

## Effects of Powdered Plant Materials as Preservatives on Proximate, Shelf Life and Associated Mycoflora on Groundnut Paste

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### Abstract

Research on the Effects of Powdered Plant Materials as Preservatives on Proximate, Shelf Life and Associated Mycoflora on Groundnut Paste was conducted in the Botany Laboratory of the Rivers State University, Port Harcourt, Nigeria. Three varieties of groundnut were used namely Sam nut 21, Sam nut 23 and Sam nut 24. Six plant materials comprising three different leaf samples viz: *Vernonia amygdalina*, *Occimum gratissimum* and *Solanum melongena*, were used for the study. The samples were aseptically treated and sundried for three days and crushed into powder. 10 grams of the groundnut paste was weighed and varying concentrations of the powdered leaf samples were added to the pastes and labelled accordingly. The treated groundnut paste samples were allowed to store in the laboratory and their proximate compositions, tested for a period of six months on a monthly basis to determine the effects of the applied plant materials. For *Vernonia amygdalina* significant reduction was observed in phosphorous, potassium and Vitamin A, while moisture, ash, fibre, carbohydrate, Sodium, Vitamin C, significantly increased at ( $p < 0.05$ ) across the three different varieties. *Occimum gratissimum* showed a significant reduction in lipids, calcium, Iron, potassium and Vitamin A, while all other parameters such as moisture, fibre, carbohydrate, Sodium, Vitamin C significantly increased at ( $p < 0.05$ ) across the three varieties. Powdered *Solanum melongena* indicated no significant difference in fibre, thiamin, phytates and tannins across the three different varieties. A significant reduction was observed in lipids, calcium, iron, magnesium, phosphorous, potassium, Niacin and Vitamin A, while all other parameters such as moisture, carbohydrate, Sodium, Vitamin C, significantly increased at ( $p < 0.05$ ) across the different varieties. The result from this work revealed that the addition of the various plant materials to groundnut paste generally increased the shelf life of groundnut paste during the Six months of study. Five fungal pathogens were found to cause spoilage of groundnut paste viz: *Aspergillus niger*, *Aspergillus flavus*, *Fusarium oxysporum*, *Penicillium italicum* and *Candida tropicalis*.

**Key Words:** Groundnut paste *Vernonia amygdalina*, *Occimum gratissimum* and *Solanum melongena*, fungi, Proximate Composition.

### INTRODUCTION

Groundnut (*Arachis hypogea* L) is a legume and occupies a relevant position in the monetary value of different countries mainly in developing nations of the world. It is believed to have originated from South Africa and have been domesticated in different part of the world. The major *Arachis hypogea* L producing countries include India, China and USA. *Arachis hypogea* L was introduced into Nigeria in the 16<sup>th</sup> century and has been estimated to have been planted on up to 1.4 million hectares of land (Sales and Resurreccion, 1985). The producing of *Arachis hypogea* L has been hampered flossing its spoilage by fungi mainly *Aspergillus flavus* which

secretes *aflatoxin* and application cancer in man. It has also been said that that the incidence of *Aspergillus flavus* is enhanced through broken shells at harvest, and kernel splitting at making. Faster scholars have said that the identification of this fungus in Tokyo, 1986 – 1990. Groundnut nut is consumed in Nigeria in a different means as boiled, fried, dried and usually consumed in mixing with other commodities like maize, tapioca, egg in garden and cucumber. It can be processed into other forms as meals applied at traditional ceremonies like marriages, chieftaincy coronation, etc. Part of food of *Arachis hypogea L* is kulikuli (*Arachis hypogea L* cake) a traditional recipe prepared after extracting oil from groundnut, fried and consumed as snake. It is filled with in protein and applied in feeding livestock and man. Another local product from *hypogea L* is “yaji” *Arachis hypogea L* flour that has been mixed with pound ginger, dried cereals, native pepper and added salt to taste. Dankwa is another local product from *hypogea L* which has been added pound native peper, dried cereal, sugar, salt and made to balls. These condiments are seen among the Hausas. However, in the east and the southern Nigeria the most popular is the *Arachis hypogea L* paste called okwuse. Groundnut paste which is called okwuse is a cherished delicacy in the Niger Delta and among the Igbos. It is usually prepared by frying healthy *Arachis hypogea L* seeds and grinding the seeds in sterilized blender. The goundnut paste is usually spiced with different spices to give it the needed taste. The recipe could be consumed with egg in garden, cucumber and any other food of interest. The *Arachis hypogea L* paste is prepared both in the market place and at home and sold in the market, along road sides under unhygienic condition. This product is sold as they last without any knowledge of the base existence and the associated deteriorating fungi (Chuku, 2011). It is based on this dearth of knowledge on the base existence of paste and the associated fungi that this study was embarked upon.

## **MATERIALS AND METHODS**

Twenty kilograms of 3 varieties of freshly harvested and shelled groundnut was purchased from Rumuokoro market in Port Harcourt metropolis and transported to School to Land Farm at Rumuodamaya for identification. The groundnut varieties identified were Samnut 21, Samnut 22 and Samnut 23. The groundnut were transported to Ozuoba in Obio/Akpor Local Government Area, in Rivers State for further preparation. The seeds were sorted and the bruised ones were removed from the unblemished ones. The seeds were wetted by sprinkling with water and small quantity of salt and mixed thoroughly and sundried for one hour. The dry seeds were then fried in a metallic frying pan using a low heated local oven powered by fire wood. Care was taken to ensure that the seeds were well fried without allowing them to burn. Smooth frying was achieved by frying the groundnut seeds in garri. The fried seeds were allowed to cool before peeling. After peeling, the seeds were ground in manual blender and preserved for further studies (Okogbule, 2017)

### **3.2 Collection and Preparation of Plant Materials.**

Six plant materials were purchased from Rumuokoro markets comprising three different seeds samples viz: Garden egg leaf, Scent leaf and Bitter leaf. The seed samples were washed and sun dried for five days. The leaf samples were crushed into powder by blending in a manual blender and each of the samples stored in a clean plastic container and labelled accordingly for further studies.

### **3.3 Determination of Proximate Composition of Groundnut Paste and the Plant Materials**

The various prepared samples were taking to Food Science Technology Laboratory in the Rivers State University for analysis. The method of analysis used was the AOAC (2005).

**Table 1: Effects of treatment of *Occium gratissimum* (Scent Leaf Seed) on the proximate composition of different species of groundnut paste.**

Scent Leaf		Moisture%	Ash %	Lipid %	Fibre %	CHO %	Protein%
SAM 21_2g	NUT	14.67±0.41 <sup>a</sup>	2.77±0.08 <sup>b</sup>	31.47±0.33 <sup>f</sup>	2.23±0.08 <sup>abc</sup>	22.43±0.08 <sup>ab</sup>	26.43±0.16 <sup>ab</sup>
SAM 21_3g	NUT	13.75±0.12 <sup>ab</sup>	2.86±0.02 <sup>b</sup>	31.17±0.41 <sup>f</sup>	2.43±0.08 <sup>ab</sup>	22.17±0.41 <sup>ab</sup>	27.63±0.8 <sup>a</sup>
SAM 21_4g	NUT	13.5±0 <sup>bc</sup>	2.7±0.24 <sup>b</sup>	32.43±0.16 <sup>ef</sup>	2.5±0 <sup>a</sup>	23.42±0.2 <sup>a</sup>	25.45±0.61 <sup>abc</sup>
SAM 21_Ctrl	NUT	10.67±0.41 <sup>g</sup>	3.22±0.04 <sup>b</sup>	45.04±0.51 <sup>a</sup>	1.52±0.04 <sup>d</sup>	16.29±0.35 <sup>cd</sup>	23.4±0 <sup>cd</sup>
SAM 23_2g	NUT	12.03±0.59 <sup>def</sup>	3.8±0.77 <sup>ab</sup>	41.45±0.92 <sup>abc</sup>	1.73±0.32 <sup>cd</sup>	19.88±1.83 <sup>abc</sup>	20.95±2.64 <sup>de</sup>
SAM 23_3g	NUT	12.35±0.51 <sup>de</sup>	3.77±0.71 <sup>ab</sup>	41.18±1.13 <sup>abc</sup>	1.4±0.24 <sup>d</sup>	18.28±0.66 <sup>bcd</sup>	23.52±1.7 <sup>bcd</sup>
SAM 23_4g	NUT	12.47±0.83 <sup>cd</sup>	3.63±0.84 <sup>ab</sup>	38.75±4.85 <sup>cd</sup>	2.73±0.57 <sup>a</sup>	20.25±2.52 <sup>abc</sup>	23.42±1.39 <sup>cd</sup>
SAM 23_Ctrl	NUT	11.33±0.75 <sup>efg</sup>	3.28±0.08 <sup>ab</sup>	43.45±1.41 <sup>ab</sup>	1.57±0.05 <sup>d</sup>	16.1±0.89 <sup>cd</sup>	23.77±0.75 <sup>bcd</sup>
SAM 24_2g	NUT	12.33±0.41 <sup>de</sup>	3.48±0.79 <sup>ab</sup>	41.68±0.97 <sup>abc</sup>	1.93±0.33 <sup>bcd</sup>	21.02±1.95 <sup>ab</sup>	19.41±2.57 <sup>e</sup>
SAM 24_3g	NUT	12.55±0.57 <sup>cd</sup>	3.47±0.72 <sup>ab</sup>	40.63±1.24 <sup>bc</sup>	1.41±0.42 <sup>d</sup>	18.53±1.63 <sup>bcd</sup>	23.74±2.29 <sup>bcd</sup>
SAM 24_4g	NUT	12.92±0.87 <sup>bcd</sup>	4.38±0.97 <sup>a</sup>	36.43±4.67 <sup>de</sup>	2.23±0.41 <sup>abc</sup>	21.5±2.45 <sup>ab</sup>	24±1.33 <sup>bc</sup>
SAM 24_Ctrl	NUT	11±0.55 <sup>fg</sup>	3.25±0.05 <sup>b</sup>	44.04±1.33 <sup>ab</sup>	1.53±0.05 <sup>d</sup>	14.11±6.36 <sup>d</sup>	23.68±0.57 <sup>bcd</sup>
<b>Pr &gt; F(Model)</b>		< 0.0001	0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
<b>Significant</b>		Yes	Yes	Yes	Yes	Yes	Yes

**CHO=Carbohydrate.**

**Table 2: Effects of treatment of Garden egg leaf (*Solanum melongena*) on the proximate composition of different species of groundnut paste.**

Garden Egg		PROXIMATE COMPOSITION					
		Moisture%	Ash %	Lipid %	Fibre %	CHO %	Protein%
SAM 21_2g	NUT	12.83±0.82 <sup>ab</sup>	3.08±0.04 <sup>a</sup>	40.05±0.12 <sup>abc</sup>	1.07±0.04 <sup>c</sup>	17.75±0.37 <sup>ab</sup>	25.22±0.33 <sup>abc</sup>
SAM 21_3g	NUT	12.85±0.37 <sup>ab</sup>	3.02±0.04 <sup>b</sup>	40.27±0.46 <sup>abc</sup>	1.12±0.04 <sup>bc</sup>	17.58±0.2 <sup>ab</sup>	25.23±1.14 <sup>abc</sup>
SAM 21_4g	NUT	13.08±0.2 <sup>ab</sup>	25.95±17.89 <sup>b</sup>	38.27±1.2 <sup>abc</sup>	1.37±0.08 <sup>bc</sup>	18.17±0.33 <sup>ab</sup>	24.77±0.16 <sup>abc</sup>
SAM 21_Ctrl	NUT	10.67±0.41 <sup>d</sup>	3.22±0.04 <sup>b</sup>	45.04±0.51 <sup>a</sup>	1.52±0.04 <sup>abc</sup>	16.29±0.35 <sup>ab</sup>	23.4±0 <sup>c</sup>
SAM 23_2g	NUT	12.43±0.63 <sup>abc</sup>	3.67±0.65 <sup>b</sup>	40.25±0.81 <sup>abc</sup>	1.36±0.38 <sup>bc</sup>	18.18±0.31 <sup>ab</sup>	24.17±1.43 <sup>abc</sup>
SAM 23_3g	NUT	13.07±0.73 <sup>ab</sup>	3.15±0.23 <sup>b</sup>	36.75±4.49 <sup>abc</sup>	1.73±0.64 <sup>bc</sup>	19.7±1.78 <sup>a</sup>	25.61±1.84 <sup>ab</sup>
SAM 23_4g	NUT	12.62±0.3 <sup>ab</sup>	3.18±0.15 <sup>b</sup>	39.95±0.33 <sup>abc</sup>	1.24±0.12 <sup>bc</sup>	18.18±0.21 <sup>ab</sup>	24.6±0.24 <sup>abc</sup>
SAM 23_Ctrl	NUT	11.33±0.75 <sup>cd</sup>	3.28±0.08 <sup>b</sup>	43.45±1.41 <sup>ab</sup>	1.57±0.05 <sup>abc</sup>	16.1±0.89 <sup>ab</sup>	23.77±0.75 <sup>bc</sup>
SAM 24_2g	NUT	12.2±0.45 <sup>bc</sup>	3.9±0.67 <sup>b</sup>	40.7±0.59 <sup>abc</sup>	2.15±0.96 <sup>a</sup>	18.35±0.37 <sup>ab</sup>	23.48±1.49 <sup>c</sup>
SAM 24_3g	NUT	13.45±0.86 <sup>a</sup>	15.83±13.88 <sup>ab</sup>	35.25±4.69 <sup>bc</sup>	1.88±0.61 <sup>ab</sup>	19.42±3.37 <sup>a</sup>	26.16±1.99 <sup>a</sup>
SAM 24_4g	NUT	12.8±0.31 <sup>ab</sup>	3.07±0.2 <sup>b</sup>	33.73±14.57 <sup>c</sup>	1.34±0.14 <sup>bc</sup>	18.22±0.17 <sup>ab</sup>	24.7±0 <sup>abc</sup>
SAM 24_Ctrl	NUT	11±0.55 <sup>d</sup>	3.25±0.05 <sup>b</sup>	44.04±1.33 <sup>ab</sup>	1.53±0.05 <sup>abc</sup>	14.11±6.36 <sup>b</sup>	23.68±0.57 <sup>bc</sup>
Pr	>	< 0.0001	< 0.0001	0.0016	0.0004	0.0032	0.0002
F(Model)							
Significant		Yes	Yes	Yes	Yes	Yes	Yes

**CHO=Carbohydrate**

Means within the same column with different superscript (abcd) are significantly different (P<0.05)

**Table 3: Effects of treatment of Bitter leaf (*Vernonia amygdalina*) on the proximate composition of different species of groundnut paste.**

Bitter Leaf	PROXIMATE COMPOSITION					
	Moisture%	Ash %	Lipid %	Fibre %	CHO %	Protein%
SAM NUT 21_2g	12.08±0.69 <sup>bcde</sup>	4.38±0.29 <sup>a</sup>	41.08±0.29 <sup>ab</sup>	1.48±0.04 <sup>d</sup>	18.43±0.16 <sup>ab</sup>	22.53±0.08 <sup>ab</sup>
SAM NUT 21_3g	11.67±0.41 <sup>cde</sup>	4.63±0.41 <sup>a</sup>	41.37±0.36 <sup>ab</sup>	1.73±0.08 <sup>bcd</sup>	18.08±0.2 <sup>ab</sup>	22.45±0.61 <sup>ab</sup>
SAM NUT 21_4g	10.83±0.82 <sup>e</sup>	4.58±1.02 <sup>a</sup>	42.28±0.53 <sup>ab</sup>	2.02±0.04 <sup>abc</sup>	17.17±0.41 <sup>ab</sup>	23.12±0.29 <sup>ab</sup>
SAM NUT 21_Ctrl	10.67±0.41 <sup>e</sup>	3.22±0.04 <sup>a</sup>	45.04±0.51 <sup>a</sup>	1.52±0.04 <sup>d</sup>	16.29±0.35 <sup>ab</sup>	23.4±0 <sup>ab</sup>
SAM NUT 23_2g	14.08±1.05 <sup>a</sup>	3.23±0.6 <sup>a</sup>	34.88±5.7 <sup>b</sup>	2.02±0.42 <sup>abc</sup>	20.77±3.39 <sup>a</sup>	25.02±1.73 <sup>ab</sup>
SAM NUT 23_3g	12.92±1.11 <sup>abc</sup>	3.52±0.99 <sup>a</sup>	35.33±4.85 <sup>b</sup>	2.1±0.39 <sup>ab</sup>	20.68±2.23 <sup>a</sup>	25.48±3.22 <sup>a</sup>
SAM NUT 23_4g	12.88±1.08 <sup>bcde</sup>	3.6±1.08 <sup>a</sup>	35.12±5.72 <sup>b</sup>	2.22±0.17 <sup>a</sup>	20.07±2.38 <sup>a</sup>	21.17±3.7 <sup>ab</sup>
SAM NUT 23_Ctrl	11.33±0.75 <sup>cde</sup>	3.28±0.08 <sup>a</sup>	43.45±1.41 <sup>a</sup>	1.57±0.05 <sup>cd</sup>	16.1±0.89 <sup>ab</sup>	23.77±0.75 <sup>ab</sup>
SAM NUT 24_2g	13.48±0.83 <sup>ab</sup>	3.47±0.6 <sup>a</sup>	38.38±5.3 <sup>ab</sup>	1.75±0.35 <sup>bcd</sup>	18.58±2.97 <sup>ab</sup>	24.33±1.72 <sup>ab</sup>
SAM NUT 24_3g	12.59±1.2 <sup>abcd</sup>	3.93±0.97 <sup>a</sup>	37.75±4.95 <sup>ab</sup>	1.85±0.35 <sup>abcd</sup>	19.25±1.75 <sup>ab</sup>	24.1±3.64 <sup>ab</sup>
SAM NUT 24_4g	12.33±0.98 <sup>bcde</sup>	4.05±1.06 <sup>a</sup>	38.57±5.58 <sup>ab</sup>	2.1±0.15 <sup>ab</sup>	18.7±2.28 <sup>ab</sup>	24.28±3.21 <sup>ab</sup>
SAM NUT 24_Ctrl	11±0.55 <sup>de</sup>	3.25±0.05 <sup>a</sup>	44.04±1.33 <sup>a</sup>	1.53±0.05 <sup>d</sup>	14.11±6.36 <sup>b</sup>	23.68±0.57 <sup>ab</sup>
Pr > F(Model)	< 0.0001	0.0013	< 0.0001	< 0.0001	0.0007	0.0653
Significant	Yes	Yes	Yes	Yes	Yes	No

### CHO=Carbohydrate

Means within the same column with different superscript (abcd) are significantly different (P<0.05).

### Treatment with *Occium gratissimum* (Scent Leaf)

The results of the effects of treatment of different varieties of groundnut paste with *Occium gratissimum* is presented in Table 1. The proximate composition was analyzed. The Treatment of groundnut paste with different concentrations of powdered seeds of Scent leaf (*Occium gratissimum*) as revealed from the research indicated a significant reduction observed in Lipids, concentration of the different species of nut when compared with their respective control samples, while all other parameters such as Moisture Content significantly increased at (p<0.05).

The value recorded for the effects on the shelf life of groundnut paste with ground Scent leaf stored for Six months depicted higher moisture content at the various concentration levels compared to the control irrespective of the concentration levels and the different varieties.

The result of the treatment effect on the shelf life of groundnut paste with ground Scent leaf stored for Six months showed high Ash content at the various concentration levels of Sam Nut 22 and Sam Nut 23 when compared to the control irrespective of the concentration levels and the different varieties.

### **Treatment with *Solanum melongena* (Garden egg leaf)**

The results of the effects of treatment of different varieties of groundnut paste with *Solanum melongena* is presented in Table 2. The proximate composition was analyzed. The Treatment of groundnut paste with different concentrations of powdered Garden egg leaf (*Solanum melongena*) as revealed from the research indicated no significant difference in fibre, across the three different varieties.

There was a significant reduction observed in lipids, , while all other parameters such as moisture, carbohydrate significantly increased at ( $p < 0.05$ ) across the three different varieties. The value recorded for the effect on the shelf life of groundnut paste with ground Garden egg leaf stored for Six months depicted higher moisture content at the various concentration levels compared to the control irrespective of the concentration levels and the different varieties.

The result of the treatment effect on the shelf life of groundnut paste with ground Garden egg leaf stored for Six months showed little or no difference in the Ash content at the various concentration levels compared to the control irrespective of the concentration levels and the different varieties.

### **Treatment with *Vernonia amygdalina* (Bitter leaf)**

The results of the effects of treatment of different varieties of groundnut paste with a *Vernonia amygdalina* is presented in Table 3. The proximate composition was analyzed. The Treatment of groundnut paste with different concentrations of powdered *Vernonia amygdalina* as revealed from the research indicate that there was a significant reduction observed in lipids, while all other parameters such as moisture, ash, fibre, carbohydrate significantly increased at ( $p < 0.05$ ) across the three different varieties.

The value recorded for the effect on the shelf life of groundnut paste with ground Bitter leaf stored for Six months depicted higher moisture content at the various concentration levels compared to the control irrespective of the concentration levels and the different varieties.

The result of the treatment effect on the shelf life of groundnut paste with ground Bitter leaf stored for Six months showed higher Ash content at the various concentration levels compared to the control irrespective of the concentration levels and the different varieties.

## **CONCLUSION**

It was revealed from this work that the addition of the various plant materials to groundnut paste depicted moisture content of the groundnut paste during the Six months of study. The research was done with the aim of isolating the fungi associated with groundnut paste with some plant materials and with the objective of determining the proximate composition on different varieties of groundnut paste and also the shelf life using different plant materials.

## **REFERENCE**

- Achinewhu, S. C. (1996). *Plants: Man's prime necessity in life*. A Professorial Inaugural lecture series. Rivers State university of Science and Technology, Port Harcourt. 87pp.
- Adegbola J. D. (1972). Molluscicidal properties of some African plants. *Journal of Parasitology* 107:108-115.
- Ahonkhai I, Ayinde B, Edogun O, Uhuwmangho Mu, Antimicrobial Activities of the Volatile Oils of *Ocimum Bacilicum* L. And *Ocimum Gratissimum* L. (Lamiaceae) against some aerobic Dentel Isolates. *Pak.J. Pharm. Sci.*, Vol.22, No.4, pp.405-2009
- Alper C, Mattes R (2003). Peanut consumption improves indices of cardiovascular disease risk in healthy adults. *J. Am. Coll. Nutri.*, 22:133-141.
- AOAC (2005). *Official Methods of Analysis of AOAC International*. 18<sup>th</sup> edition. Association of Official Analytical Chemists, Washington, D.C, USA. 234.

- Asawalam E. F. and Hassanali A (2006) Constituents of the essential oil of *Vernonia Amygdalina* as amaize weevi protectants. *Trop. Subtrop. Agroecosyst*, 6:95-102.
- Ashok K. and Upadhyaya K. (2012), Tannins are Astringent, *Journal of Pharmacognosy and Phytochemistry. IC Journal*, 3(1): 49.
- Bansal, P. (2013). Development of value added products using peanut flour for nutritional and health benefits. M.Sc. Thesis (Food and Nutrition). Punjab Agricultural University, Ludhiana, Punjab. 129p.
- Barnett, H. L and Hunter, B.B (2008). *Illustrated genera of fungi imperfecti*, 3<sup>rd</sup> Edition, Burgess Publication Co; Minneapolis.
- Challand S. and Willcox M. (2009). A clinical trial of the traditional medicine *Vernonia Amygdalina* in the treatment of uncomplicated malaria. *J Altern Complement Med* 15: 1231-1237.
- Chuku, E.C and Chuku, O.S (2016). Studies on the Phytochemicals, proximate, minerals and vitamins composition of some medicinal herbs in the Niger Delta. *International Journal of Bioscience*, 11(1): 39-44.
- Chuku, E.C. and Okogule, F.N.C. (2017). Shelf Life Preservation of Groundnut Paste with Some Powdered Botanicals. *Journal of Biology and Genetic Research*. Vol. 3, 2545-5710.
- Danquah-Jones, A. (2000). Variation and correlation among agronomic traits in Garden Egg (*Solanum gilo* Raddi). Department of crop science, Accra, University of Ghana, Legon 30.
- Grosso, N.R. and Guzman, C.A. (1995). Chemical composition of aboriginal peanut (*Arachis hypogaea*) seeds from Peru. *J. Agric. And Food Chem.*, 43, 102-105.
- Mann A. (2012). Phytochemical Constituents and Antimicrobial and Grain Protectant Activities of clove Basil (*Ocimum Gratissimum* L.) Grown in Nigeria. *International Journal of Plant Research*, 2(1):51-58.
- Nwachukwu C. U., Ume N.C. Obasi M. N., Nzewuihe G. U. and Oyirioha C. (2010), The Quantitative Uses of Some Medicinal Plants in Ikeduru L.G.A. of Imo State, Nigeria, *New York Science Journal*, issue 3, vol. 11, p. 132.