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# COMPARATIVE ANALYSIS OF PHYSICO-CHEMICAL PROPERTIES OF OIL EXTRACT FROM TWO VARIETIES OF FLUTED PUMPKIN SEEDS USING DIFFERENT EXTRACTION METHODS

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## ABSTRACT
This study investigates physical and chemical properties two seeds namely Ugba (*Telfairia pedata*) and Ugwu (*Telfairia occidentalis*) using soaking soxhlet methods of extraction. The physical properties examined are moisture content, ash content, crude protein, fat and oil, crude fibre and carbohydrates. The chemical properties examined are Acid value (mgKOH/g), saponification value, iodine value, free fatty acid, peroxide and refractive index. Higher mean values of moisture content, ash content, crude fibre and carbohydrates were noticed in Ugwu than in Ugba under soaking method. However, the trend was reversed for crude protein and free fatty acid, in whose case they appear to be higher in Ugba than in Ugwu. For soxhlet method, moisture content, ash content, crude fibre and carbohydrates seems to have higher mean values in Ugwu seed compared to when Ugba seed was used. However, crude protein and fat and oil content were higher using Ugba seed than Ugwu seed oil. For soaking method, Ugba seed seem to produce higher mean values of sap value, iodine value, and refractive index when compared with Ugwu seed. On the other Ugwu, seems to produce acid value, free fatty acid and peroxide value when compared with ugba for soaking method. Using soxhlet apparatus however, Ugba seed produces higher mean values for acid value, sap value, iodine value, and free fatty acid compared to Ugwu. The reverse was the case with peroxide and refractive index, still with soxhlet apparatus.

**Keywords:** Saponification, Iodine value, Extraction, Solvent, oil

## INTRODUCTION
Fluted pumpkin (*Telfaria occidentalis*) is a tropical crop belonging to the Cucurbitaceae family [1]. It is reported to be indigenous to the West tropical rain forest areas of Nigeria [2]. The seeds

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of fluted pumpkin are widely consumed in Nigeria, especially in the southern part of Nigeria where it is used as soup condiment. The fermented seeds are also used in formulation of marmalade and cookies [3]. Fluted Pumpkin seeds are used for propagation, extraction of oil and as soup condiment in thickening fluid soup. It said to have contained 93% essential amino acids, 53% crude fat and 27% crude protein [4]. The seed contains oil which is used for cooking [5]. The oil has saponification value that is beyond the range for most oils of plants origin and less than that of palm oil. Meaning that, the oil has larger molecular weight than the common oils [6]. It also has high iodine value compared to palm oil, indicating that it has high content of unsaturated fatty acids relative to palm oil. It may be used for cooking or manufacturing of margarine. It has a high specific gravity compared to commonly known vegetable oil. Its low acid value also indicates that the oil is edible [7].The oily seeds have lactating properties and are widely consumed by the nursing mothers [8]. Fluted pumpkin seed oil has been reported to ameliorate the effect of quinine induced testicular damage [9]. Due to its high phosphorus content, it is said to be a potential agent in reducing kidney bladder stone disease [10]. The anti-oxidative property of Fluted pumpkin seed oil could also enhance fertility [11]. It has a close relative, *Telfairia pedata* (Sims) Hook "Queen Oyster Nut" which used to be cultivated in Ethiopia, Kenya, Madagascar, Malawi, Mozambigue, Rwanda, Tanzania, Uganda and Zanzibar [12].

Solvent extraction is traditionally employed to extract oil from oil seeds, and n-hexane is currently preferred worldwide for its efficacy and availability. Solvent extraction is a simple procedure based on the fact that a solute is distributed in two phases according to the equilibrium ratio, determined by the nature of the component and the two phases [13]. To facilitate oil extraction, seed or grain size is reduced by cracking or rolling [14]. Heat treatment before or during extraction causes cell emulsion rupture and reduces oil viscosity. Both of these properties facilitate oil fluidity and movement, and lower oil surface tension, but can negatively affect its chemical quality and increase the oil's susceptibility to oxidation. Nonetheless, preheating offers clear advantage over other methods such as pressing and aqueous extraction [15], and the use of other solvents such as petroleum ether, and mixtures of chloroform/methanol with hexane, acetone, methanol, ethanol, ethyl acetate, and water, among others.

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Thus, this present research work will examine the chemical compositions present in oil extract from two pumpkin cultivars, fluted gourd and oysternut using Soxhlet apparatus and soaking method with a view to providing useful information towards effective utilization of these oils.

## MATERIALS AND METHODS

### Collection of seed samples

The fresh Fluted Pumpkin pods (Ugba and Ugwu) were gotten from a market in Kwara State. The pods were opened to remove the seeds; the seeds were sun dried for 24hours. The seeds were then pounded and sieved with a 2mm sieve. Plate 1 and 2 show the fluted pumpkin pod and de-podded fluted pumpkin respectively.

**Plate 1.** Fluted pumpkin pod

**Plate 2.** De-podded fluted pumpkin seeds

### Extraction of oil

The Extraction of Oil was done by two methods namely; Soxhlet apparatus and soaking method.

### Solvent extraction

The Solvent extraction was done using the Soxhlet apparatus in the Chemical Engineering laboratory.

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**Procedure using Soxhlet apparatus**

200ml of petroleum ether was put in the conical flask, 100g of the seed was weighed after grounding and put in a muslin cloth and the muslin cloth placed in the extraction tube, then the extraction tube fixed into the conical flask and the condenser tube was also fixed into the condenser tube as shown in figure 3 below. The whole set up then placed in the heating mantle and left to run for two (2) hours at a temperature of $60^0$C. After the oil has been gotten, the conical flask was placed in an oven dryer at a temperature of $70^0$C and weighed at an interval of 3minutes until constant weight is achieved. Plate 3 shows the setup of the Soxhlet apparatus.

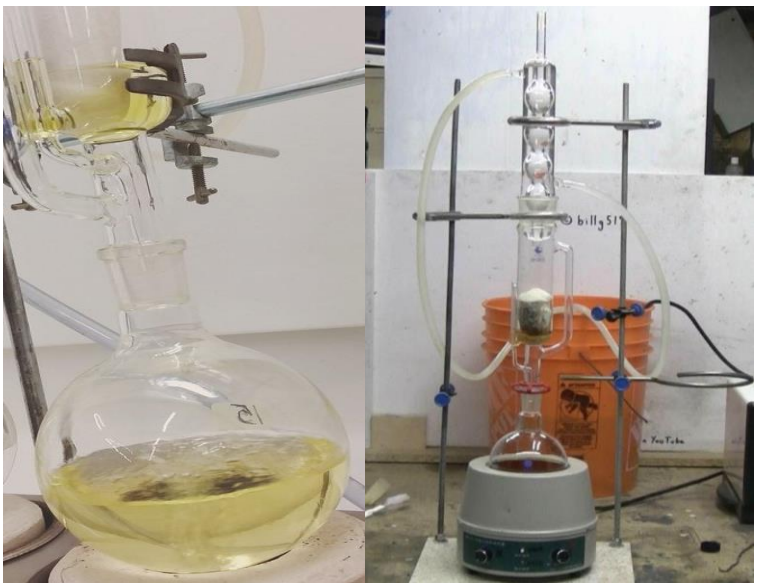

**Plate 3.** Soxhlet apparatus set up

**Procedure for soaking method**

The seed from which the oil is to be extracted was first weighed. 100g of the seed was weighed for size reduction using a blender. 200ml of petroleum ether was measured into a plastic container, the ground seeds sample was poured into the petroleum ether, and the container covered tightly to avoid escape of the petroleum ether. The mixture was shaken at an interval of 4hours and left for 72hours (3days). The mixture was filtered using filter paper, separating funnel and a flask. The filtrate was heated to obtain the oil with the solvent (petroleum ether) heated off

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in an oven dryer at a temperature of $70^0$C. The procedure is repeated for each of the varieties. Plate 4 and 5 show the apparatus for soaking method and filtration/clarification method.

**Plate 4**. Soaking method process **Plate 5.** Filtration/clarification

**Determination of physico-chemical properties and proximate compositions of the oil seeds**
The analysis of the Physico-chemical properties and proximate compositions was done using [16] (Association of Official Analytical Chemist). The Physico-chemical properties determined were; Saponification value, Acid value, Iodine value, Peroxide value, free fatty acid and Refractive index.

## RESULTS AND DISCUSSION

### Physical Properties of the Seeds

Table 1 describes the mean and the variability of the data collected on the physical properties of the two seeds under soaking and Soxhlet apparatus respectively.

Percentage moisture content (5.680± 0.010, 5.777± 0.015) and (5.373±0.015, 5.430± 0.010) were safe for long period storage without spoilage, because dried seeds having this low moisture content are not highly susceptible to microorganism attack [17]. The values obtained showed that the seed contained high percentage of fat and protein in soaking (47.413 and 43.923), (36.317

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and 29.837) and Soxhlet method at (36.290 and 28.910), (47.443 and 46.390) % respectively. The protein and fat contents agree with the values (34.1 and 46.3%) reported by [18]. Compared with 16.0% for *T. occidentalis* [19].These differences may be caused by the species variations and environmental conditions. In addition, the protein content of the seeds from our study was higher than those of other oilseeds, e.g. cashew nuts (22.8%), cottonseed (21.9%), and sesame (18.7%), and that of animal proteins (16.0-18.0%) such as lamb, fish, and beef [17]. The fluted pumpkin seeds are considered to be rich in protein. The protein content of the fluted pumpkin seed suggests that it can contribute to the daily protein need of 23.6 g/100 g for adults as recommended by some authorities [17]. Percentage carbohydrate content was (7.290 ± 0.010, 8.470±0.010) and (16.167± 0.021, 15.060 ±0.020). This value was much higher than 5.6% reported by [20]. Ash content determination is important because it is an index of the quality of feeding materials used by animal feed producers for poultry and cattle feeding [19]. Crud fibre content was low compared to 12.1% for *Cucurbita pepo* and *Cucurbita maxima* [20]. The low level of crude fibre can probably be due to the use of dehulled seed samples. It has been claimed that such differences in the oil content can be attributed to genetic diversity and climate conditions [21].

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**Table 1.** Descriptive Statistics of the Proximate Analysis

| **Parameter** | **Methods** | **Seed type** | **Proximate Analysis** | |
|---|---|---|---|---|
| | | | **Mean** | **SD** |
| Moisture content (%) | Soaking | Ugba | 5.680 | ±0.010 |
| | | Ugwu | 5.777 | ±0.015 |
| | Soxhlet App | Ugba | 5.373 | ±0.015 |
| | | Ugwu | 5.430 | ±0.010 |
| Ash content (%) | Soaking | Ugba | 2.280 | ±0.010 |
| | | Ugwu | 2.660 | ±0.010 |
| | Soxhlet App | Ugba | 1.520 | ±0.020 |
| | | Ugwu | 2.453 | ±0.015 |
| Crude protein (%) | Soaking | Ugba | 36.317 | ±0.015 |
| | | Ugwu | 29.837 | ±0.015 |
| | Soxhlet App | Ugba | 47.443 | ±0.021 |
| | | Ugwu | 46.390 | ±0.010 |
| Fat and oil content (%) | Soaking | Ugba | 47.413 | ±0.015 |
| | | Ugwu | 43.923 | ±0.025 |
| | Soxhlet App | Ugba | 36.290 | ±0.010 |
| | | Ugwu | 28.910 | ±0.010 |
| Crude fibre content (%) | Soaking | Ugba | 1.063 | ±0.015 |
| | | Ugwu | 1.673 | ±0.021 |
| | Soxhlet App | Ugba | 0.970 | ±0.010 |
| | | Ugwu | 1.830 | ±0.010 |
| Carbohydrate content (%) | Soaking | Ugba | 7.290 | ±0.010 |
| | | Ugwu | 16.167 | ±0.021 |
| | Soxhlet App | Ugba | 8.470 | ±0.010 |
| | | Ugwu | 15.060 | ±0.020 |

*Ugba *(Telfairia pedata)*,Ugwu *(Telfairia occidentalis)*

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**Chemical Analysis of the Seeds**

Table 2 also describes the statistical properties of the chemical analysis. Generally, soxhlet apparatus gives higher mean values of all parameters studied irrespective of seed type. The only exception is in sap value where soaking method produces more than 10 times ash content compared to what was observed in soxhlet apparatus. Most of the seed oils reviewed have their refractive index values within the acceptable range of 1.4677 to 1.4707 for virgin, refined and refined-pomace oils according to Codex Standards for fats and oils from vegetable/plant sources [22].

Acid value however accounted for the presence of free fatty acids in the oils as an indicator of the presence and extent of hydrolysis by lipolytic enzymes and oxidation [23]. Low acid value in oil indicates that the oil will be stable over a long period of time and protect against rancidity and peroxidation. This could be attributed to presence of natural antioxidants in the seeds such as vitamins C and A as well as other possible phytochemical like flavonoids. Acid value is used as an indicator for edibility of an oil and suitability for use in the paint and soap industries [24]. High acid value showed that the oil may not be edible, but however, be useful for production of paints, liquid soap and shampoos [24]. Also appreciable acid value of oils is an indication that the plant might be poisonous for livestock [24]. An increase in saponification value in oil increases the volatility of the oils. It enhances the quality of the oil because it shows the presence of lower molecular weight components in 1 g of the oil which will yield more energy on combustion [25]. The low saponification value is an indication that the oil may not be suitable for soap making, oil-based ice-cream and shampoos. It has been reported by [6] that oils with high saponification values contain high proportion of lower fatty acids. Oils with iodine value less than 100 gI2/100g of oil are non-drying oils; correspondingly, [24] reported that the lower the iodine value the lesser the number of unsaturated bonds; thus the lower the susceptibility of such oil to oxidative rancidity. Therefore, non-drying oils are not suitable for ink and paint production due to their non-drying characteristics but may be useful in the manufacture of soaps [26] and can be regarded as liquid oil. A good drying oil should have iodine value of 130 and above. Thus, ugba and ugwu can be grouped as drying oils. High iodine value is a pointer to the presence of high percentage of unsaturated fatty acids in the seed oil; as such amount of iodine that will be absorbed by the unsaturated acids would be higher [27] and oils with such characteristic may

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therefore be find useful as raw materials in the manufacture of vegetable oil-based ice cream [28].

**Table 2.**Descriptive Statistics of the Chemical Analysis, [*Ugba *(Telfairia pedata)*, Ugwu *(Telfairia occidentalis)*]

| **Parameter** | **Methods** | **Seed type** | **Chemical Analysis** | |
|---|---|---|---|---|
| | | | **Mean** | **SD** |
| Acid value (mgKOH/g) | Soaking | Ugba | 32.539 | 0.010 |
| | | Ugwu | 84.143 | 0.021 |
| | Soxhlet App | Ugba | 326.491 | 0.036 |
| | | Ugwu | 137.452 | 0.016 |
| Saponification value | Soaking | Ugba | 596.420 | 0.020 |
| | | Ugwu | 588.047 | 0.057 |
| | Soxhlet App | Ugba | 33.620 | 0.020 |
| | | Ugwu | 11.210 | 0.010 |
| Iodine value | Soaking | Ugba | 160.553 | 0.015 |
| | | Ugwu | 140.370 | 0.010 |
| | Soxhlet App | Ugba | 160.633 | 0.015 |
| | | Ugwu | 142.413 | 0.015 |
| Free fatty acid | Soaking | Ugba | 16.270 | 0.010 |
| | | Ugwu | 42.082 | 0.016 |
| | Soxhlet App | Ugba | 163.240 | 0.018 |
| | | Ugwu | 68.718 | 0.016 |
| Peroxide value | Soaking | Ugba | 9.870 | 0.026 |
| | | Ugwu | 10.490 | 0.010 |
| | Soxhlet App | Ugba | 9.267 | 0.015 |
| | | Ugwu | 10.680 | 0.010 |
| Refractive Index | Soaking | Ugba | 1.475 | 0.014 |
| | | Ugwu | 1.472 | 0.016 |
| | Soxhlet App | Ugba | 1.470 | 0.010 |
| | | Ugwu | 1.479 | 0.012 |

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**REFERENCES**

[1] Egbekun M K, Nda-Suleiman E O & Akinyeye O, Utilization of fluted pumpkin fruit (*Telfairia occidentalis*) in marmalade manufacturing, *Plant food hum. nutr*, 52 (1998), 171-176.

[2] Giami S Y & Barber L I, Utilization of protein concentrate from ungerminated and germinated fluted pumpkin *(Telfairia occidentalis Hook F)* seed in cookie formulations, *Journal of science food agric*, 84 (2004), 1901-1907.

[3] Fagbemi T N F, Eleyimi A F, Atum H N & Akpambang O, *Nutritional composition of fermented fluted pumpkin (Telfairia occidentalis) seed for production of "ogiriugu" fermented foods and beverages*, General IFT annual meeting, New Orleans, 2005.

[4] Agatemor C, Studies of selected physiochemical properties of fluted pumpkin seed oil and tropical almond seed oil, *Pakistan Journal of Nutrition*, 5(4) (2005), 306-307.

[5] Okoli B E & Nyanayo B, Poynology of Telfairia L. *(Cucurbitacae)*, *Folia geobotanica et phytotaxonomica*, 2 (1988), 281-286.

[6] Pearson D, *The chemical analysis of foods*, 7th Ed, Churchill Living Stone, London 1976.

[7] Agatemor C, Studies of selected phytochemical properties of fluted pumpkin (*Telferia occidentalis hook F.)* seed oil and tropical almond *(Terminalis catappia L.)* seed oil, *Pakistan journal of nutrition*, 5(4) (2006), 306-330.

[8] Ajibade S R, Balogun M O, Afolabi O O & Kupolati M D, Sex differences in the biochemical contents of *Telfairia occidentalis Hook F, Journal of food agric. environ.*, 4 (2006), 155-156.

Sunmonu *et. al.*, Vol. 13, No. II, December 2017, pp 48-60.

[9] Nwangwa E K, Mordi J, Ebeye O A & Ojieh A E, Testicular regenerative effects induced by the extract of *Telfairia Occidentalis* in rats, *Caderno de Pesquisa, série Biologia,* 19(1) (2006), 27.

[10] Suphakarn S, Yarnnon C & Ngunboonsri P, The effect of pumpkin seeds on oxalcrystalluria and urinary compositions of children in hyper endemic area, *American journal clinical nutrition,* 45 (1987), 115–21.

[11] Murkovic M, Hillebrand A, & Winkler J, Variability of fatty acid content in pumpkin seeds *(Cucurbita pepo L.), Z lebensm unters forsch,* 203(3) (1996), 216-219.

[12] Schippers R R, *African indigenous vegetables, an overview of the cultivated species*, Revised edition on CD-ROM, National Resources International Limited, Aylesford, United Kingdom, 2002.

[13] Bockish M, Extraction of vegetable oils, In Bockish M. (Eds.), *Fats and oils handbook Champaign*, IL: AOCS Press, 1998, 151.

[14] Prámparo M, Mattea M & Gregory S, Influencia del tipo decontacto sólido líquido en la extracción de aceites vegetales, *Grasas Y Aceites*, 53(4) (2003), 592–597.

[15] Evon P H, Vandenbossche V, Pontalier P Y, & Rigal L, Direct extraction of oil from sunflower seeds by twin-screw extruder according to an aqueous extraction process: feasibility study and influence of operating conditions, *Ind. Crops prod*, 26 (2007), 351–359.

[16] *Official methods of analysis*, Association of Official Analytical Chemists, Washington, DC, 2005.

[17] Ajayi I A, Oderinde R A, Kajogbola D O & Uponi J I, Oil content and fatty acid composition of some underutilized legumes from Nigeria, *Food chem*, 99 (2006), 115–120.

[18] Achinewhu S C, Composition and food potential of african oil bean (*Pentaclethra macrophylla*) and velvet bean (*Mucuna urines*), *Journal of food science*, 47 (1982), 1736-1737.

[19] Esuoso K, Lutz H, Kutubuddin M & Bayer E, Chemical composition and potential of some underutilized tropical biomass I: fluted pumpkin *(Telfairia occidentalis)*, *Food chem.*, 61 (1998), 487–492.

[20] Lazos E S, Nutritional, fatty acid, and oil characteristics of pumpkin and melon seeds, *J. Food Sci*, 51 (1986), 1382–1383.

[21] Stevenson D G, Eller F J, Wang L, Jane J L, Wang T & Inglett G E, Oil and tocopherol content and composition of pumpkin seed oil in 12 cultivars, *J. Agric. Food Chem*, 55 (2007), 4005–4013.

[22] Codex alimentarius, *Codex standards for named vegetable oils*, Rome, 8 (1999), 12-22.

[23] Gordon M, Fats, fatty foods, *Food industries manual*, 23rd edition, Blackie academic and professional, London, 1993, 179 –186.

[24] Aremu M O, Olaofe O & Akintayo E T , Chemical composition and physicochemical characteristics of two varieties of bambara groundnut *(Vigna subterrenea)* flours, *J. applied sciences*, 6(9) (2006a), 1900 –1903.

[25] Engler C R, & Johnson L A, Effects of processing and chemical characteristics of plant oils on performance of an indirect-injection diesel engine, *Journal of american oil chemical society*, 60(8) (1983), 1592 –1596.

[26] Kochhar S L, Economic botany in the tropics, 2nd ed, *Macmillan India ltd*, 1998, 354 – 355.

[27] Eze S O, Physicochemical properties of oil from some selected underutilized oil seeds available for biodiesel preparation, *African journal of biotechnology*, 11(42) (2012), 10003 –10007.

[28] Oderinde K A, Ajayi I A, & Adewuyi A, Characterization of Seed and Seeds oil of *Hura crepitans* and the kinetics of degradation of the oil during heating, *E-Journal of environment, agriculture & food chemistry*, 8(3) (2009), 201 –208.