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Baillonella Toxisperma (Mimusop) Oil -Its Quality, Stability and Adaptability for Human Nutrition

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ABSTRACT
Baillonella toxisperma oil was investigated to determine its quality, stability and adaptability for human nutrition. Seeds of the plant were sourced from local farmers and properly processed after which the oil was extracted using the soxhlet extractor with a benzene solvent. Oil samples were further analyzed in the laboratory for fatty acid composition, proximate composition, mineral nutrients and cholesterol content. The proximate parameters of the seeds were also analyzed. Results for moisture content (5.78±0.37), ash content (5.30±0.52), crude protein content (5.95±1.03), crude fiber (6.50 ±0.81), CHO (27.72±1.83) and ether extract (48.75±0.38) confer some level of stability on the oil seeds; since these parameters are an index of stability quality and shelf life of the seeds. Also, results show that the oil has a high level of Na, (709.00±203.38), K(5469.30±573.10) and phosphorus (2214.10±78.64). At these high levels, these minerals can increase the oxidation rate of the oil and thus may become harmful. Mg also showed a high presence (4319.80±375.30) while Cu (5.13±1.02), Zn (14.33±0.92) and Fe (13.71±0.79) should mild presence in the oil. These elements could have deleterious effects on the flavor and oxidative stability of the oil since some metals could catalyze oxidation of fatty acid chains exacting a deleterious influence on shelf life and nutritional value if consumed in this state. The oil has more saturated fatty acids than the unsaturated. The saturated fatty acids include caproic, caprilic, capric, lauric, myristic, palmitic, stearic which recorded (20.190±0.18%, 3.2500±0.87%, 3.2600±0.23%, 45.10±2.10%, 15.91±1.21%, 0.88±0.20% and 0.27±0.80 respectively)while the only mono-unsaturated fatty acid, oleic acid recorded 11.70±2.86%. The oil can be considered stable and qualitative considering the fact that it has more saturated than the unsaturated fatty acid since the higher the degree of unsaturated fatty acid in vegetable oils, the more susceptible they are to oxidative deterioration. The cholesterol content of Baillonellatoxispermaoil (0.73±0.16) shows that it is as good as the cholesterol content of the more popular groundnut oil (0.00±0.00) indicating that the oil is adaptable for human consumption. It is recommended however, that the high mineral content of B. toxispermaoilespecially of Na, K, P and Mg could be reduced by refining in other to make it completely suitable for human consumption. Further research should be carried out to determine the peroxide and iodine content of the oil.

I. INTRODUCTION

In Nigeria today, the major vegetable oils available for consumption are basically palm oil, (Elaeisguinenis) and groundnut oil from, (Arachis hypogea). Unfortunately however, palm oil has become very expensive owing to the fact that palm trees are on the verge of extinction and new palm plantations are not spring up as expected. Groundnut oil on the other hand has become the choice of most people even though it is equally expensive. Currently, Nigeria is faced with a lot of economic challenges including high unemployment rate, low capacity utilization in industries, soaring double digit inflation, increased inequality and poverty, lowered standard of living and depleted foreign reserves as well as scarcity of foreign exchange to import goods and services.

The Nigeria Bureau of Statistics (NBS) reported that the food index rose by 17.39% in December 2016 which indicated a 0.20% increase from November of the same year. The increase it said was caused by hike in prices of meat, bread, cereal, oil and fat, fish, vegetable, milk, cheese and

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eggs. As a result of the forgoing, the current economic situation in the country has led to severe tightening up in term of the finances in circulation, a situation which affect the rural populace as well as theurban residents. Vegetable oils such as palm and groundnut oils which are very popular in most Nigerian homes have gone out of the reach of the poor. This situation therefore calls for sourcing alternative sources of vegetable oils which could become handy at these austere times. Vegetable oils are important in human nutrition, providing energy and essential fatty acids as well as facilitating absorption of fat soluble vitamins. They constitute about 80% of the world's supply of natural oil and fats, the remaining being of animal origin. Although, many plant parts may yield oil, in commercial practice however, oil is extracted primarily from seeds. This seed that contains oil are known as oil seeds. Oil seeds are thus the largest source of vegetable oil even though most oil bearing tree fruits provide the highest oil yields (Gunstone, 2002, Sarwar, 2013). Also, oil seeds are frequently used in the production of animal feeds because of their high protein content. Their seeds contain energy for the sprouting embryo mainly as oil, compared with cereals which contain energy in form of starch (Mckerith, 2005).

Baillonella toxisperma, also known as African pear wood is a species of tree in the family sapotaceae and it is the only species in the genus baillonella. The species has a restricted distribution which is limited to low land and rainforest of West and Central Africafrom South East Nigeria and Cameroun to Gabon, Republic of Congo, Angola and Zaire (Keay, 1989, Vivien and Faure, 1989, Laird and Betafor, 1997). The species is not a gregarious tree but is described as being local in distribution, generally scattered or very rarely in groups of several trees. In southern Nigeria, where the tree is generally known as mimusopdjave, it is described as a large tree observed along the Cross River, Sunderland and Tchuolo (1999) found the tree to be a mid-to- late secondary species which is often predominant in farm bushes and late secondary forest and has being described as occurring 'occasionally in cocoa plantations' (Ntamang, 2007). The species is intolerant to heavy saturated soils preferring soils that are more freely draining and sandier (Laird and Betafor, 1997).

In Cross River State, the species is especially found in Okwu 1 and 2, Buanchor, Katanbang, Abu, Bushi, and Okwabang all in Eastern Boki,Boki Local Government Area of the state. While in the Cameroun Republic, it is commonly found in Obonyi1,2 and 3, Kekanye, Kekonkegu all in the Manyu Division in Takumada National Park. It is a valuable timber tree that is priced for the distinctive oil obtained from its fruit by local people who use other part of the tree for medicinal purposes. The oil is reported to be of high fat, and its content is very suitable for commercial production of cooking oil. However, its use has not attained prominence in Nigeria. The study therefore is to investigate the extraction and characterization of Baillonella toxisperma oil with the view of determining its quality, stability and adaptability for human nutrition.

II. MATERIALS AND METHODS

Baillonella toxisperma seeds were procured from local farmers in Buanchor, Boki Local Government Area of Cross River State. The seeds were carefully de-pulped and washed with water to remove dirt. The seeds were sundried for 2 weeks to enhance loss of moisture and then split open to remove the cotyledon from the endocarp. It was then grounded to paste and spread under the sun for few hours for the element of water in the paste to evaporate.

ETRACTION OF OIL

Baillonella toxisperma oil was extracted using the soxhlet extractor with a benzene solvent as described by Warra et al, (2012), at the Faculty of Agriculture, Forestry, wildlife and Natural Resources Management, Central Resources Laboratory, University of Calabar(UNICAL). The solvent for extraction that is, benzene was placed in a flat bottomed flask and the powder was packed in the thimble and put in a chamber and heat was applied using an electric heater. The oil was obtained when the solvent was shaken in reduced temperature and pressure, refluxing at 70^0c to rid excess solvent used in the oil. The mixture of solvent and oil was then heated in a flask so that solvent vaporized. The vapor formed was passed down to a condenser which was cooled by circulating water in its outer jacket. Benzene having a low boiling point compared to those of the oil evaporated, leaving the oil behind.

SAMPLE ANALYSIS

Fatty Acid Composition Determination

The fatty acid composition analysis was done using a gas-liquid chromatography. Fatty acid methyl esther (FAME) of the fat was prepared by trans-esterification hydrochloride (KOH) according to the method of Firestone, (1998). The sample was mixed with methyl to the proportion of 200mg of lipids for 10ml of the hydrochloric methanol. After dilution, the fat phase was extracted with 20ml of hexane, then washed until neutralite, concentrated

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by evaporation and dried using sodium sulphate. The prepared samples were injected into the chromatograph (model cac-15A, Shimadzu corporation, Japan) equipped with a hydrogen flame detector. The fatty acids in the sample were identified by comparing retention times of the FAME's with those of standard FAME. The fatty acids were expressed as relative area present.

PROXIMATE COMPOSITION ANALYSIS

Crude Fiber Content Determination

The Weende method was used (FAO, 1988, modified by Ibitoye, 2008). 5g of the sample was boiled in 200ml of 1.25% H_2S0_4 solution for 30minutes and washed in hot distilled water using a two-fold muslin cloth to retain the sample particles. The boiled, washed sample was transferred back to the boiling flask and 200ml of 1.25% NAOH solution was added to it and boiled again for 30minutes, washed again, allowed to drain dry and then transferred to a weighed porcelain crucible. It was dried in the oven at 105^0c for 1hour, cooled in a desiccator, weighed and recorded as w_2. Finally,it was burnt to ashes in a muffle furnace; cooled in a desiccator, reweighed and recorded as w_3. The crude fiber content was calculated by difference and expressed as a percentage of the weight of sample analyzed. The formula below was used:

Crude fiber = 100/w x (w_2-w_3)

Where, w = weight of sample

W_2 = weight of crucible + sample before boiling and drying.

W_3 = weight of crucible + sample after washing.

MOISTURE CONTENT DETERMINATION

The gravimetric method (AOAC 1993 modified by Ibitoye, 2008) was used. 10g of each sample were weighed into previously weighed moisture and dried in the oven at 105^0c for 3hours in the first instance. It was cooled in a desiccator and reweighed. The sample was returned to the oven for further drying. Drying, cooling and weighing were done at hourly intervals as constant weight was obtained. The moisture content was calculated as a percentage of the ratio of moisture loss to the weight of samples analyzed. The formula below was used in calculation.

$$\% \text{ moisture content} = 100 - \frac{(w_2-w_3)}{(W_2-w_1)}$$

Where w_1 = weight of moisture can

W_2 = weight of moisture can + sample before drying

W_3= weight of moisture can +sample after drying to constant weight

Note: Dry matter = 100 - % moisture content.

PERCENTAGE ASH DETERMINATION

This was done by using the furnace incineration gravimetric method described by (FAO, 1988, modified by Ibitoye, 2008). The organic component of 5g of each sample put in a previously weighed porcelain crucible was burnt off at high temperature of 600^0c in an electronic muffle furnace, burning was continued until the sample became grey ash. Care was taken to ensure that no ash particle was lost by wind blowouts. A pair of tongs was used to carefully transfer the burnt sample to a desiccator and allowed to cool before it was reweighed. The weight of the inorganic matter left was calculated by difference as a percentage of the sample analyzed. The ash was reserved for acid extraction and subsequent mineral determination. The formula below was used to calculate the ash content.

$$\% \text{ ash} = 100\frac{(w_2-w_1)}{w}$$

Where; w= weight of sample analyzed

W_1 = weight of empty crucible

W_2 = weight of empty crucible + ash

CRUDE FAT CONTENT DETERMINATION

Crude fat was determined as the ether extract using the continuous solvent extract in a soxhletapparatus (Excello, England). The method described by (AOAC, 1975, modified by Ibitoye, 2008) was employed. 5g of the sample was wrapped in a previously weighed porous filter paper (Whatman No 1) and put in a soxhlet reflux flask for complete extraction. The flask was mounted unto an oil extraction flask containing 200ml of solvent (N-Hexane). In this process, as the solvent was heated, it vaporized, condensed into the reflux thereby covering the wrapped sample. The solvent remained in contact with the sample until the flask filled up and siphoned over thus, carrying extracted oil (fat) down to boiling tube. This process was allowed to continue repeatedly for about 4hours before the defatted sample was carefully removed with a pair of forceps and dried in the oven at 100^0cfor 30minutes, cooled in a desiccator and weighed. The fat content was determined as the weight loss due to extraction from the sample and calculated as follows:

$$\% \text{ Fat (ether extract)} = 100\frac{(w_2-w_3)}{(W_2-w_1)}$$

Where;

Where w_1 = weight of empty paper

W_2 = weight of filter paper + sample before defatting

W_3= weight of filter paper +sample after defatting

CRUDE PROTEIN DETERMINATION

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Protein was determined by the Kjeldahl method (Kjeldahl,1983, modified by Ibitoye, 2008). The total nitrogen content was determined and multiplied with factor 6.25 to obtain the protein content.

A measured weight of each sample (0.5g) was digested by boiling in 10ml of concentrated H_2SO4 in the presence of selenium catalyst. Boiling was done under a fume cupboard until a clear solution was obtained. The digest was diluted to 100ml with distilled water in a volumetric flask. 10ml portion of the digest was mixed with an equal volume of 40% NaOH solution and the mixture was distilled in a macham distillation apparatus (Excello, England). The distillate was collected into 10ml of 4% boric acid solution containing three drops of mixed indicator (methyl red and bromocresol green). A total of 50ml distillate was collected and back titrated against 0.02 NHclsolutionsto a deep red end point. A reagent blank was also run and treated as sample. The nitrogen content and hence the protein was calculated using the formula below:

% Protein = $\%N_2$ x 6.25

$$\% N = 100/w \times \frac{14 \times N}{1000} X \quad \frac{V_f \times T}{V_a} - BLK$$

Where; w= weight of sample analyzed
N= Normality of titrant (Hcl)
V_f= total volume of digest
V_a= volume of digest distillated
T=titre value of sample
BIK= titre value of reagent blank

NFE DETERMINATION

NFE (CHO) = crude protein + crude fiber + moisture + crude fat + crude ash
i.e 100 – the sum of other parameters

ENERGY DETERMINATION

= Kcl @ water factor
Multiply CHO X 4, protein x 4, and fat x 4
i.e their sum = energy

DETERMINATION OF CHOLESTEROL TOTAL CONTENT

The method adopted is as described by Ojiako and Akubugo, (1997). Total of 0.1ml of sample oil each and standard cholesterol dissolved in chloroform in ratio 1:10 was evaporated to dryness in a water bath at 50^0c. Glacial acetic acid (3.0ml) and 3.0ml of color reagent (a solution of 0.05% ferric chloride/ concentrated glacial acetic acid/ concentrated sulphuric acid) was added to each sample and the standard, and then shaken rigorously to dissolve the oil. The blank contained 2.0ml of chloroform, 3.0ml glacial acetic acid and 3.0ml of color reagent. After cooling for 30minutes, at room temperature, absorbance of standard and samples were read at 560nm. Cholesterol content was estimated with formula:

$$\text{Cholesterol mg/L} = \frac{AB}{AS} \times CS$$

Where; AB = absorbance of oil sample
AS = absorbance of standard cholesterol
CS = concentration of standard cholesterol

Determination Of Mineral Contents

1g of the sample was weighed accurately and transferred into a 250ml conical flask. 10ml of the acid digestion mixture (per chloric,nitric and sulphuric acid in the ration 1:2:2) was added to the sample and heated on a hot plate in a fume hood. The mixture was heated until a white fume was observed which signified that digestion was complete. The sample was allowed to cool and 20ml of distilled water was added to bring the metals into solution. Sample was filtered using ashlesswhatman filter into a 100ml volumetric flask and made to mark with distilled water. The digest was subsequently analyzed for mineral contents using phoenix 986 (flame atomic absorption spectrophotometer).

III. RESULTS AND DISCUSSIONS

Results of the various analyses are presented below:

Table 1: mean values of the proximate composition of Baillonellatoxisperma seeds

VARIABLES	RESULTS IN PERCENTAGES (%)
Moisture content	5.78 ± 0.37
Dry matter content	94.22 ± 2.1
Ash content	5.30 ±0.52
Crude protein content	5.95 ± 1.03
Crude fiber content	6.50 ± 0.81
NFE (CHO)	27.72 ± 1.83
E.E (ether extract)	48.75 ± 0.38
Energy	573 ± 161.79

Table 1 shows that Baillonellatoxisperma seed has very low moisture content (5.78 ± 0.37) which is the quantity of water in the seed expressed as a percentage. A small change in seed moisture content has a large effect on the storage life of the seed. Moisture content influences seed quality and storability. In other words, the moisture content is an index of stability, quality, shelf life and also high yields (Levander, 1990). It is also a widely used parameter in the processing and testing of food. It is important to know the moisture content

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in order to make a reasonably accurate prediction of the possible storage life of each accession. The moisture content of the seed Baillonellatoxisperma is comparable to those reported for legumes by Arkroyed and Doughty, (1964) ranging between 7-10% as well as those reported for Pumpkin seeds by Igeet al, (1984).

Ash is the incombustible inorganic residue remaining after the water and organic matter have been removed by heating in the presence of oxidizing agents which provides a measure of the total amount of minerals within a food. In other words, the presence of ash is a reflection of inorganic matter in a food sample. Baillonellatoxisperma seeds have a high ash content (5.30± 0.52) showing that it contains more inorganic matter thus, making it nutritionally consumable. It is however above the range of 1.5-2.5 recommended for seeds and tubers for animal formulation (Pomeranz and Clifton, 1981).

Table 1 also shows that Baillonellatoxisperma seeds contain very high carbohydrate content (27.72 ± 1.83) showing that it is very nutritious and hence, good for human consumption. It is also comparable to other legumes which have as high as 20-60% carbohydrate content. However, with respect to protein content, the seed of Baillonellatoxisperma are rather low in protein content (5.95 ± 1.03) which does not compare favorably with those of protein rich foods such as soybeans, cowpea and pumpkin with contents ranging from 23.1 – 33.0% (Olaofeet atl, 1994). Indeed, this protein value falls short of the recommended daily allowance for children (23-36%) (NRC, 1989).

The ether extract (crude fiber content) of (48.75 ± 0.38) obtained forBaillonellatoxisperma seeds agrees closely with that reported by Ige et al, (1984) for varieties of melon oil seeds which range from between (47.9 ± 5.51%). The value also is almost in agreement with that obtained for pumpkin seed (47.0%) (Fagbemi and Oshodi, 1991). It is however, too high compared to that obtained for soybean (23.5%) (Paul and Southgate, 1980).

The crude fiber content for Baillonella toxisperma seed (6.50 ± 0.81) is quite comparable to those of legumes (5.0-6.0) (Aremuet al, 2006). Crude fiber contains indigestible materials which can reduce constipation by increasing bowel movement. It is a measure of the quantity of indigestible cellulose, pentosans, lignin and other components present in food. It is the residue of plants materials remaining after solvent extraction followed by digestion with dilutes acid and alkali. These components have little food value but provide the bulk necessary for proper peristaltic action in the intestinal tract. Crude fiber is essential in reducing the risk of chronic disease such as diabetes, obesity, cardiovascular diseases and diverticulitis. It also acts to lower the concentration of low density lipoprotein cholesterol in the blood by binding with bile acids. Finally, fiber helps eliminate waste from the gastrointestinal track because of its ability to bind water and thus, softens the stool. The presence of dietary fiber suggests that the consumption of Baillonella toxisperma seeds would greatly enhance digestibility and aid the prevention of non-communicable diseases.

Table 2: MEAN VALUES OF THE MINERAL CONTENTS OF BaillonellatoxispermaOIL.

VARIABLES	RESULTS (mg/kg)
Na	709.00 ±203.38
K	5469.30 ± 573.10
P	2214.10 ± 78.64
Ca	2.56 ± 1.05
Mg	4319.80 ± 375.30
Cu	5.13 ± 1.02
Zn	14.33 ± 0.92
Fe	13.71 ± 0.79

Results of the mineral composition of Baillonella toxisperma oil sample is given in table 2. It is important to analyze the quantity of heavy minerals in vegetable oils since these heavy minerals are useful micro nutrients for plants, humans and animals but become toxic for them when their concentration exceeds a limit (Khemnani et al, 2012). From the results, sodium, potassium and phosphorus showed unusually high levels of presence in the oil (709.00 ± 203.38, 5469.30 ± 573.10 and 2214.10 ±78.64 respectively). Sodium is necessary to maintain balance in physical fluid system and is also required for the operation of nerves and muscles. However, high sodium diets are linked to a number of health problems including damage to the kidney and increase in the possibilities of hypertension (Mir-margues et al, 2012). The sodium content of Baillonella toxisperma oil (709.00 ± 203.38) is higher than both the minimum and maximum dietary allowance of 1500mg and 2400mg/day respectively (recommended by (FNB, 2004, USDA, 1995). Although, sodium is an essential nutrient involved in fluid and electrolyte balance and is also required for normal cellular function, the high amount recorded in Baillonella toxisperma oil can lead to high blood pressure(if consumed in that state), which is a risk factor for ischemic heart disease, stroke and renal disease which are major causes ofmorbidity and mortality. Excessive

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sodium also leads to an increase in plasma osmolality, resulting in the sensation of thirst and an increase in the secretion of antidiuretic hormone which increases water retention in the kidney. Studies have revealed that there is consistent evidence that increased sodium ingestion induces a substantial increase in the urinary excretion of calcium (SACN, 2003, FNB, 2004, New and Bonjour, 2003). Also, consumption of a higher sodium diet, leading to an increase in plasma sodium may be sufficient to stimulate vascular reactivity (Sumon and Knocks, 2003). Thus, increased sodium consumption may exert a direct effect on the rigidity of vessels and also on their responsiveness to vasodilatory stimuli (Knocks et al, 2004).

Potassium is an essential nutrient involved in fluid, acid and electrolyte balance and is required for normal cell function. A delicate balance of this element is reported to prevent an increase in blood pressure and maintain normal cardiac rhythm (Desideri et al, 2012). It plays a major role in the homeostasis or balancing of the body's chemical and electrical impulses. However, whilepotassium efficiency may result in disturbed cell membrane function, muscle weakness, disturbances in heart function leading to arrhythmia and heart seizure as well as mental disturbances, an increased potassium intake can lower blood pressure and increase urinary sodium excretion (Galeynse et al, 2003, Gu et al, 2001, Nasmith and Braschi, 2003). However, when blood potassium levels are too high, it can inhibit muscle regulation including heartbeat. This can lead to irregular heartbeat, reduced or absent pulse, muscle weakness and difficulty in breathing. Baillonella toxisperma oil recorded a potassium value of (5467.30 ± 573.10) which is far above the recommended daily intake of 4700mg according to FAO/WHO (FNB, 2001). Phosphorus on the other hand has been recognized as an essential nutrient involved in many physiological processes such as the cells' energy circle, regulation of the whole-body-acid-base-balance, as a component of the cell structure (as phospholipids), in cell regulation and signaling and in the mineralization of bones and teeth. Excessive intake of this mineral results to hypophosphatemia leading to secondary hyperparathyroidism,skeletal deformations, bone loss and/or ectopic calcification especially in people with end-stage renal disease (Grimm et al, 2001).

Baillonella toxisperma oil is however a rich source of many health benefiting minerals (table 2) such as calcium, magnesium, copper, zinc and iron. Calcium helps to build bones and teeth and it is also essential in blood clothing, muscle contraction and also in certain enzymes in metabolic activities. Magnesium is a co-factor in hundreds of enzymatic reactions many of which involve energy metabolism as well as playing an important role in protein and nucleic acid synthesis. It also has a stabilizing and protecting effect on membranes, besides being essential in maintaining Ca, Na and K homeostasis (Durlach 1988, Seelig, 1989). However, magnesium over-doze (hypomagnesaemia) leads to nausea and vomiting lethargy, muscle weakness, irregular beats, low blood pressure, urine retention, respiratory distress and cardia arrest. The values recorded for calcium (2.56 ± 1.05) is moderate enough while the magnesium content (4319.80 ± 375.30) is too high compared to the recommended dietary allowance of 350mg/day set by (FNB, 2004). But nevertheless, the availability of calcium, magnesium and phosphorous in Baillonellatoxisperma oil is a good indication that the oil is rich in the minerals for bone formation.

High amounts of copper (1.13 ± 1.02), zinc (14.33 ± 0.92) and Fe (13.71 ± 0.79) were recorded for Baillonellatoxisperma oil. These values for copper (5.13 ± 1.02) and zinc (14.33 ± 0.92) are higher than the recommended daily dietary allowance of 0.9mg/day and 11.0mg/day respectively while the value for Fe (13.71 ± 0.79) is lower than the recommended daily dietary allowance (18mg/day (FNB, 2001). Copper is essential for life since it is an important component of many enzymes and proteins. It is required in the production of red blood cells and for infant growth, host defense mechanisms, bone strength, red and white blood cell maturation, iron transport, cholesterol and glucose metabolism (Kany et al, 1998). High copper levels however have been cited as a possible risk factor for heart diseases (Ferns et al, 1998). Zinc on the other hand, is essential for growth and development, testicular maturation, neurological function, wound healing and immunocompetence. Additionally, it maintains the configuration of a number of non-enzymatic proteins such as pre-secretory granules of insulin and some mammalian gene transcription proteins (Struhl, 1989) and thymulin. Excess intake of zinc however results in reduced absorption and increased secretion (WHO, 2001). Iron is required for red blood cell formation and cellular metabolism. It can thus be concluded that Baillonellatoxisperma oil contains very essential minerals that are necessary for the maintenance of life though in rather larger amount.

Table 3: Mean Values of Fatty Acid Contents of Baillonellatoxisperma Oil

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Variables	Results
Caproic acid	20.190 ± 0.81
Caprylic acid	325.00 ± 0.87
Capric acid	3.26 ± 0.23
Lauric acid	45.10 ± 2.10
Myristic acid	15.90 ± 1.21
Palmtic acid	0.88 ± 0.20
Stearic acid	0.27 ± 0.80
Oleic acid	11.70 ± 2.86
Linoleic acid	•
Linolinic acid	0.0
Arachidic acid	0.0

An important feature common to most plant origin oils and fats is the high percentage of unsaturated fatty acids in the triacylglycerols. In general, the higher degree of unsaturated fatty acids in vegetable oils, the more susceptible they are to oxidative deterioration (St-Angelo, 1996, Zambiazi and Zambiazi, 2000, Bradley and Min 1992). Therefore, it is essential to know the composition of fatty acids of an oil or fat to determine their characteristics and also determine possible adulterations as well as to know the stability and physical- chemical properties of these products (St Angelo, 1996, Zambiazi, 1999).

Results show that Baillonella toxispermaoil contains a number of saturated fatty acids (SFA's) including caproic, caprylic, capric, lauric, myristicpalmitic and stearic acids. It also contains a mono-saturated fatty acid (oleic acid) and no poly-saturated fatty acid (table 3).

The presence of caproic acid (20.19 ± 0.81), caprylic acid (3.25± 0.87) and capricacid (32.6±0.23) in Baillonellatoxispermaoil is an indication that the oil is rich in essential fatty acid necessary for human health. Capric acid for instance helps to increase levels of high density lipoprotein (HDL) -the good cholesterol which has strong antiviral and anti-microbial properties.It also combats viruses, bacteria and the yeast candida albicans and it is broken down quickly and processed in the liver (St-Onge2008). Caprylic acid has antibacterial, antiviral, antifungal and anti-inflammatory properties. It is linked to the prevention of urinary tract infection, bladder infections, candida virus, sexually transmitted diseases, oral infections like gingivitis etc. It is also widely known for its antifungal effects especially in regards to keeping the digestive and reproductive organs including the bladder, gut and urethra functioning properly. Research also suggest that caprylic acid has positive application for fighting inflammation, cancer, age related cognitive decline including Alzheimer's disease, autism and circulatory problems.

Another saturated fatty acid thatshowed a high presence in Baillonellatoxisperma oil was lauric acid (45.10 ± 2.10). This acid is easily absorbed by the body and fight weight loss. It is easily digestible and use as a source of direct energy, helps lower blood cholesterol levels. It can also improve cholesterol levels by raising the good high density lipoprotein (HDL) cholesterol (USDA, 2010). Research findings also show that lauric acid has the potentials to fight against viral infection such as influenza, common cold, genitalherpes as well as treatment for bronchitis, gonorrhea and yeast infections.

The study oil also contained myristic acid (15.90 ± 1.21) which is far below the 79% myristic acid of nutmeg reported by (Piras et al 2012). According to Meng et al, (2009), myristic acid is an important saturated fatty acid (SFA) which the body uses to stabilize many different proteins including proteins used in the in the immune system. It also helps in metabolism, weight reduction, and anti-aging improvement including delayed senility and dementia as well as activating enzymatic proteins called sirtuins. Palmiticacid was mildly present in Baillonellatoxisperma oil (0.88 ± 0.21). The recommended value of codex stan 26 (1933a) is 7-12%. This shows that Baillonellatoxisperma oil has a lower value than the recommended value. Many medicinal authorities such as the World Health Organization (WHO) say that the dietary intake of saturated fatty acid such aspalmitic acid increases the risk of cardio-vascular diseases. However, in moderation, palmitic acid might not be entirely bad as it does not raise cholesterol levels if it is combined with linoleic acid. So, its mild presence in Baillonellatoxisperma oil is an affirmation that it is not harmful to health. Also, Baillonellatoxisperma oil showed a low level of stearic acid (0.27 ± 0.80). This value is quite low compared to 10-12.3% recorded for cucumeropsismanni seed oil by (Badifu, 1991, Fokou et al, 2009) and 4.87-11.2% recorded for cucurbitapepo seed oil by (Tsakins et al, 1997, El-Adawy and Taha 2001, Nakic et al, 2006 and Nyam et al, 2009). The value recorded is equally lower than the recommended value of Codex stan 26 (1993a) of 3.5-6.0%. Stearic acid has a neutral effect on blood total and low density lipoprotein (LDL), hence, it does not increase the risk of cardiovascular disease. As a matter of fact, the effect of stearic acid on HDL cholesterol and Triglyceride levels are inconsistent (Kris et al, 2005 and Mensik, 2005). Recent investigation in humans however show that diets enriched in stearic acid have a natural or beneficialeffect on thrombotic tendency (Kris et al, 2005, Kelly et al,

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2001, Kelly et al, 2002, Tholstrup, 2005 and Thijssen et al, 2005).The only mono-unsaturated fatty acid found in Baillonellatoxisperma oil was oleic acid which recorded (11.70 ± 2.86). This isvery close to the (10.21%) reported by Sew et al, (2010) for melon seed oil and also the (13.25-18.1%) reported by El-Adawy and Taha, 2001, Milovanovic and Picuric-Jovanovic, 2005, Mariod et el, 2009, Nyam et al, 2009, Baboli and Safe Kordi, 2010) for melon seed oil. These findings suggest that Baillonellatoxisperma oil could be a potential source of omega-6-dietary supplements.

Table 4. Mean Value of Cholesterol Content of Baillonellatoxisperma Oil

Variable	Results (%)
Cholesterol	0.73 ± 0.16

Table 4 shows result of the mean value of cholesterol content in Baillonellatoxisperma oil. It shows that the oil has a very mild value of cholesterol content (0.73 ± 0.16). This value is not significantly different from cholesterol content of groundnut oil (0.00 ± 00) (Edem, 2002) but low compared to that of palm oil (13.00 ± 0.52) (Ayo, 2017). In other words, with respect to cholesterol content Baillonellatoxisperma oil is as good as groundnut oil. This finding is quite significant because cholesterol levels are great determinants of the toxic levels of vegetable oil. At normal levels, cholesterol is an essential substance for the body's normal functioning. Cholesterol contributes to the structure of cell walls, makes up digestive bile acid in the intestines, allows the body to produce vitamin D and enables the body to make certain hormones. But evidence indicates that high cholesterol can increase the risk of narrowing of atherosclerosis, heart attack, stroke, mini-stroke and peripheral arterial disease (PAD). This is because cholesterol can build up in the artery wall, restricting the blood flow of the heart, brain and the rest of the body. It also increases the risk of a blood clot developing somewhere in the body. The mild presence of cholesterol in Baillonellatoxisperma oil makes ita consumable oil for human health.

IV. CONCLUSION

Baillonellatoxisperma oil which is common and popular in Boki Local Governmeent Area of Cross River State and parts of the Cameroons is a vegetable oil of high economic potentials. The mineral, fatty acid and cholesterol content of the oil from this study makes it highly desirable as cooking oil. However, it must be noted that the high mineral contents especially of Na, K, P and Mg could affect its quality and therefore its consumability except if could be refined through further research. The high carbohydrate and protein content shows that the oil is very nutritious and therefore good for human consumption.The moisture content in the seed of Baillonellatoxisperma confers on it stability, quality and long shelf-life. Further investigation on other aspects of this oil is strong recommended in order to boost rural income and close the food security gap.Again, studies on the physio and phytochemical properties of the oil should becarried out in order to determine the properties that need refining and plantations of Baillonellatoxisperma (mimosup) should be established in the study area to enhance its production.

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