

Proximate and Physicochemical Analysis of the Fruit and Oil of Avocado Pear

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Abstract Physicochemical analysis of the flesh, skin, seed and oil from avocado pear purchased from markets in Mowe Ogun State was carried out using standard procedures. The result of the proximate analysis of the fruit showed that the crude protein ranged from 4.03 ± 0.04 % (flesh) to 3.40 ± 0.09 % (seed), the carbohydrate content was found to be highest in the seed 18.69 ± 0.09 % while the skin had the highest ash content (0.53 ± 0.01 %). Phytochemical screening detected the presence of tannins, phenols, flavonoids and steroids in all the three parts, while saponins and alkaloids were detected only in the skin and seed. Analysis of the oil showed the flesh having the highest iodine value (68.27 ± 1.59 g/100g) and an acid value of 0.561 ± 0.00 mgKOH/g. The results of the proximate analysis show the three parts of the avocado fruit contain valuable nutrients which can be used as food. The presence of the various phytochemicals is an indication that this fruit may have some medicinal benefits. With acid, peroxide and iodine values which fall within the recommended range the oil from the avocado flesh can be used both for domestic and industrial purposes

Key Words: Avocado pear, proximate composition, physicochemical analysis, avocado oil

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1.0 Introduction

Vegetables and fruits are essential foods in our diet and also contain many compounds that are beneficial for health due to minor components (Gómez *et al.*, 2014). They supply vitamins and minerals to the diet and are sources of phytochemicals that function as antioxidants,

phytoestrogens, and anti-inflammatory agents and through other protective mechanism (Slavin, and Lloyd, 2012) Consumption of the raw forms of fruits and vegetables have been shown to be more beneficial to the mental well being of the body (Brookie *et al.*, 2018). Avocado fruit is one of such fruits which are consumed in the raw form.

Also known as *Persea Americana*, it has been shown to have excellent nutritional and medicinal qualities as well as industrial uses (Duartel *et al.*, 2016). Believed to have originated from Puebla in Mexico (Maitera *et al.*, 2014), avocado is now grown commercially throughout tropical America and around the world in warm climates (Indriyani *et al.*, 2016). When ripe the colour of the skin is purple black. The flesh of the fruit constitutes 65%, and the seed constitute about 20% the skin is about 15% of the total weight of the fruit (Orhevba and Jinadu, 2011). Avocado is a rich source of energy and an important constituent of diabetic's diet because its low sugar content. It also contains high amount of digestible oil. It also contain lots of vitamins such as vitamins C, E, K, B-1, B-2, B-6, B-9 and minerals such as phosphorus, sodium, magnesium, potassium, iron and zinc (Adaramola *et al.*, 2016, Orhevba & Jinadu, 2011; Oluwole *et al.*, 2013 and Maitera *et al.*, 2014). Avocado skin contains significant amount of minerals and can also be consumed as medicinal food (Rotta *et al.*, 2016). Some phytochemicals have been isolated from seed and peel of avocado fruit which provide good sources of antioxidant capable of preventing inflammatory diseases (Antasionasti *et al.*, 2017).

Avocado fruit exists in various shapes, sizes, colors depending on their variety (Indriyani *et al.*, 2016), and their composition also vary with geographical location (Maitera *et al.*, 2014). There are reports of chemical composition of varieties of the fruit consumed in different parts of the world (

Dreher and Davenport, 2013 ; Duarte *et al.* 2016; Indriyani *et al.*, 2016), and some parts of Nigeria (Maitera *et al.*, 2014; Nnaji and Okereke, 2016 ; Bala and Bashar, 2017) unfortunately , there is a dearth of information on studies of avocado fruits and oil obtained from Mowe, in Ogun state . It is therefore for this reason that this study carried out a proximate and phytochemical analysis of the three parts of the avocado fruits and also determine the physicochemical properties of the oil extracted from these parts.

2.0 Materials and Method

Mature and almost ripe avocado pear fruits without any skin blemish were purchased from a local market at Mowe, Ogun state, Nigeria. The samples were washed to remove any dirt, the three components of the fruits which are skin, flesh and seed were separated. The samples used for moisture determination in the proximate analysis were weighed and then dried in the oven at 100°C until constant weight was achieved. The flesh was cut into small pieces and blended in a blender to form a paste which was spread in a tray and sun dried. When dried, it was stored in a container until needed for further use. The skin was also cut and blended in a blender to form a paste, which was also sun dried and stored until needed for further analysis. The seeds were sun dried before they were crushed in a mortar and pestle after which they were further sun dried then pulverized into coarse powder.

2.1 Proximate analysis

The determination of moisture, ash content, crude protein, crude lipid and carbohydrate was carried out as described by AOAC (2000) while the crude fibre was determined using the method described by Parameswaran and Murthi (2014).

2.2 Preparation of extract from avocado fruit

A combined dichloromethane and methanol (1:1) extract of each sample (skin, flesh and seed) was used for the phytochemical screening .The method described by Teufack *et al.* (2017) was adapted for the extraction A quantity weighing 100g of each of the three parts of the sample (skin, flesh and seed) were macerated in a 300ml combined dichloromethane and methanol in ratio 1:1. The mixture was stored in three different Amber bottles for a week to enable complete extraction. After a week, the mixture was filtered and freeze dried moderately to reduce the solvent for the crude

extract. The extracts were used for the analysis as specified in their various procedures.

2.3 Phytochemical analysis

Chemical tests were carried out on the Dichloromethane and Methanol (1:1) mixture extract of the powdered specimens using standard procedures to identify the constituents. The methods described by Ezeonu and Ejikeme (2016) were used for the various phytochemical tests.

2.4 Extraction of oil

Extraction of oil from Avocado flesh was carried out via cold pressed method and Soxhlet extraction method. Extraction of oil from the skin and the seed was done via Soxhlet extraction method only, because their oil content could not be extracted by cold pressed method. The cold pressed extraction was carried out on the flesh by putting 100g of the prepared pulp into a sieve and squeezing it until the oil flowed out. The oil was collected and stored in a hermetically closed colored bottle.

For the Soxhlet extraction, the samples were extracted with petroleum ether (50° C) in a Soxhlet extractor for 6 hours, the petroleum ether used as solvent which was recovered back. The separated oil was kept in a sealed glass bottle.

2.5 Determination physicochemical properties

The physicochemical properties of oils from the flesh, skin and seeds of avocado were also determined. The saponification value, refractive index, acid value, iodine value and peroxide value were determined using the method described by Ogbunugafor *et al.* (2011) moisture content (Odoom *et al.*, 2014), density (Brubaker, 2017) while the percentage yield of oil was determined using the formula of Maridass *et al.* (2008).

3.0 Results and Discussion

The results of the proximate analysis, phytochemical screening, percentage yield of oil and the physicochemical properties of oil from avocado fruit are presented in Tables 1 and 2 respectively.

The proximate analysis, phytochemical analysis and yield of oil from avocado flesh, skin and seed as well as physicochemical analysis of the extracted oils have been studied.

From Table 1 which shows the result of the proximate analysis, the flesh presented the highest percentage moisture content ($75.55 \pm 0.06 \%$) followed by the skin ($72.64 \pm 0.03 \%$), the seed had



the least moisture content (64.91 ± 0.09 %). This trend is observed to be in agreement with that reported by Vinha *et al.* (2013) in which percentage moisture content from Algarvian avocado flesh was (70.83 ± 3.53 %), followed by the skin (69.13 ± 2.58 %) then the seed has the lowest value of (54.45 ± 2.33 %). The high moisture content of avocado pear

has some disadvantages as it reduces the shelf life. The moisture content is one of the most important indices evaluated in foods, especially fruits. Moisture content influences the taste, texture, weight, appearance, and shelf life of foodstuffs (Appoldt and Raihani, 2017).

Table 1: Proximate composition of Avocado fruit

Parameters	Flesh	Skin	Seed
Moisture content (%)	75.55 ± 0.06	72.64 ± 0.03	64.91 ± 0.09
Crude lipid (%)	10.28 ± 0.32	6.42 ± 0.02	9.81 ± 0.10
Ash (%)	0.48 ± 0.02	0.53 ± 0.01	0.43 ± 0.02
Carbohydrate (%)	8.53 ± 0.17	13.24 ± 0.13	18.69 ± 0.09
Crude Protein (%)	4.03 ± 0.04	3.70 ± 0.10	3.40 ± 0.09
Crude fibre (%)	1.16 ± 0.35	3.47 ± 0.03	2.78 ± 0.81
Caloric Value (Kcal/100g)	142.76 ± 0.30	125.54 ± 0.17	176.65 ± 0.10

****Values were expressed as mean \pm S.D for duplicate different preparations**

Table 2: Qualitative phytochemical constituents the flesh, skin and seed of avocado fruit.

Parameters	Flesh	Skin	Seed
Tannins	+	+	+
Saponins	-	+	+
Terpenoids	+	-	-
Alkaloids	-	+	+
Flavonoids	+	+	+
Phlobatannins	-	-	-
Steroids	+	+	+
Phenols	+	+	+
Anthraquinones	-	-	-
Cardiac glycosides	-	-	-
Reducing sugars	-	+	-

****+ = Presence - =absence**

The avocado flesh had the highest percentage crude lipid (10.28 ± 0.32 %) in comparison to the three parts studied. This value was close to 12.18 % which was obtained from avocado flesh by Orhevba and Jinadu (2011) but much lower than the values of 18.77 ± 2.61 %, 14.63 ± 1.57 %, 16.23 ± 2.03 % obtained by Nnaji and Okereke (2016) from Brogdon, Russel, Choquette avocados flesh respectively. However, the value obtained in this study is still within the range (5 – 25 %) reported by Ogunwusi and Ibrahim (2016) for various cultivars of avocado pear. The seed had a value of 9.81 ± 0.1 % crude lipid which is lower than the values of 17.90

± 0.4 % and 14.7 ± 0.32 % from avocado seeds reported by Ejiofor *et al.* (2018) and Vinha *et al.* (2013) respectively. Though the skin has the lowest value of percentage crude lipid (6.42 ± 0.02 %), it was higher than the value of 0.9 ± 0.04 % from Fortuna avocado skin by Galvão *et al.* (2014) and 2.20 ± 1.65 % from avocado skin by Vinha *et al.* (2013). These differences may be as a result of species differences in the avocado used for the various studies or climatic condition and soil type that is used for the cultivation of the fruit (Galvão *et al.*, 2014; Maitera *et al.*, 2014). From the results, the flesh is a better source of oil, more suitable for oil extraction and will give a better yield of oil than the skin and seed.

Crude protein analysis result showed the flesh with the highest percentage protein content of 4.03 ± 0.04 % which is lower than the values of 7.17 ± 0.01 % for Margarida and 5.66 ± 0.02 % for Hass avocado flesh obtained by Jorge *et al.* (2015). This is followed by the skin which has protein content of 3.70 ± 0.1 % though higher than the value of 1.91 ± 0.08 % from avocado skin obtained by Vinha *et al.* (2013) but in agreement with the value of 3.6 ± 0.09 % obtained for Fortuna avocado skin by Galvão *et al.* (2014). The seed had a percentage crude protein content of 3.40 ± 0.09 % though much lower than 15.55 ± 0.36 % reported in Ejiofor *et al.* (2018) is closer to 6.34 ± 0.4 % reported by Talabi *et al.* (2016).



The results of the crude fibre analysis showed that the skin had the highest crude fibre content of $3.47 \pm 0.03\%$. High fibre content leads to increased bulk and movement in the gastrointestinal tract which may mean better digestion (Maitera *et al.*, 2014) unfortunately, this skin is usually discarded by most consumers of the fruit.

Though the seed showed the highest percentage of carbohydrate ($18.69 \pm 0.09\%$) this value is much lower than $67.68 \pm 0.31\%$ reported by Talabi *et al.* (2016) on raw avocado seed since their result was based on dry matter. However, percentage carbohydrate from the skin ($13.24 \pm 0.13\%$) is in agreement with the value of $13.81 \pm 0.07\%$ obtained by Oluwole *et al.* (2013). The percentage carbohydrate from the flesh ($8.53 \pm 0.17\%$) agrees with the value of $8.64 \pm 2.05\%$ from Russel avocado flesh and a bit slightly higher than the value of $7.96 \pm 1.38\%$ from Choquette avocado flesh obtained by Nnaji and Okereke (2016). Using the Atwater general factor (FAO, 2003) to calculate the caloric value of the various parts of the avocado fruit, the seed was seen to have the highest caloric value compared to the flesh and the skin.

Table 2 shows the results of the qualitative analysis of the phytochemical components of dichloromethane and methanol (1:1) mixture extract of the avocado fruit. Tannins, phenols, flavonoids, steroids were found in the three parts of the fruit. Saponins and alkaloids were found in the skin and seed but not in the flesh. Terpenoids were however found only in the flesh. Phlobatannin, anthraquinone and cardiac glycosides were however not found in the extracts from any part of the fruit. Parameswaran and Murthi, (2014) in their study on the methanol extract of avocado flesh detected the presence of phenols, terpenoids, steroids, tannins, saponins, alkaloids but not flavonoids while phenols, terpenoids, flavonoids, steroids and alkaloids but not tannins and saponins were detected in the aqueous extract of avocado flesh. Uzor *et al.* (2016) using ethanol extract detected alkaloids, saponins, tannins, phenols, flavonoids and steroids present in the seed. The obvious fact from these studies is that phytochemicals abound in avocado pear fruit. Tannins, phenols, flavonoids, steroids which are present in the three parts of the avocado fruit have been known to possess antidiabetic effects acting through various mechanisms (Nyamai *et al.*, 2016). Terpenoids found in the flesh have shown inhibitory

effects on various forms of tumors (Nyamai *et al.*, 2016). Alkaloids present in the seed and skin extracts anti-arrhythmic effects, antihypertensive effects, anticancer and antimalarial activity (Dastmalchi *et al.*, 2007; Sharma *et al.*, 2010; Abdirahman *et al.*, 2015). Saponins, also detected in the skin and seed, enhance antibody production, inhibit tumor growth, and prevent hyperlipidemia and liver injury (Nyamai *et al.*, 2016).

Table 3 present percentage yield for oil from different parts of Avocado fruit. Cold pressed extraction method was only able to yield oil from the flesh, the seed and skin of the avocado pear did not yield oil from this method of extraction. The percentage oil yield from the flesh was $31.11 \pm 0.11\%$ while solvent extraction of the oil from the flesh yielded $38.8 \pm 0.06\%$, this is higher than the percentage oil yield (27.17%) from avocado flesh extracted by Orhevba and Jinadu (2011). High oil content in plant fruit implies that processing it for oil will be economical (Nnaji and Okereke, 2016). This implies that oil from avocado flesh is suitable and economical for commercial production (Anyasor *et al.*, 2009). The values obtained from the oil yield of the flesh, skin and seed in this study are in agreement with the report of Wong *et al.*, (2010) in which they stated that the flesh of an avocado can contain up to 30% oil but there is very little in the seed ($\approx 2\%$) and the skin ($\approx 7\%$). Seeds are considered as oil seeds when their oil yield is greater than 17% (Adaramola *et al.*, 2016) thus avocado seed with oil yield of $2.39 \pm 0.01\%$ is not an oil seed and therefore not suitable and economical for commercial production. The colour of the oil from the flesh is emerald green and the one from the skin oil is greenish which were in agreement with the emerald green colour reported by Wong *et al.*, (2010). This green colour, is attributed to high levels of chlorophylls and carotenoids in the oil, thus indicating high level of chlorophyll which is a natural source magnesium and one of the best known natural substance for removing heavy metals like mercury and lead from the liver, kidneys, brain and other organ (Taylor, 2015). It therefore shows that avocado flesh and skin oil may be used to detoxify the body. The brownish-red colour of the seed oil was also obtained by Adaramola *et al.*, (2016) from avocado seed oil.



Table 3: Percentage yield of oil from different parts of avocado fruit

Sample	Solvent extraction (%)	Cold extraction (%)	Color
Flesh	38.58 ± 0.06	31.11 ± 0.11	Emerald green
Skin	7.68 ± 0.04	–	Greenish
Seed	2.39 ± 0.01	–	Brownish red

** Values were expressed as mean ± S.D for duplicate results.

Table 4 presents the result from the physicochemical analysis of the oil from the avocado fruit. Oil from the seed, skin and flesh had acid values of 1.5428 ± 0.14 mgKOH/g, 1.2623 ± 0.14 mgKOH/g and 0.561 ± 0.00 mgKOH/g respectively which compare favorably with the values of 1.19 ± 0.01 mgKOH/g, 1.06 ± 0.23 mgKOH/g and 0.49 ± 0.03 mgKOH/g oils from Fortuna avocado seed, peel (skin) and pulp (flesh) respectively obtained by Galvão *et al.* (2014). These values are also below the maximum levels recommended by FOA (2001) for edible fats and oils 0.6 mgKOH/g (refined), 4.0 mgKOH/g (virgin and cold pressed). Since the oils have acid

value within the recommended standards, it means that they can be used for cooking purposes. The lower the acid value of oil, the fewer free fatty acids it contains which makes it less susceptible to rancidity (Adaramola *et al.*, 2016), thus, the oils from avocado flesh, skin and seed are less susceptible to rancidity. Rancidity of oils can produce potentially toxic compounds associated with long-term health effects such as neurological disorders, heart and cancer (Kaleem *et al.*, 2015). Since these oils are less susceptible to rancidity, it shows that they are good for the heart, has anti-cancer effect and good for the body.

Table 4: Physicochemical Properties of the Oil from Avocado fruit

Properties	Flesh	Skin	Seed
Acid value (mgKOH/g)	0.561 ± 0.00	1.262 ± 0.14	1.543 ± 0.14
Iodine value (g/100g)	68.270 ± 1.59	61.920 ± 1.58	49.220 ± 1.59
Peroxide value (meq/kg)	4.0 ± 0.71	1.5 ± 0.50	5.0 ± 0.00
Saponification value (mgKOH/g)	71.570 ± 0.05	81.370 ± 0.03	82.710 ± 0.03
Density@25°C	0.907 ± 0.001	0.917 ± 0.001	0.917 ± 0.00
Refractive index@25°C	1.461 ± 0.02	1.433 ± 0.00	1.422 ± 0.00
Moisture content (%)	0.075 ± 0.00	0.085 ± 0.00	0.110 ± 0.00

** Values were expressed as mean ± S.D for duplicate results.

The peroxide values (PV) for the seed oil (5.0 ± 0.00 meq/kg), the flesh oil (4.0 ± 0.71 meq/kg) and the skin oil (1.5 ± 0.5 meq/kg) though higher than the values of 2.40 ± 0.57 meq/kg from avocado seed oil (Adaramola *et al.*, 2016), 2.60 ± 0.05 meq/kg from Fortuna avocado flesh oil obtained by Galvão *et al.*, (2014) the value of 0.39 ± 0.01 meq/kg from ripe avocado skin oil obtained by Oluwole *et al.*, (2013) were still below the proposed recommended standards for extra virgin avocado oil which are maximum of 4.0 meq/kg for extra virgin avocado oil; 8 meq/kg for virgin avocado oil and 0.5 meq/kg for pure avocado oil (Wong *et al.*, 2010). Since the PV of the oils fall within the standards, it shows that they are of good quality. According to Olaniyi *et al.*

(2014), rancidity begins to be noticeable in oil when the peroxide value is above 10 meq/kg. Since the peroxide values obtained from these oils are lower than 10 meq/kg, it shows that the oils are not rancid. High peroxide value is also undesirable in oil because it is a threat to human health (Dermis *et al.*, 2012), these oils are therefore healthy and do not pose a threat to human health and are suitable for consumption. The lower the peroxide and acid

values, the better the quality of the alimentary fats and their state of preservation (Koczon *et al.*, 2008).

The result of the determination of the saponification value (SV) shows that the seed oil had the highest saponification value of 82.71 ± 0.03 mgKOH/g while the flesh oil has the least SV of 71.57 ± 0.05



mgKOH/g which is lower than the values (181.77 ± 4.02 , 182.92 ± 2.90 , 182.50 ± 2.56 mgKOH/g) from Brogdon, Russel, Choquette avocado flesh oil respectively by Nnaji and Okereke (2016). The higher the saponification value of an oil sample, the better the soap making ability of the oil (Odoom and Edusei, 2015)

In the determination of the iodine value (IV), the flesh oil had the highest iodine value of 68.27 ± 1.59 g/100g while the least IV for this study (49.22 ± 1.59 g/100g) was from the seed oil. Dyminska *et al.* (2017) recorded a higher iodine value of 89.47 g/100g from avocado flesh oil which could be attributed to the difference in methodology. The higher the iodine value the greater the degree of unsaturation (Odoom and Edusei, 2015). It shows that among the three the flesh oil has the highest degree of unsaturation while the seed oil has the lowest degree of unsaturation. According to Odoom and Edusei (2015), drying oils have IV of 200-130 g/100g, semi drying oils have of IV 130-100 g/100g and Non-drying oils have IV lower than 100 g/100g. This implies that these extracted oils can be classified as non-drying oils because their IVs are lower than 100 g/100g which makes them suitable and desirable for frying and cooking purposes. The higher the iodine value, the less stable the oil and the more vulnerable it is to oxidation and free radical production (Fife, 2014). This implies that the oils obtained in this study are stable and are less vulnerable to oxidation because of their low iodine value. Also, according to Otaigbe *et al.* (2016), non-drying oils do not readily form films, so the oils can be used as plasticizers and lubricants. It also indicates that these oils will have slow drying rate which makes them suitable for use in artists' paintings where they aid in gradual development of the painting.

The density obtained for the oil from the avocado flesh (0.9073 ± 0.001 g/cm³) is in agreement with the value of 0.9032 g/cm³ from avocado flesh oil obtained by Orhevba and Jinadu (2011). The oils from the skin and seed have densities of 0.9166 ± 0.001 g/cm³ and 0.9174 ± 0.00 g/cm³ respectively. This shows that oils from avocado skin, flesh and seed are less dense than water and could therefore be useful in cream production as this will make the oil spread easily on the skin (Adaramola *et al.*, 2016). Oils with the density of lower values are highly appreciable to consumers (Dermis *et al.*,

2012). This also indicates that oils from avocado flesh, skin and seed will be appreciable to in the cosmetic industry.

The values for the refractive index of the oil extracted from the three parts of the avocado fruit flesh (1.4613 ± 0.02) skin (1.4329 ± 0.0002) and the seed (1.4218 ± 0.0001) are in agreement with the values reported by Galvão *et al.* (2014) from oils from the flesh (1.4637 ± 0.0005), skin (1.4467 ± 0.0022) seed (1.4212 ± 0.016) of avocado fruit. Refractive index increases with increasing chain length of fatty acids in the triglycerides or with increasing unsaturation (Al Majidi and Bader, 2015). Refractive index is used to check purity and to follow and control hydrogenation and isomerization process (Ikhuoria and Maliki, 2013). The flesh oil having the highest value for refractive index thus has the highest degree of unsaturation of the three parts.

The result of the moisture content determination on the oils shows the seed oil had the highest moisture content of $0.11 \pm 0.01\%$ while the flesh oil had the lowest moisture content of $0.075 \pm 0.01\%$. The values are within the proposed standard recommended moisture content for avocado pulp oil which are 0.1% for extra virgin avocado oil, virgin avocado oil and pure avocado oil (Wong *et al.*, 2010). It also indicates that the oils will be less susceptible to microbial attack which make it to have long storage shelf life because oils with high moisture content are not able to be preserved for a longer period according to Orhevba and Jinadu (2011).

4.0 Conclusion

This study aimed at the chemical analysis involving the proximate composition and phytochemical screening of the avocado fruit as well as the physicochemical analysis of the oil extracted from this fruit. The results of this study show the presence of the macro nutrients in avocado pear. It is obvious from this study that phytochemicals abound in avocado pear fruit. Avocado seed may not classify as an oil seed due to the percentage of oil got from the seed during extraction. The low acid values of the oils from avocado flesh, skin and seed imply that they are less susceptible to rancidity. Also, the low iodine values imply that they are less vulnerable to oxidation

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6.0 References

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