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Comparative Studies on the Influence of Fermentation on Chemical Characteristics of Oil Extracted from African Locust Bean (*Parkiabiglobosa*)

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Abtract:- African Locust bean (*Parkiabiglobosa)* has been a fermented condiment in Africa from the antiquity used in soup preparation to bring out the required flavor and taste. This research focused on the effect of fermentation on the oil from *Parkiabiglobosa* when wholly consumed or extracted for home and industrial purposes. Oil from unfermented *biglobosa*has the highest acid value (6.17±0.02mgkOH/g) while oil from fermented has the lowest acid value (5.61±0.01mgkOH/g). These showed that both oils are suitable for edible purposes irrespective of the toxicity of the raw flour sample.The saponification values were 161.00mgKoH/g and 187.93mgKoH/g for oil from unfermented and fermented, the higher saponification value in the oil from fermented sample to lower value of oil from unfermented *parkiabiglobosa* Suggested that fermented *Parkiabiglobosa* oil had low level of impurities to raw oil sample.Peroxide value ranged from 9.94 – 13.4mεq/kg$^{-1,}$ This resulted to low acid taste in in both oil and low level of rancidity.The result obtained from the study indicated that oil from fermented *parkiabiglobosa* are good for soap making due to higher saponification value, and could be used for both domestic and industrial purposes. Also, raw oil sample can be employed in the manufacture of, oil paints, cosmeticsand also serve as edible oil due to the level of the unsaturationas indicated in high iodine value and as non-drying oil as observed from the physical properties.The mineral composition as indicated in table2 for the oil contributes to its nutritional values. The values obtained for the raw oil sample indicated higher values in potassium, sodium, calcium, iron, lead, manganese and copper except Magnesium of closed values (190.100 to 190.200). These indicate the advantage of the nutritional value of raw oil sample to fermented oil sample.

Keywords:- *African locust bean, Fermentation, Oil, Physico-chemical, Raw.*

I. INTRODUCTION

Fermented African locus bean (Iru) is the second most popular indigenous condiments and It is an oil seed (Omafuvbee*t al.,* 2004). Yoruba tribe in western Nigeria called the fermented condiment produced from African locust bean (*Parkiabiglobosa*)' Iru'. Hausa land in northern Nigeria called it 'dawadawa; and different ethnic gruops equally called it different names (Odunfa, 1985).

Fermentation has been regarded as one of the oldest approaches used for food preservation. The skills and methods of fermentation is widespread in Africaas well as the processing of fruits and other carbohydrate based crop to produce alcoholic and non-alcoholic brews, the manufacturing of sour tasting *ogi* from fermented cereal products provide instant calorie in breakfast and convalescent diets (Adewusi*et al*., 1991; 1992). There are some Oil seeds such as melon seed, castor oil seed, mesquite bean and soybean that can also be fermented to give condiments like African locust bean.

Chemical transformation of organic substrate takes place duringfermentation to produce simpler compounds by the action of enzymes produced by microorganisms such as moulds, yeasts and bacteria (Shurtleff and Akiko, 2007). Almost all the physical characteristics of legumes are altered during fermentation to improve the level of some nutrients in them and their bioavailability (WHO, 1998) and effect some microbial properties present (Mensah *et al*., 1990). Fermentation of oil seeds brings about an increased in the nutritional value and wholesomeness over the initial material and this may contributeto changes in vitamins and micro- nutrients. Toxicity of the condiment reduced duringfermentation and improve palatability and bring out the desirable flavor in foods. Development of some essential micronutrients has occurred during fermentation and has contributed to rapid growth in infancy, adolescence and late pregnancy (Odumodu, 2007).Mainly, the production of condiments is on a traditional small-scale and household origin under highly adaptable environments (Odunfa, 1985). Also, the fermentation is frequently prepared in a moist solid state, involving contact with appropriate inocula of assorted microorganisms and this is achieved by the normal temperatures of the tropics. The favorite state of fermentation of the condiments is specified by the formation of mucilage and the production of of ammonia as a result of the breakdown of amino acids during the fermentation process (Omafuvbe, 1994). Atypical ammonia calodour and flavor produced by the condiments augment the taste of traditional soups and sauces, especially the various soups used as supplement to the starchy food diets. Condiments are also recognized to contribute to the calorie and protein intake (Simmons, 1976; Umoh and Oke, 1974) and this has been constantly added to soups as low-cost meat substitute by low-income families in some communities in Nigeria (Odunfa, 1985).

To mention but a few, some researchers have worked on the production of fermented condiments-*iru*-from African locust bean (Odunfa, 1985), melon seed fermented *ogiri* (Odunfa, 1981; Achinewhu, 1983) and soybean to produce*daddawa* (Omafuvbe*et al.*, 2000; 2002). Oil seeds are known as seeds that are generally processed to yield condiments but so far, no investigation has been carried out on the changes in the oil component of these seeds as a result of fermentation. Furthermore, comparative chemical and biochemical changes occurring during fermentation have been neglected especially in the fermentation of the most popular condiments(*iru).*

The main objective of the present study is to extract oil from the processed unfermented and processed fermented African locust bean and to determine the physico-chemical properties and mineral composition of the two extracted oil. The major objectives of this work are; to know whether the effect of the chemical transformation of organic substrate into simpler compounds by the action of enzymes which are produced by microorganisms such as moulds, yeasts and bacteria during fermentation will equally affect the physico-chemical properties and mineral composition of the oil from fermented *Parkiabiglobosa*by whencompared with just processed unfermented sample , Also,to evaluate their industrial application and suitability for human consumption based on the values obtained from the raw and fermented sample.

II. MATERIALS AND METHOD

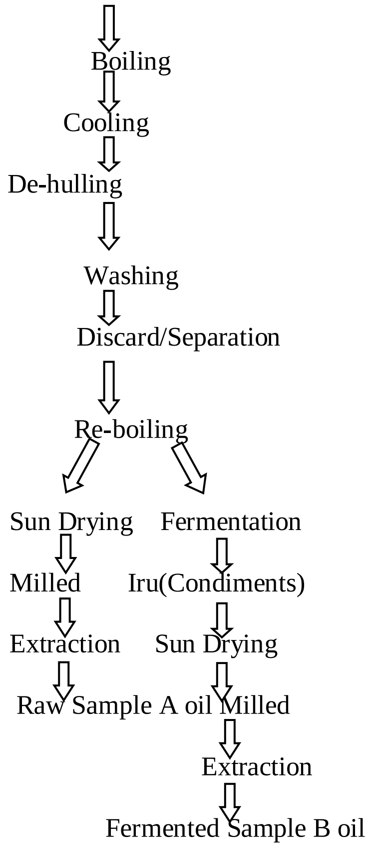
A. Sample Collection:

African locust beans were purchased from king's market in Owo, Owo local government Area, Ondo State, Nigeria.

B. Preparation and Processing of African locust beans to produce 'iru'(Condiments):

The method described by Ikenebomeh and Kok (1984), on the production of 'iru' from *Parkiabiglobosa* seeds was adopted and modified for normal fermentation process except that of raw(no fermentation) before extraction. Two kilograms (2kg)(preferably) of the dried African locust bean seeds were soaked in water for 15 minutes and boiled under pressure for two hours (2h). The cooked seeds were deshelled and washed thoroughly to eliminate the testa. The cotyledons were boiled for the second time under pressure for 45mins and drained,it was divided into two equal parts,while one part was sundried immediately(Sample A) for three days, the second part was fermented in an incubator at 35ºC for 36h before sun drying for three days(Sample B). Both dried samples A and B were milled mechanically by small milling machine in the market and stored in a clean bottle for extraction process.

III. AFRICAN LOCUST BEAN SEEDS



Flow chart 1: Oil from Raw (sampleA) and fermented(sampleB) African locust bean (*Parkiabiglobosa*)

C. Extraction of oil from African locust bean:

300 ml of hexane was poured into a round bottom flask. 10g of the sample was placed in the thimble and was inserted in the center of the extractor. The soxhlet was heated at 40-60ºC. When the solvent was boiling the vapour rose through the vertical tube into the condenser at the top. The liquid condensed anddropped into the filter paper inside the thimble at the center thatconfined the solid sample in the which the oil is extracted. The extract (oil) with the solvent moved through the pores of the thimble and occupied the siphon tube, where it flowed back down into the round bottom flask. This was allowed to continue for 30min. It was then removed from tube, dried in the oven, cooled in the desiccators and weighed again to determine the amount of oil extracted. Further extraction was carried out at 30min intervals until the sample weight at further extraction and previous weight became equal. The experiment was repeated by placing 5g of the sample into the thimble again. When the extraction has been completed, the resulting mixture comprising the oil was heated to recover solvent from the oil.

D. Analysis procedures:

Physico-chemical composition likeAcid Value, Iodine Value, Saponification Value, Peroxide Value, Specific Gravity, Refractive index and colourwere analyzed as well as the mineral composition as described by Associationof Official Analytical Chemist (AOAC, 2000)

IV. RESULTS AND DISCUSSION

A. Results

Parameter	RO	FO
Acid value (mg/g)	6.170±0.02	5.610±0.01
Iodine value (g/100g)	80.400±0.20	70.400±0.20
Saponificationvalue (mgKoH/g)	161.00±1.20	187.930±1.20
Peroxide value (mmol/g)	13.400±1.02	9.940±1.01
Refractive Index	1.420±0.02	1.452±0.02
Specific gravity	0.881±0.20	0.871±0.10
Colour	Light-yellow	Deep-yellow

Table 1: Physico-chemical properties of oil extracted from Raw and fermented *Parkia-biglobosa*(Locust bean)

±SDV of triplicate values

Key: RO – Oil from processed Raw Locust bean FO –Oil from processed Fermented Locust bean

Mineral Composition(mg/kg)	**RO**	**FO**
Potassium (k)	**30.010**	**28.750**
Sodium (Na)	**180.510**	**120.400**
Calcium (Ca)	**250.300**	**210.600**
Iron (Fe)	**79. 210**	**61.420**
Lead(Pb)	**10.200**	**9.100**
Magnesium(Mg)	**190.100**	**190.200**
Manganese(Mn)	**3.300**	**3.100**
Copper(Cu)	**6.400**	**5.100**

Table 2: Mineral Composition of oil extracted from Raw and fermented *Parkia-biglobosa*(Locust bean)

B. Discussion

The results in table1 were the values obtained for physico-chemical properties of raw and fermented locust bean oil. Acid value is asign for edibility and suitability of the oil. *Parkiabiglobosa* Oil from unfermented *biglobosa*has the highest acid value (6.17±0.02mgkOH/g) while oil from fermented has the lowest acid value (5.61±0.01mgkOH/g). These results showed that both oils are suitable for edible purposes and also in accordance with the report of Akintayo*et al.* (2004) and Akanni*et al.* (2005) for edible oils. The iodine value which is useful in predicting the drying property of oils and the level of saturation.The oil was found to be in the ranged 70.4 – 80.4. Oil with iodine value lowerthan 100 indicates that the oil is not a drying oil. Both oil could be classified as a non-drying oil, since iodine value are lower than 100 (Kirsehenbauer, 1965). The high iodine value is evidence that the oil could be used in the manufacture of cosmetics, oil paints and vanishes and also serve edible purpose due to the level of the unsaturation. The low iodine value could be also being of significant in the manufacture of leather, dressing, candle lubricants and hydraulic brake fluids, as reported by Adelaja (2006)due to the level of the saturation. The iodine value is also an index for assessing the ability of oil to go rancid.Low iodine value indicated high saturation. Higher saturation of oil in fermented sample (70.4±0.20) to raw sample(80.4±0.20) indicated that raw sample can easily go rancid to fermented sample.

The saponification values were 161.00mgKoH/g and 187.93mgKoH/g for oil from unfermented and fermented because of the level of the unsaturation with the highest saponification value in the oil from fermented sample whileoil from unfermented *parkiabiglobosa*had the lower value. When high saponification value recorded for the seed oils,this Suggested that the oil had low level of impurities and is the evidence that the oil could be used in soap making in soap manufacturing industry (Alander and Anderson, 2002; Akanni*et al*., 2005).Hihger value was in fermented *parkiabiglobosa*oil.

Peroxide value ranged from 9.94 – 13.4mεq/kg$^{-1,}$ lower than the value between 20 and 40mεq/kg^{-1} result to acid taste in oil sample reported by Adelaja, (2006). Refractive index of the raw *parkiabigboga*and fermented *parkiabiglobosa*ranged from 1.420±0.02-1.452±0.02 for both samples. The oil from fermented seed of*parkiabiglobosa* had the highest refractive index while the raw had the lowest.

Most popular oils have specific gravity ranging from 0.9100 – 0.9400 and the 0.920 is considered a pretty good number for any cooking oil (Elert, 2000). Moreover, some authors have stated that specific gravity suitable for edible oils ranged from 0.8800 to 0.9400 (Toolbox, 2005). Value of 0.871±0.30 and 0.881±0.20 specific gravity of oil from unfermented and fermented *parkiabiglobosa* respectively are in the range of common cooking oils.

The mineral composition as indicated in table2 for the oil contributes to its nutritional values. The values obtained for the raw oil sample indicated higher values than oil from the processed fermented sample in potassium (30.010 to 28.750),sodium (180.510 to120.400) calcium (250.300 to 210,600), iron, lead, manganese and copper except Magnesium of closed values (190.100 to 190.200).

V. CONCLUSION

This study revealed the effective uses of oil from unfermented *Pakiabiglobosa* seed over the fermented oil.Seed oils are known to deteriorate when processed inadequately with the principal decomposition reaction being oxidation. However, the physico-chemical property of the seed oils studied showed that high values were obtained for unfermented oil sample than fermented sample except saponification value (187.93 mgKOH/g) for chemical characteristics and refractive index(1.452±0.02) for physical characteristics. Also, the mineral composition favored the oil from the unfermented *Pakiabiglobosa*seed The results obtained from this study revealed that higher iodine value and peroxide value obtained from oil from unfermented locust bean were also an index for assessing the ability of oil to go rancid than oil from fermented sample.High saponification value recorded for the oils in fermented sample Suggested that the oil had low level of impurities and is the evidence that the oil could be used in soap making in soap manufacturing industry and could be used as baseline data to develop the oil for both domestic and industrial application. It can be stated thatthe action of enzymes which are produced by microorganisms such as moulds, yeasts and bacteria during fermentation effect of the chemical transformation of organic substrate into simpler compounds which equally affect the physico-chemical properties and mineral composition of the oil from fermented *Parkiabiglobosa*by whencompared with just processed unfermented sample. There is a significant increase in the mineral composition of oil from processed raw sample for domestic consumption compared to the oil from fermented process sample.

- **Recommendation:**

The result obtained from the study indicated that oil from fermented *parkiabiglobosa*are good for soap making due to higher saponification value, and could be used for both domestic and industrial purposes. Also, raw oil sample can be employed in the manufacture of cosmetics, oil paints and vanishes and also serve edible purpose due to the level of the unsaturation according to value obtained for its iodine value.It is therefore recommended that further analysis should be carried out on the anti-microbial and anti-nutrients properties of oil from raw and fermented *parkiabiglobosa*for its healing effect.

- **Author Contributions**

G. Aladekoyi sought for the study authorization from the relevant government institutions for the process of*parkiabiglobosa* into condiment. He developed the study methodology that also comprised preparing a checklist that was used in data collection. G. Aladekoyi, K. Akinolaand O.C Arijeniwa analyzed the samples and interpreted the data. G. Aladekoyi undertook a literature review that included the introductory background information and the theoretical context. All authors edited the paper to ensure completeness and consistency with the journal's formatting guidelines.

- **Conflict of Interest**

The authors declare that there are no conflicts of interest regarding the publication of this manuscript. In addition, the ethical issues; including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy has been completely observed by the authors.

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