will include a feasibility study of both the micro (companies internal capabilities) and macro (other external market forces) environment in which the business will be operating and competing in.

It will be located in Epe, a suburb of Lagos state. This is because it offers cheaper land cost construct the factory and is also close to the Lagos-Ore-Benin Express, which provides a close proximity for easy movement to other markets outside Lagos, once expansion program kick starts.

Little or no research has been done on the plantain-peanut burger because it is a new product that is being developed, it was discovered that while the business of locally made roasted plantain (boli) and groundnut was relatively very competitive in Lagos state, given a large number of producers presently in operation, the large consumer space offered by the busy metropolis and its higher per capita income, ensures the market offers a healthy niche for profit to be made.

From the analysis drawn from the internal capabilities of the business, the best market entry solution was to initially penetrate the market using a market penetration approach – charging lower prices. This strategy would help in attracting many customers with a view of dominating the market. The prices could be then increased gradually to achieve the desired goal of the business.

3.7.2 Industry Background

The Plantain-peanut burger business will be a rich and vast industry, especially in a developing country like Nigeria. This consumable has seen a long attraction in the homes of Africans, particularly Nigeria over 40 years ago and has become a regular staple in most homes. In recent times, however, the growing frequency of in homes forced demands beyond the privacy of homes to the commercial streets of cities across the country.

Table 9. The Mean of The Sensory Evaluation [Values within the same row with different superscript letters are significantly different from each other (p<0.05)].

Sensory Parameters	200^{o}C P + 5%PB	200^{o}C P + 10%PB	200^{o}C P + 15%PB	240^{o}C P + 5%PB	240^{o}C P + 10%PB	240^{o}C P + 15%PB
Appearance	5.8^{a}	5.7^{a}	5.1^{a}	7.1^{b}	7.1^{b}	8.1^{c}
Taste	6.5^{ab}	5.9^{a}	5.4^{a}	6.7^{ab}	6.3a^{b}	7.6^{b}
Aroma	5.8^{a}	6.8^{ab}	6.4^{ab}	6.0^{a}	7.4^{b}	6.5^{ab}
Color	5.9^{a}	5.6^{a}	5.2^{a}	7.0^{b}	7.1^{b}	7.9^{b}
Mouth Feel	6.2^{b}	5.8^{ab}	4.9^{a}	6.4^{bc}	6.4^{bc}	7.6^{c}
Overall Acceptability	6.1^{a}	5.5^{a}	5.4^{a}	7.2^{b}	7.3^{b}	8.2^{c}

Legend: 200^{o}C P: Plantain Roasted At 200^{o}C; 240^{o}C P: Plantain Roasted At 240^{o}C; 5% Pb: Enrichment With 5% Peanut Butter; 10% Pb: Enrichment With 10% Peanut Butter; 15% Pb: Enrichment With 15% Peanut Butter

It could be considered one of the top-selling consumables of the streets of Lagos, ranking higher than global brands such as plantain chips, popcorn, and cheese balls, etc. It will be sold in supermarkets, marketplaces, and is particularly popular in traffic jams and major bus stops.

This is a new product which could be introduced into the Lagos market. Research findings suggest regions like the Lagos Island, Ikeja, Lekki and Yaba are strategic spots for higher sales traffic within the state.

Lagos is Nigeria's commercial capital city, holding over 20 million people and the higher middle class in Nigeria. With most of the country's living billionaires, and a per capita income of $2,700 and growing, the city boasts one Africa's biggest consumer markets, meaning large returns on sales revenue is expected for manufacturers who can successfully target their niche.

These listed key areas could be exploited to attain maximum sales, employing the marketing and business strategy that should guarantee a smooth and swift entry into the consumables market.

3.7.3 Business Environment

3.7.3.1 Political: The recent surfacing of the democratic government has allowed for easier processing of business documents, start-up filings and also the influx of foreign investor who can directly or indirectly impact the growth of the event hall industry. Also, newer government rules aimed towards bank lending have helped improve the ease with which loans are acquired to facilitate better delivery of services towards the customers. Despite this, recent terror attacks by the Boko Haram group have sparked uncertainty and some level of political and economic stability, with bomb blasts targeting key commercial clusters derailing consumer spending and discouraging outdoor activities, which are key selling points for the company.

3.7.3.2 Economic: With the world becoming an even more global and smaller village, trade and investment barriers have shrunken giving room for free transfer of goods and services necessary for the development of the company to the standard needed. Nigeria is experiencing sustainable economic growth of over 7 percent yearly, with international inflows of firms that will surely raise competition and reduce sales turnover. It, however, fosters effectiveness from companies willing to manage sustained business progress.

3.7.3.3 Technological: The increase in the use of technological gadgets such as iPad and Samsung Galaxy for the supply chain management and distribution networks will help improve the delivery for customer satisfaction.

3.7.3.4 Social: Lagos is a busy city with major traffic jams occurring daily. This leaves a lot of people stuck on the road most days and in need of a casual bite. The company, as seen with other top sellers can leverage on the social habits to grow market share and brand presence. Lagos also has the right mix of rich and poor, with a growing middle class and a healthy spending habit. This shows a number of visits paid to supermarkets and malls, ensuring that market patronage will not pose a significant challenge.

3.8 Product/Service Review

We offer one basic product, Plantain-peanut burger. However, we offer a wider range of flavours and size packs to allow us to cover every customer's individual needs:

- **Product**
  i. Plantain-peanut burger
- **Flavours**
  i. Peppered unripe flavor
  ii. Salted unripe flavor
  iii. Peppered ripe flavor
  iv. Salted ripe flavour
- **Size Packages**
  i. Extra Large (Plastic Can)
  ii. Large
  iii. Medium

3.9 SWOT Analysis

SWOT critically analyzes internal capabilities and shortcomings as well as external threats to the business survivor and also opportunities for newer market entry.

3.9.1 Strengths: Good management coupled with competent staff and an extensive distribution network form part of the company's key strengths.

Also, we critically review suppliers to establish and regulate a high level of service delivery to customers at a satisfactory height.

3.9.2 Weaknesses: Insufficient funds for capital expansion and marketing campaigns. Also, the limited workforce might dampen service delivery at the level expected by the customers.

3.9.3 Opportunities: Strategic alliances with similar firms or suppliers will create a more effective and cost driven service delivery to our customers. Also, the ease of expansion into a similar business like peanuts and popcorn bagging might provide a more robust product portfolio for the company.

3.9.4 Threats: More established competitors serve a potential business threat to the brand development of the company. Also, a recent crisis such as the Boko Haram menace can reduce the level of foreign strategic partnership to provide more effective service delivery.

3.10 Organizational Objectives and Issues

3.10.1 First Three Years Objectives

Year One:

- 3 months-6 months test marketing.

Year Two:

- Commence preliminary marketing campaigns to attract initial customers and get plantain-peanut mix (burger) into the minds of the market.
- Start production at 50% capacity levels.

Year Three:

- Develop sustainable alliances with well-established distributors and suppliers to ensure a comprehensive supply chain is effectively managed.
- Start production at 60% capacity levels.

Year Four to Year Six Objectives:

- Increase production capacity to 100%.

3.10.2 Issues: The low or almost zero availability of materials needed for infrastructural developments as well as the unavailability of technological know-how might increase the risk of lower service delivery. Hence, more cost might be incurred in ensuring a high-quality standard is kept. Meaning equipment might be imported from foreign countries.

3.10.3 Business Strategy

3.10.4 Target Market Profile: We would have a very diverse and wide target market. Most people enjoy a healthy snack, meaning we target almost every age group, asides toddlers and those with specific health conditions. Commuters who ply major traffic jam spots are our primary targets as they provide the largest sales group for us.

The wide range of flavours to choose from ensures we expand our target portfolio.

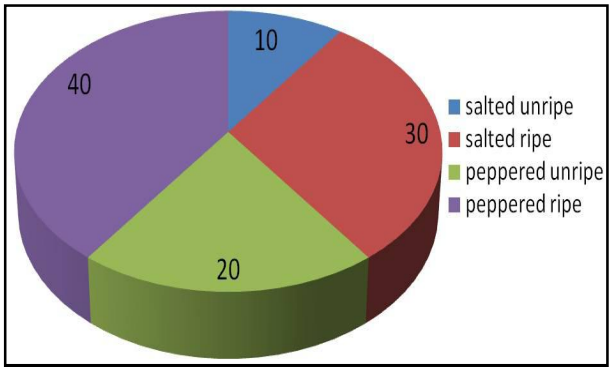

Fig 4. Chart showing the percentage target market of different flavours.

3.10.5 Business Positioning: We aim at establishing its brand in the mind of its customer through mass advertising and PR campaigns as the unique and exclusive plantain-peanut burger, bringing an extensive array of flavors to its customers.

4. Product/Service Strategy

We plan to employ both the differentiation and penetration entry strategy. Differentiation in the sense that it brings a different dimension to the usual cliché snacks offered by most competitors, and penetration strategy to give customer fair prices.

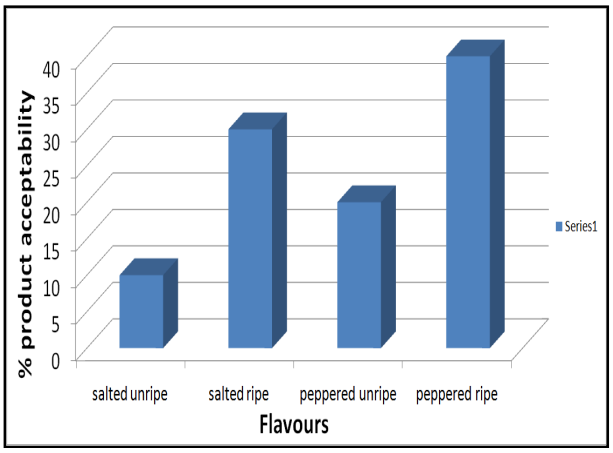

Fig 5. Chart showing the flavours of plantain peanut butter and their product acceptability.

4.1 Quality of Services

Providing quality plantain-peanut burger, produced under healthy environments with a wide array of flavors and sizes to suit any customer's need.

4.2 Flexibility

Developing a flexible relationship with our customers to suit their needs is very essential. Specialized varieties (for example; the concentration of peanut butter or either ripe or unripe plantain etc.) can be developed to suit specific needs of customers to meet customized desires.

4.3 Customer Relationship Management

CRM is essential as our customers are part of the family. Therefore, brochures will be designed and distributed regularly to showcase newer offerings as well as extra benefits on offer for our loyal customers. We will ensure regular feedback is received from loyal customers regarding all aspects of the business. This will be reviewed yearly and adjustments will be made.

5. Marketing Strategy (Promotion / Communication)

5.1 TV / Radio Advertisement

A large percentage of Nigerians patronize the TV / Radio basically media for their primary source of information, hence we will exploit this means of advertising: Using TV stations like AIT and NTA as

well as local radio stations to meet the customers at their primary source of information seeking.

5.2 Internet

The use of the website to display sample hall decorations, meeting/conference rooms and up and coming events. Also, events can be booked online and appointments with the event planner and other related staff can be arranged as well.

5.3 Buzz Marketing

The use of social networks such as Twitter and Facebook will be another source of major advertising for the company.

5.4 Market Research

As earlier noted the use of surveys both online and physical distribution will be part of a regular routine for the company in order to collect feedback from existing customers and also to understand the need and demands from potential future customers.

6. Action Programs

- **Month 1:** Organization of company's program schedules.
- **Month 3:** Search for suppliers and selection, factory worker recruitment.
- **Month 6:** Search for financial investment and funding, an advertisement for the general public.

From Table 10, the budgeted expense(s) for the first year of the business is a total of 4,500,000 Naira and it is spread across building, machinery, it also covers the cost of plantain and groundnut, vehicles, fuel and other contingencies.

Table 10. Budgeted Expenses for First Year.

Estimated Project Cost	N (Naira)
Building	2,500,000
Machinery for plantain and groundnut	1,000,000
Vehicles	500,000
Fuel	250,000
Contingencies	250,000
Grand total	4,500,000

7. Business Organization

From Table 11, the financial plan and projected cost of the business which shows the breakdown in finance spent on amortization of preliminary expenses, cost of plantain and packs, salaries and wages, fuelling and lubrication, travelling expenses, advertisement and sales promotion, medication, repairs and maintenance, professional, finance charges over the period of five years. After the first year, an increase of 10% of expenses was estimated, excluding amortization of preliminary expenses and finance charges (interest).

8. Financial Plan

Loan = 5,000,000
Total = 5,000,000

It is assumed that a loan is taken and paid back within the period of five years.

Table 11. Project Cost and Financial Plan (Project to be financed by self = N 4,500,000).

S/N	CATEGORY	1ST YEAR (N)	2ND YEAR (N)	3RD YEAR (N)	4IH YEAR (N)	5IH YEAR (N)	% ANNUAL INCREASE
1	Amortization of Prelim. Expenses	200,000	200,000	200,000	200,000	200,000	0
2	Cost of plantain and packs	2,500,000	2,750,000	3,025,000	3,327,500	3,660,250	10
3	Salaries and wages	200,000	220,000	242,000	266,200	292,820	10
4	Fuelling and lubrication	600,000	660,000	726,000	798,600	878,460	10
5	Traveling expenses		100,000	110,000	121,000	133,100	10
6	Advertisement and sales promo	100,000	110,000	121,000	133,100	146,410	10
7	Medication	100,000	110,000	121,000	133,100	146,410	10
8	Repairs and maintenance	50,000	55,000	60,500	66,550	73,205	10
9	Professional		50,000	55,000	60,500	66,550	10
10	Finance charges (interest)	30,000	30,000	30,000	30,000	30,000	0
	Total	3,680,000	4,285,000	4,690,500	5,076,050	5,627,205	

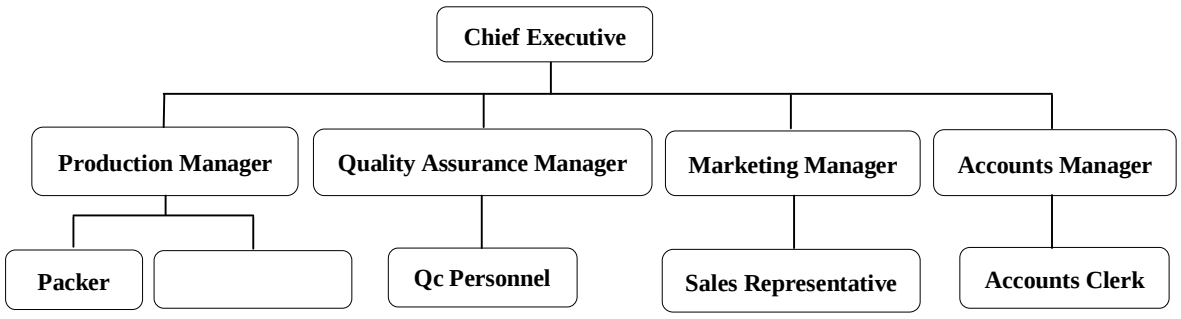

Fig. 6. Structure of business organization.

From Table 12, the loan taken in principal terms is 5,000,000 Naira and the repayment schedule is spread across five years with a 25% interest rate. The interest paid in total is 4,375,000 Naira; the principal repayment is 5,000,000 Naira, the installment payment amounts to 9,375,000 Naira.

From Table 13, in the first year, the number of packs to be sold is 15,000 packs. 50 packs would be sold daily for 25 working days in a month, in 250 days with 15,000 packs estimated as sold. From, the number of packs sold, the estimated total revenue generated, calculated, for the first year amounted to 9 million Naira and after the fifth year, the revenue amounted to 11,979,000 Naira.

From Table 14, the vehicle used for the transportation of goods was depreciated for 5 years, giving an annual depreciation of 100,000 Naira per annum.

From Table 15, the gross sales for the first and second year was 9 million Naira and there was no increase in the second year because the first and second year was used for test marketing, and there was a constant increment of 10% provided from the third year to the fifth year. The Net profit is the gross sales less production cost. The company tax used is 40% of the Net profit. And the Net profit after tax for the first year was 3,192,000 Naira. There was a reduction in profit for the second year, all because the gross sales were constant and there was repayment of the loan. The net profit increase in the third year was as a result of the 10% increase estimated in the gross sales.

From Table 16, the net profit after tax for the first year was 3,192,000 Naira, and the depreciation and finance charges were added together to arrive at the total cash generated internally.

From Table 17, for the first year, there was no provision for loan payment as the loan payment begins from the second year. The addition of the finance charges and principal loan repayment resulted in the total debt servicing and the total cash flow. The net cash balance recorded was the total internally generated cashless the total cash flow.

Table 12. Loan repayment schedule.

YEAR	Loan taken (N)	Interest paid (N)	Principal repayment (N)	Installmental payment (N)	Outstanding (N)
1	5,000,000	1,250,000		1,250,000	5,000,000
2		1,250,000	1,250,000	2,500,000	3,750,000
3		937,500	1,250,000	2,187,500	2,500,000
4		625,000	1,250,000	1,875,000	1,250,000
5		312,500	1,250,000	1,562,500	
	TOTAL	4,375,000	5,000,000	9,375,000	

Loan volume = 5,000,000; Loan period = 5 years; Interest rate = 25%

(Malomo, 2008)

Table 13. Projected Revenue.

YEAR	Number of Packs/Annum	Price/Pack (N)	Total Revenue (N)
1	15000	**N** 600	9,000,000
2	15000	**N** 600	9,000,000
3	16500	**N** 600	9,900,000
4	18150	**N** 600	10,890,000
5	19965	**N** 600	11,979,000

Table 14. Schedule of Depreciation.

ITEM	COST (N)	ANNUAL DEPRECIATION
VEHICLE	500,000	100,000

Table 15. Projected Income Statement.

	1st year	2nd year	3rd year	4th year	5th year
Gross sales	9,000,000	9,000,000	9,900,000	10,890,000	11,979,000
Less production cost	3,680,000	4,285,000	4,690,500	5,076,050	5,627,205
Net profit before tax	5,320,000	4,715,000	5,209,500	5,813,950	6,351,795
Less company tax (40%)	2,128,000	1,886,000	2,083,800	2,325,580	2,540,718
Net profit after tax	3,192,000	2,829,000	3,125,500	3,488,370	3,811,077

Table 16. Cash Flow Analysis.

ITEMS	1ST YEAR (N)	2ND YEAR (N)	3RD YEAR (N)	4TH YEAR (N)	5TH YEAR (N)
SOURCE OF FUNDS					
NET PROFIT AFTER TAX	3,192,000	2,829,000	3,125,500	3,488,370	3,811,077
ADD DEPPRECIATION	100,000	100,000	100,000	100,000	100,000
ADD FINANCE CHARGES	1,250,000	1,250,000	1,250,000	1,250,000	1,250,000
TOTAL INTERNALLY GENERATED CASH = (A)	4,542,000	4,179,000	4,475,500	4,838,370	5,161,077

Table 17. Application of Funds.

FINANCE CHARGES	1,250,000	1,250,000	937,500	625,000	312,500
PRINCIPAL LOAN REPAYMENT		1,250,000	1,250,000	1,250,000	1,250,000
TOTAL DEBT SERVICING	1,250,000	2,500,000	2,187,500	1,875,000	1,562,500
TOTAL CASH FLOW =(B)	1,250,000	2,500,000	2,187,500	1,875,000	1,562,500
NET CASH BALANCE (A-B)	3,292,000	1,679,000	2,288,000	2,963,370	3,598,570

9. Break-Even Point Analysis

From the break-even point analysis, the third year was used for the analysis because the first and second year were years of test marketing. The target capacity for the year 3 was 18,150 packs and the percentage of packs to be used was 60.5%. The variable cost obtained from adding the packaging material cost, utilities, selling and distribution expenses and contingencies amounted to 4,201,000 Naira. The semi-variable or fixed cost was obtained by the addition of wages and salaries, factory overhead expenses, admin expenses, interest, term on loan and depreciation, amounted to 1,803,000 Naira. The sales realisation for the third year was 9,900,000 Naira. The contribution which is the sales realisation less variable cost is 5,699,000 Naira. The break-even point was calculated by dividing the sales realisation by the contribution and multiplying by the percentage of packs attained. The break-even point calculated was 19.14%, meaning that profit could still be made if 19.14% of the produce is sold. The cash break-even point was calculated using the Semi-variable or fixed cost multiplied by the percentage of packs attained and divided by the 'Contribution'. The cash break-even point obtained amounted to 18.07%.

NORMAL YEAR OF OPERATION		3 YEARS	
A.	TARGET CAPACITY	18,150 PACKS	
B.	OPTIMUM TARGET		
C.	PERCENTAGE ATTAINED	60.5% PACKS	
D.	VARIABLE COST	N	N
	PACKAGING MATERIAL COST	3,025,000	
	UTILITIES	200,000	
	SELLING AND DISTRIBUTION EXPENSES	726,000	
	CONTIGENCY	250,000	4,201,000
E.	SEMI VARIABLE/ FIXED COSTS		
	WAGES AND SALARIES	242,000	
	FACTORY OVERHEAD EXPENSES	726,000	
	ADMIN EXPENSES	110,000	
	INTEREST ON TERM LOAN	625,000	
	DEPRECIATION	100,000	1,803,000
F.	SALES REALIZATION		9,900,000
G.	CONTRIBUTION (F-D)		5,699,000
H.	BREAK-EVEN POINT		

$$\frac{E/G \times 60.5}{\frac{1{,}803{,}000 \times 0.605 \times 100}{5{,}699{,}000}} = 19.14\%$$

I. CASH BREAK-EVEN POINT

$$\frac{\frac{E\text{-}DEPRECIATION \times 0.605 \times 100}{G}}{\frac{(1{,}803{,}000\text{-}100{,}000) \times 0.605 \times 100}{5{,}699{,}000}} = 18.07\%$$

10. Control Measures

- One of the control measures applied were the development of a comprehensive supply chain management and marketing information system (MIS) which includes financial accounting software, marketing software, inventory management software, database management software to keep track of financial records, marketing information, customer information and inventory records.
- Also a contingency planning for future emergencies, e.g. purchase of liquid assets that can be sold during financial distress.

11. Conclusion

Results from this study indicated that the peanut butter used in enriching the roasted plantain was able to increase the protein content as well as other proximate compositions except for the carbohydrate in the various combinations. Also, the amino acid profile of the peanut burger increased with enrichment levels. The overall acceptability of the plantain roasted at 240^{o}C enriched with 15% peanut butter received the highest rating.

In conclusion, the addition of peanut butter at 5%, 10%, and 15% levels resulted in a notable increase in protein content which could be a very good nutritional advantage to Nigerians because animal protein is quite expensive. The addition of peanut butter will have little or no effect on the price because the peanut is readily available in the market.

This project was discovered to be very viable judging from the break-even point analysis estimated to be 19.04% and 18.07% for the product and cash break-even analysis respectively. This means that selling less than 20% of the total estimated production volume per annum and at less than 20% price value, the venture would still remain viable.

References

[1]. Abioye, V.F., Ade-Omowaye, B.I.O., Babarinde, G.O. and Adesigbin, M.K. (2011). Chemical, Physicochemical and sensory properties of soy-plantain flour. *African Journal of Food Science*, 5(4): 176 – 180.

[2]. Adelakun, O.E., Adejuyitan, J.A., Olajide, J.O. & Alabi, B.K. (2005). Effect of Soybean Substitution on some Physical, Compositional and Sensory Properties of Kokoro (a local maize snack). *European Food Research and Technology*, 220: 79- 82.

[3]. Ahmed, E.M. and C.T., Young (1982). Composition, quality, and flavor of peanuts. In: Pattee, H.E. and C.T. Young (eds). Peanut Science and Technology. Yoakum, Texas: Am. Peanut Res. Edu. Soc., Yoakum, Texas, 655-688.

[4]. Akubor, P.I., Ojih, S.A. (2009). Effect of ripening of plantain fruit on the chemical and sensory qualities of fayaba-a traditional plantain: maize snack Niger. *J. Nutr. Sci*., 30 (2):116-122.

[5]. Akubor, P.I. (2003). Functional properties and performance of cowpea/ plantain/ wheat flour blends in biscuit. *Plant Foods Hum. Nutr*., 58:1-8.

[6]. AOAC (1990). Official Methods of Analysis. Association of Official Analytical Chemists, 15th ed; AOAC Arlington, Virginia.

[7]. Asibuo, J.Y., Akromah, R., Safo-Kantanka, O., Adu-Dapaah, H.K., Ohemeng-Dapaah, S. & Agyeman, A. (2008). Chemical composition of groundnut, Arachis hypogaea (L) landraces. *African Journal of Biotechnology*, 7(13): 2203-2208.

[8]. Asibuo, J.Y., Akromah, R., Adu-Dapaah, H.K. and Safo-Kantanka, O. (2008). Evaluation of nutritional quality of groundnut (*Arachis hypogaea* L.) from Ghana. AJFAND, 8(2): 133-150.

[9]. Asiedu, J.J. (1992). Processing Tropical crops a technological Approach. The Macmillan Press Publication Ltd. Second Edition, pp: 43-84, 124-145,167-788.

[10]. Bansal, U.K., Satija, D.R. and Ahuja, K.L. (1993). Oil Composition of diverse groundnut (*Arachis hypogaea* L.) Genotypes in relation to different environments. *J. Sci. Food Agric.*, 63:17-19.

[11]. Davies, G. (1993). Production domestique de la bière de banane dans la région de Mpigi, Ouganda. *Infomusa*, 2(1): 12-15.

[12]. Oerise, N.L., Lau, H.A., Ritchey, S.J. and Murphy, E.W. (1974). Yield, proximate composition and mineral elemental content of three cultivars of raw and roasted peanuts. *J. Food Sci.*, 39: 264-266.

[13]. Food Agriculture Organisation (FAO) 1990. Annuaire de la production mondiate (Annual Book of the World Production). Roma, Italy.

[14]. FAO (1999). Banana: Plantain Post-harvest Operations.

[15]. FAO (2004). Food and Agriculture Organisation, Statistics Series No. 95. Food and Agriculture Organisation of the United Nations, Rome, 2004.

[16]. FAO (2005). http//apps.fao.org/page/collection?subset=agriculure.

[17]. FAO (2005). http//apps.fao.org/page/collection?subset=agriculure.

[18]. FAO (2004). http//apps.fao.org/page/collection?subset=agriculure.

[19]. FAO (1990). FAO Corporate Document Repository.

[20]. Frankel, E.N. (2005). Lipid Oxidation, 2nd ed., Oily Press Lipid Library Series. Bridgwater, England, pp.1-470.
[21]. Grosso, N.R., Nepote, V., Giannuzzo, N., Guzman, C.A. (2002). Composicion porcentual de acidos grasos y de esteroles de algunos genotipos de especies silvestres de mani. Anales-Asociacion Quimica Argentina (Journal of the Argentine Chemical Society) 90 (4/6): 45-54.
[22]. Grosso, N.R., Resurreccion, A.V.A. (2002). Predicting consumer acceptance ratings of cracker-coated and roasted peanuts from descriptive analysis and hexanal measurements. *J. Food Sci*., 67: 1530-1537.
[23]. Iwe, M.O. (2002). Handbook of Sensory Methods and Analysis. Projoint Communications Services Ltd., Enugu, Nigeria.
[24]. Jennette, H. (2003). The beneficial role of peanuts in the diet - Part 2. *Nutr. Food Sci.*, 33: 56-64.
[25]. John, P. and Marchal, J. (1995). Ripening and biochemistry of the fruit. In: Gowen, S.R. (ed.). Bananas and Plantains. World Crop Series. Springer, Dordrecht.
[26]. Malomo, Olu, Ogunmoyela O.A.B., Adekoyeni, O.O., Jimoh, O., Oluwajoba, S.O, Sobanwa, M.O. (2012). Rheological and Functional Properties of Soy-Poundo Yam Flour. *International Journal of Food Science and Nutrition Engineering*, 2(6): 101-107.
[27]. Marriott, J., Lancaster, P.A. (1983). Bananas and Plantains. In: Handbook of Tropical Foods. Harvey Jr. TC (Ed), Marcel Dekker, Inc. pp. 85-142.
[28]. Maziya-Dixon, B., Akinyele, I.O., Oguntona, E.B., Nokoe, S., Sanusi, R.A. and Harris, E. Nigeria Food Consumption and Survey, 2001-2003, summary. International Institute of Tropical Agriculture, Ibadan, 2004.
[29]. Morelle, S. (1997). Production et utilisation de farine de plantains et bananes à cuire. pp. 22. Rapport de stage effectué au CRBP de Njombé au Cameroun du 1er Juillet au 29 Août 1997.
[30]. Morteza Mashayekh, Mohammad Reza Mahmoodi and Mohammad Hasan Entezari (2008). Effect of fortification of defatted soy flour on sensory and rheological properties of wheat bread. *International Journal of Food Science and Technology*, 43:1693-1698.
[31]. Nepote, V., Mestrallet, M.G., Accietto, R.H., Galizzi, M., Grosso, N.R. (2006a). Chemical and sensory stability of roasted high-oleic peanuts from Argentina. *J. Sci. Food Agric.*, 86: 944-952.
[32]. Nepote, V., Mestrallet, M.G., Grosso, N.R. (2006b). Oxidative stability in fried-salted peanuts elaborated with high-oleic and regular peanut from Argentina. *International Journal of Food Science and Technology*, 41: 900-909.
[33]. Nepote, V., Mestrallet, M.G., Olmedo, R.H., Ryan, L.C., Conci, S., Grosso, N.R. (2008). Chemical Composition and Sensory Analysis of Roasted Peanuts Coated with Prickly Pear and Algarrobo Pod Syrups. *Grasas y Aceites*, 59: 174-181.
[34]. Ogazi, P.O. (1996). Plantain: production, processing and utilization. Paman and Associates Ltd., Imo State, Nigeria, pp: 305.
[35]. Pancholy, S.K., Deshpande, A.S. and Krall, S. (1978). Amino acids, oil and protein content of some selected peanuts cultivars. *Proc. Am. Peanut Res. Educ. Soc.*, 10:30-37.
[36]. Robinson, J.C. (1996). Bananas and Plantains. CAB International, Wallingford, UK, pp: 238.
[37]. Savage, G.P., Keenan, J.I. (1994). The composition and nutritive value of Groundnut kernels. In: Smart, J. (Ed.). The Groundnut Crop: Scientific Basis for Improvement, Chapman and Hall, London, 173-213.
[38]. Sommer, A. (1989). New imperatives for an old vitamin (A). *J. Nutr.*, 119: 96-100.
[39]. Stover, R.H. and N.W. Simmonds (1987). Bananas. 3rd ed. Wiley. New York, USA: 97-103.
[40]. Swennen, R. (1990). Plantain Cultivation under West African Conditions - A Reference Manual. International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria.
[41]. Sanghvi, T. and Murray, J. (1997). Improving child health through nutrition: the nutrition minimum package. Arlington, Va, BASICS project, for USAID USA Pp 3-10.
[42]. Woodroof, J.G. (1983). Peanuts: Production Processing, Products. 3rd edition. AVI publishing company, Inc., Westport Connecticut.
[43]. Weiss, E.A. (1983). “Oilseed Crops” First edition, pp: 100-117.
[44]. Weiss, T.J. (1983). Physical and Chemical Properties of Fats and Oils and Their Uses. 2nd Edn., AVI Publishers, Westport, USA., pp: 25-31, 44-84.