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Comparative Studies on the Quality and Antimicrobial Effect of the Fruit Oils of *Canarium schweinfurthii* Engl. (Atili), *Dacryodes edulis* H.J. Lam (Ube) and *Persea americana* Mill (Avocado)

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ABSTRACT

Increase in consumption of oils from plant origin has led to a wide debate regarding their health effects. This study was undertaken to on three types of fruit oils, *Canarium schweinfuthii*, *Dacryodes edulis* and *Persea Americana* to determine the percentage yield, their phytochemical constituents, cholesterol levels and their microbial effect on some selected fungi and bacteria species. Cold maceration technique using n-Hexane was the extraction method used and the percentage yield was determined. Phytochemical screening and cholesterol levels were determined using standard methods. Antimicrobial activities were carried out on the clinical isolates of the fungi (*Aspergillus flavus*, *Aspergillus fumigatus* and *Aspergillus terreus*) and bacteria (*Escherichia coli*, *Staphylococcus aureus* and *Pseudomonas aeruginosa*) using disk diffusion techniques. The results of the extraction showed that 300g each of *D. edulis* had the highest percentage oil yield of 41.71%, followed by *C. schweinfuthii*, 36.31% and *P. Americana* had the lowest amount with 18.37%. The phytochemical screening also revealed the presence of secondary metabolites such as steroids, anthraquinones, terpenes and cardiac glycosides, but alkaloids, flavonoids, tannins and saponins were all absent in the oils. The cholesterol analysis showed *P. americana* having the highest level of 3223.32 mg/ml (3.22%), followed by *D. edulis* with 3108.69 mg/ml (3.11%) and *C. schweinfurthii* had the lowest, 2760.86 mg/ml (2.76%). It was observed that the oils had no antifungal activities on the test organisms. The antibacterial activity was in a concentration-dependent manner as *S. aureus* was the most susceptible to the oils with *C. schweinfuthii* having the highest activities of 7.77±0.47-10.07±0.00 followed by *D. edulis* oil 6.67±0.35mm-9.00±0.00mm and *P. americana* oil which had no activity on the test organism. *D. edulis* had the highest activity on *E. coli* 7.47±0.47-10.07±0.00 while *C.*

***schweinfurthii* and *P. americana* had no activity on the test organism. *D. edulis* also had the highest activity of 6.67±0.33-10.33±0.33 which was significantly different from *C. schweinfurthii* and *P. americana* which had no activity on the test organism, therefore, at P<0.05, there was a significant difference in the antibacterial activities of the oil. This implies from the study that the secondary metabolites found in the oils possess healthy properties. The cholesterol levels of the oil samples showed that the oils contain an acceptable amount of cholesterol and the antibacterial activities of these oils showed that they have significant effects on the bacteria used in the study; hence, the results of these findings support the use of these oils as therapeutic agents.**

Keywords: Fruit oils, cholesterol level, antifungal and antibacterial activities

INTRODUCTION

Vegetable oils are a group of fats that are derived from seeds, nuts, cereal grains, and fruits. It is important to understand that not all of these vegetable oils are liquid oils at ambient temperatures. In addition, not all of the vegetable oils produced in commercial quantities are considered to be edible in the sense of being typical dietary components (Hammond, 2003). Edible vegetable oils are mainly used in cooking, as salad dressings, in manufacture for margarines, spreads, and bakery.

Olive oil is the oldest known edible oil used in humans' diet. It is a main constituent of the traditional Mediterranean diet, which has a protective role against a number of diseases including cardiovascular disease and cancer (Savva *et al.,* 2016). An important characteristic of these sources of oil from plants is the high degree of unsaturation in their constituent fatty acids which directly relates to their higher susceptibility to oxidative deterioration (Roxana and Ovidiu, 2016). Vegetable oils and fats are principally used for human consumption but are also used in animal feed, for medical purposes, and for certain technical applications. Oils are also gotten from; soybean, rape, sunflower, peanut, cotton, corn, grape, fiberflax, safflower, rice, perilla, oil palm, olive, walnut, hazelnut, pine, cocoa.

Edible vegetable oils form a vital part of the human diet and can provide the energy and fatty acids needed by the body and promote the digestion and absorption of fat-soluble vitamins (Ma *et al.,* 2014). The content and proportion of oil intake are closely related to human health. Consuming an appropriate amount of oil is conducive to the normal metabolism of fat, while excessive ingestion leads to the deposition of fat in the body, resulting in hypertension, hyperlipidemia and other diseases (Meng *et al*., 2009). Edible vegetable oils also contain certain amounts of vitamin E and phytochemicals, such as phytosterols and sqaulene (Wu *et al*., 2019). Furthermore, edible vegetable oils are rich in phytosterols, providing an excellent way for humans to ingest these compounds (Gao *et al.,* 2015).

There are issues of high cholesterol content in some fruit oils that are consumed by humans, thus, posing a great challenge to the quality nature of such oils and also different health challenges; furthermore, microorganisms are known to cause infections in humans and some strains are resistant to the existing synthetic drugs, thereby posing great concern to health and other commercial products. Hence, the need to find other sources of oils with low cholesterol content which can inhibit the metabolic activities of certain microorganisms, especially pathogenic microorganisms.

MATERIALS AND METHODS

Plant Materials

Fresh and ripened fruits of *Canarium schweinfurthii, Dacryodes edulis* and *Persea americana* were collected from local marketers in Chobe and Farin gada markets of Jos north LGA, Plateau state, in June 2021. The fruits collected were taken to the herbarium of the Department of Plant Science and Biotechnology, University of Jos, Plateau State, for identification. The fruits were sorted properly to remove any dirt or foreign materials and then they were weighed using a weighing balance and 300g was gotten for each specimen. The fruits were then washed in cold tap water to remove any dirt adhering to the surface of the fruits. A sterilized laboratory knife was then used to separate the pulp from the seeds of the fruits of *C. schweinfurthii, D. edulis* and *P. americana.*

The pulp was then cut into smaller pieces and oven dried at 60^0C for 24 hours to remove the moisture content and get the dry matter of the fruits. After the fruits pulp were properly oven dried, it was now pulverized using a laboratory mortar and pestle in order to get the granulated form of the fruits pulp. Using a weighing balance, the granulated form of *Canarium schweinfurthii, Dacryodes edulis* and *Persea americana* were weighed and recorded. The powdered pulp of *Canarium schweinfurthii, Dacryodes edulis* and *Persea americana* were now appropriately stored in sterile air-tight bottles and were properly labeled until when needed.

Extraction By Cold Maceration

The extraction method used in this study was maceration method as described by Abdulkadir *et al*. (2015). The powdered plant samples (108.92g, 125.13g, and 55.11g) each of *Canarium schweinfurthii, Dacryodes edulis and Persea americana* were soaked in 500ml of n- Hexane solvent in separate 1 liter capacity conical flasks stopped and kept for 48 hours. The cold extracts thus obtained were kept in a water bath for 1 hour at 69^oC. After cooling, the extracts were filtered successively through ordinary chesses cloth and Whatmann filter paper. The n-Hexane extracts of *Canarium schweinfurthii, Dacryodes edulis and Persea americana* were evaporated in order to get the pure samples of the oil. The oils gotten were now stored in sterile bottles, labeled appropriately and kept at 37^0C (room temperature) until needed.

Determination of the Percentage Yield of the Extract

This was done using the formula described by Falana and Nurudeen (2020). The yield of extract (extractable components) expresses on dry weight basis of pulp was calculated from the following equation: Yield (g/100g) = (W1x 100)/W2 where W1 is the weight of the extract residue obtained after solvent removal and W2 is the weight of peel or pulp taken.

Phytochemical Analysis

Phytochemical analysis for qualitative detection of alkaloids, flavonoids, tannins, saponins, terpenes, steroids, carbohydrates, cardiac glycosides and anthraquinones were carried out on the extracts as described by Sofowora (2008).

Test for Alkaloids:

About 2ml of each plant extract was stirred with 3ml of 1% aqueous hydrochloric acid on steams bath and filtered. 1ml of the filtrate was treated with a few drops of Mayer's reagent and a second 1ml portion was treated similarly with Dragedorffs reagent. Precipitation with either of those reagents was taken as evidence for the presence of all alkaloids (Sofowora, 2008).

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Test for Saponins:
About 2ml of each plant extracts were added to 4.0ml of distilled water in a test tube and the test tube was stopped and shaken vigorously for about 30 seconds. The test tube was allowed to stand for half an hour. Frothing which persist on warming was taken as preliminary evidence for the presence of Saponins (Sofowora, 2008).

Test for Flavonoids:
Lead sub-acetate test 2ml of each plant extract was dissolved in 5ml of distilled water, heated for 5 minutes and filtered. The filtrate was allowed to stand for 5 minutes to cool and about 2-3 drops of lead acetate solution was added to the filtrate. A yellow-colored precipitate indicated the presence of flavonoids (Sofowora, 2008).

Test for Tannins:
About 2ml of each plant extract was stirred with 1ml of distilled water, filtered and few drop of ferric chloride were added to the filtrate. A blue-black, green precipitate was taken as evidence for the presence of tannins (Sofowora, 2008).

Tests for Anthraquinones:
About 2ml of each plant extract was taking into a test tube and 5ml of chloroform was added and shaken for 5 minutes. The extract was filtered and the filtrate shaken with an equal volume of 100% NH_3 solution. A pink –violet color in the ammonical layer indicate the presence of free anthraquinones (Sofowora, 2008).

Test for Cardiac Glycosides:
About 3ml of each plant extract was dissolved in 1 ml of glacial acetic acid containing one drop of $FeCl_2$(Ferric chloride) solution. It was then under-layered with 1 ml of concentrated H_2SO_4. A brown ring was observed at the interphase, which is a positive reaction for the presence of a deoxy-sugar characteristic of cardiac glycosides (Sofowora, 2008).

Test for Carbohydrates:
About 1ml of each plant extract was dissolved in 3ml of distilled water and mixed with a few drops of Molisch reagent (10% solution of α- naphthol in alcohol). Then 1ml of concentrated sulphuric acid was carefully added down the side of the inclined tube so that the acid forms a layer beneath the aqueous solution without mixing it. A reddish or violet ring at the junction of the liquids was observed indicating the presence of carbohydrate (Sofowora, 2008).

Cholesterol Screening
The cholesterol content test was carried out as described by Ojiako and Akubugwo (1997). About 0.1ml of the sample oil extracts each and standard cholesterol dissolved in chloroform in ratio 1:10 was evaporated to dryness in water bath at 50^0C. Glacial acetic acid (3.0mL) and 3.0mL of color reagent (a solution of ferric chloride/glacial acetic acid/sulphuric acid), was added to each sample and the standard, then shaken vigorously to dissolve the oil. Blank contained 2.0mL of chloroform, 3.0mL glacial acetic acid and 3.0mL of color reagent. After cooling for 30mins at room temperature, absorbance of standard and samples were read at 560nm using JENWAY 6310 spectrophotometer.

Source of Microorganisms

The test organisms were collected from the microbiology laboratory of the University of Jos. The organisms were then sub-cultured and incubated at 37^0C for 48hours for authentication.

Preparation For Antimicrobial Screening

Sterilization of Glassware:

All glass wares (Test-tubes, universal Bottles, and pipettes) were washed thoroughly with detergent, rinsed with clean water, wrapped in Aluminium foil paper and dried in hot oven at about 170^0C for 30mins as described by Cheesbrough (2000).

Culture Media and Inoculate Preparation:

Potato dextrose agar (PDA) was used for the fungi. 100g of the potato was weighed and peeled and washed properly, and then it was cut into tiny pieces and put into a beaker. 500ml of distilled water was added and the beaker was now placed on a hot plate and allowed to boil. 10g of dextrose/glucose was weighed and added into a conical flask and 7.5g of agar was also weighed and added into the same conical flask. Using a sieve and a beaker, the potato was sieved from the broth. 200ml of the broth was measured and an added 20ml of distilled water and it was poured into the conical flask containing the dextrose and the agar. It was shaken properly and then heated on a hot plate for 15mins to aid uniform dissolution and then it was poured into sterile bottles that were closed properly and autoclaved at 121^0C for 15mins for sterilization. The agar was brought out and allowed to cool, but not solidify for 1 minute. Nutrient agar (NA) was used for the bacteria. 5.6g of the nutrient agar was poured into a conical flask and 200ml of distilled water was added to it. It was then placed on a hot plate to heat up, but not to solidify to aid uniform dissolution It was then poured into sterile air tight bottles and autoclaved at 121^0C for 15mins for sterilization. The agar was brought out and allowed to cool but not to solidify for 1 minute.

Culture Media Sterility Testing:

The already prepared and sterilized media (nutrient agar and potato dextrose agar) were incubated at 37^oC for 24 hours for sterility checking. Media plates without growths were then used for anti-bacterial screening.

Antimicrobial Susceptibility Test

Agar Disk Diffusion Method:

The method of Lamikanra (1999) and Cheesbrough (2000) was adapted. Standardization of culture were carried by suspending some colonies of the test organisms overnight in 5ml of nutrient broth and comparing the turbidity using a nephelometer with that of 0.5 McFarland turbidity standard after incubating at 37^oC for about 4-6 hours.

Nutrient Agar Potato dextrose agar plates were then aseptically seeded with about 0.lml of both cultures containing the test organisms. For each of the three organisms, plates were prepared in duplicate and used per plant oil extract. The plates were allowed to dry for a few minutes at room temperature with lids closed and five (5) filter paper disks, each of 6mm in diameter were impregnated. The forecep was sterilized by flaming after each disc was impregnated. Four out of the five (5) disks were dispensed with various concentrations (20, 30, 40 and 50mml) of the oil extracts while the fifth was dispensed with Gentamicin as the positive control for bacteria and Fluconazole as the positive control for fungi. The plates were left to stand at room

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temperature for about an hour for diffusion of the oil extract into the agar to take place. The plates of the bacteria were incubated at 37^0C for 24 hours and that of the fungi were incubated at 37^0C for 72 hours. The diameters of the resulting zones of inhibition were measured in millimeters, using a transparent ruler according to the method described by Andrew (2017).

Statistical Analysis

Data obtained were subjected to two-way analysis of variance (ANOVA) to verify the activities of the microorganisms on the extracted oils, and also on the cholesterol content of the oils.

RESULTS

Results of Percentage Yield of the Oils

The percentage yields in grams (300g) each of the different oil extracts employed in the study are shown in Table 1. The highest percentage (41.71%) yield was obtained from *Dacryodes edulis*, (36.31%) was obtained from *Canarium schweinfurthii,* while lowest percentage yield (18.37%) was obtained from *Persea americana.*

Table 1: The percentage yield of the oils of C*anarium schweinfurthii*, Engl (Atili), *Dacryodes edulis*, H.J. Lam (Ube) and *Prsea americana,* Mill (Avocado)

	C.schweinfurthii	*D.edulis*	*P. americana*
Initial weight of plants (g)	300g	300g	300g
Residue after extraction (g)	191.08g	174.87g	244.89g
Weight of extract into the oil (g)	108.92g	125.13g	55.11g
Volume of solvent used (ml)	500ml	500ml	500ml
Percentage yield (%)	36.31%	41.71%	18.37%

Results of the Preliminary Phytochemical Screening of the Oils

As shown in table 2, Preliminary phytochemical screening of the extracts of *Canarium schweinfurthii, Dacryodes edulis* and *Persea. americana* revealed the presence of Steroids, Terpenes, Cardiac glycosides and Anthraquinones and Carbohydrates and the absence of Tannins, Saponins, Flavonoids, and Alkaloids. Steroids were moderately present in *C.schweinfurthii,* highly present in *D. edulis* and moderately present *P.americana.* Terpenes was moderately present in *C. schweinfurthii*, highly present in *D. edulis* and moderately present in *P. americana*. Anthraquinones was slightly present in *C. schweinfurthii*, absent in *D. edulis* and moderately present in *P. americana*. Cardiac glycoside was slightly present in *C. schweinfurthii*, moderately present in *D. edulis* and slightly present in *P. americana*. Alkaloids, Saponins, Tannins and Flavonoids were not found in any of the oil extracts.

Table 2: The Phytochemical Screening on the different oils extracted using n- Hexane

	Phytochemicals	**C. schweinfurthii**	**D. edulis**
Alkaloids	-	-	-
Saponins	-	-	-
Tannins	-	-	-
Flavonoids	-	-	-
Carbohydrates	+	+	+
Steroids	++	+++	++
Terpenes	++	+++	++

Anthraquinones	+	-	++
Cardiac glycosides	+	++	+

Keys: -Negative, +Present, ++Moderately present, +++Highly present

Results of Cholesterol Content Level

As shown in table 3, the cholesterol level of the three oils. *P. americana* had the highest cholesterol level of 3223.32mg/ml which was significantly different from *D. edulis* 3108.69mg/ml and *C. schweinfurthii* 2761.86mg/ml. Therefore, the results of the cholesterol analysis showed that at $p \leq 0.05$, there was a significant difference, the percentage of the cholesterol contents in the oils showed *P. americana* with the highest percentage of 3.22%, followed by *D. edulis* with 3.11% and *C. schweinfurthii* had the lowest percentage of 2.76%.

Table 3: The Cholesterol level of the oil samples of *Canarium schweinfurthii, Dacryodes edulis* and *Persea americana.*

PLANTS	CHOLESTEROL LEVEL (mg/ml)
Canarium schweinfurthii	2761.86±0.02 (2.76%)
Dacryodes edulis	3108.69±0.01 (3.11%)
Persea americana	3223.32±0.02 (3.22%)
L. S. D	0.02
P- value	<0.0001
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At $p \leq 0.05$ there was a significant difference in the cholesterol level of the three different oils. Values are presented as mean standard error of mean. Ranking was done across oil and values with same superscript are not significant.

Results of Antimicrobial Activity Assay

The Antibacterial Activities of the Oil of *Canarium schweinfurthii:*

The results of antimicrobial activities of the various extracts on the test microorganisms in terms of zone of inhibition exhibited are shown in Tables 4-7 Tables 4, 5 and 6 shows the result of antibacterial activities of the oils of *Canarium schweinfurthii, Dacryodes edulis* and *Persea americana* respectively on the selected microorganisms. As shown in table 4, for *Canarium schweinfurthii* oil, *S.aureus* had the highest zone of inhibition ranging from 7.77±0.23mm-14.50±0.25mm respectively at 20mg/ml-50mg/ml followed by *E. coli* ranging from 0.00±0.00mm-8.83±0.09mm respectively at 20mg/ml-50mg/ml and *P. aeruginosa* had the lowest zone of inhibition ranging from 0.00±0.00mm-7.73±0.22mm respectively at 20mg/ml-50mg/ml, while the control (Gentamicine) had the higher zone of inhibition ranging from 22.77±0.23mm-28.77±0.39mm respectively at 30mg/ml.

Table 4: The antibacterial activities of the oil of *Canarium schweinfurthii.*

Organism	20mg/ml	30mg/ml	40mg/ml	50mg/ml	Control
S. aureus	7.77±0.23	9.90±0.38	11.57±0.26	14.50±0.25	22.77±0.23
E. coli	0.00±0.00	6.00±0.00	6.33±0.33	8.83±0.09	11.93±0.07
P. aeruginosa	0.00±0.00	0.00±0.00	6.33±0.20	7.73±0.22	28.77±0.39
L.S.D	0.60				
S.F	****				

At P≤ 0.05 there was a significant difference in the antibacterial activities of the oil of *Canarium schweinfurthii* on the different bacteria. Values are presented as mean standard error of means.

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The Antibacterial Activities of the Oil of *Dacryodes edulis:*

As shown in table 5, for D. edulis oil, E. coli had the highest zone of inhibition ranging from 7.47±0.47mm-10.07±0.09mm respectively at 20mg/ml-50mg/ml followed by P. aeruginosa ranging from 6.67±0.33mm-10.33±0.07mm respectively at 20mg/ml-50mg/ml and S. aureus had the lowest zone of inhibition ranging from 6.67±0.35mm-9.00±0.00mm respectively at 20mg/ml-50mg/ml, while the control (Gentamicine) had the higher zone of inhibition ranging from 22.77±0.23mm-28.77±0.39mm respectively at 30mg/ml.

Table 5: The antibacterial activities of the oil of *Dacryodes edulis.*

Organism	20mg/ml	30mg/ml	40mg/ml	50mg/ml	Control
S. aureus	6.67±0.35	7.60±0.31	8.53±0.27	9.00±0.00	22.77±0.23
E. coli	7.47±0.47	7.90±0.45	8.90±0.45	10.07±0.09	11.93±0.07
P. aeruginosa	6.67±0.33	7.67±0.33	8.67±0.35	10.33±0.33	28.77±0.39
L.S.D	0.94				
S.F	****				

At P≤ 0.05 there was a significant difference in the antibacterial activities of the oil of *Dacryodes edulis* on the different bacteria. Values are presented as mean standard error of means.

The antibacterial activities of the oil of *Persea americana.*

As shown in table 6, for P. americana oil, S. aureus had the highest zone of inhibition ranging from 0.00±0.00mm-7.80±0.20mm respectively at 20mg/ml-50mg/ml followed by E. coli ranging from 0.00±0.00mm-6.17±0.17mm respectively at 20mg/ml-50mg/ml and P. aeruginosa had the lowest zone of inhibition ranging from 0.00±0.00mm-0.00±0.00mm respectively at 20mg/ml-50mg/ml, meaning there was no zone of inhibition here. While the control (Gentamicine) had the higher zone of inhibition ranging from 22.77±0.23mm-28.77±0.39mm respectively at 30mg/ml.

Table 6: The antibacterial activities of the oil of *Persea americana*.

Organism	20mg/ml	30mg/ml	40mg/ml	50mg/ml	Control
S. aureus	0.00±0.00	0.00±0.00	6.33±0.33	7.80±0.20	22.77±0.23
E. coli	0.00±0.00	0.00±0.00	0.00±0.00	6.17±0.17	11.93±0.07
P. aeruginosa	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	28.77±0.39
L.S.D	0.52				
S.F	****				

At P≤ 0.05 there was a significant difference in the antibacterial activities of the oil of *Persea americana* on the different bacteria. Values are presented as mean standard error of means.

The Comparative Analysis of the Antibacterial Activities of the oils of *Canarium schweinfurthii, Dacryodes edulis* and *Persea americana.*

The antibacterial activity was in a concentration dependent manner. *S. aureus* was the most susceptible to the oils with *C. schweinfurthii* having the highest activities of 7.77±0.23mm-14.50±0.25mm, followed by *D. edulis* oil 6.67±0.35mm-9.00±0.00mm and *P. americana* oil had no activity on the test organism. *D.edulis* had the highest activity on *E. coli* 7.47±0.47-10.07±.0.00 followed by *C. schweinfurthii* which had no activity on the test organism and *P. americana*. *D.edulis* also had the highest activity of 6.67±0.33-10.33±0.33 which was significantly different from *C. schweinfurthii* which had no activity and *P. americana* also had no

activity on the test organism, therefore at P<0.05 there was significant difference in the antibacterial activities of the oils

Table 7: The Comparative Analysis of the Antibacterial Activities of the oils of *Canarium schweinfurthii, Dacryodes edulis* and *Persea americana.*

Organisms	Oils	20mg/ml	30mg/ml	40mg/ml	50mg/ml
S. aureus	*D. edulis*	6.67±0.35^{b}	7.60±0.31^{b}	8.53±0.27^{b}	9.00±0.00^{b}
	C. schweinfurthii	7.77±0.23^{a}	9.90±0.38^{a}	11.57±0.26^{a}	14.50±0.25^{a}
	P. americana	0.00±0.00^{c}	0.00±0.00^{c}	6.33±0.33^{c}	7.80±0.20^{c}
E. coli	*D. edulis*	7.47±0.47^{a}	7.90±0.45^{a}	8.90.0.45^{a}	10.07±0.00^{a}
	C.schweinfurthii	0.00±0.00^{b}	6.00±0.00^{b}	6.33±0.33^{b}	8.83±0.09^{b}
	P. americana	0.00±0.00^{b}	0.00±0.00^{c}	0.00±0.00^{c}	6.17±0.17^{c}
P. aeruginosa	*D. edulis*	6.67±0.33^{a}	7.67±0.03^{a}	8.67±0.35^{a}	10.33±0.33^{a}
	C.schweinfurthii	0.00±0.00^{b}	0.00±0.00^{b}	6.33±0.20^{b}	7.73±0.22^{b}
	P. americana	0.00±0.00^{b}	0.00±0.00^{b}	0.00±0.00^{c}	0.00±0.00^{c}
L. S. D		0.68			
P- value		<0.0001			
		****			

At P≤0.05 there was a significant difference in the comparative antibacterial activities of oils on the test organisms. Values are presented as mean standard error of mean. Ranking was done across oil and values with same superscript are not significant.

DISCUSSION

The percentage yield in 300g each of the different oil extracts employed in the study showed the highest percentage (41.71%) yield was obtained from Dacryodes edulis, (36.31%) was obtained from Canarium schweinfurthii, while lowest percentage yield (18.37%) was obtained from Persea americana, hence this research is in agreement that vegetable oils like the seed of rape has a high value of oil (40-48%) and protein (18-25%), as reported by Marinkovic et al. (2009).

Preliminary phytochemical screening of the extracts of Canarium schweinfurthii, Dacryodes edulis and Persea americana revealed the presence of Steroids, Terpenes, Cardiac glycosides, Anthraquinones and Carbohydrates which were moderately present in C. schweinfurthii, highly present in D. edulis and moderately present in P. americana. Terpenes was moderately present in C. schweinfurthii, highly present in D. edulis and moderately present in P. americana. Anthraquinones was slightly present in C. schweinfurthii, absent in D. edulis and moderately present in P. americana. Cardiac glycoside was slightly present in C. schweinfurthii, moderately present in D. edulis and slightly present in P. americana. These phytochemicals exhibit diverse pharmacological and biochemical actions when ingested (Amadi et al., 2006). Stereoidal compounds are of impotance due to their relationship with some compounds such as sex hormones opined by Okwu (2001), hence the result of this research agrees with Okwu (2001) due to the presence of steroids detected in the three oil samples. Steroids, glycosides, terpenes and alkaloids have been reported to exert inhibiting activity against most bacteria (Camacho-Corona et al., 2008; Al-Bayati and Suleiman, 2008), which also agrees with the result of this study due to the presence of the compounds except alkaloids.

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The results of the cholesterol analysis showed that P. americana had the highest percentage of cholesterol level of 3.22% which was significantly different from D. edulis 3.11% and C. schweinfurthii 2.76% which implies that $p \leq 0.05$, there was a significant difference in the cholesterol level of the three oils. The findings from this study supports previous work by Shukla et al. (2002), which showed that cholesterol is present in vegetable oils, although in small proportions, (up to 5% of the total sterol). Furthermore, cholesterol has been detected as one of the major sterols in the surface lipids of higher plants especially in the leaves of rape (Noda et al., 1988). The result of this study may further validate this assertion, as all the oil samples analyzed led to the detection of cholesterol in varying proportions. This, however, is in sharp contrast to the claim by most of the producers of these vegetable oils. Okpuzor et al. (2009) reported similar values for a study conducted on the estimation of cholesterol levels in different brands of vegetable oils with the Laser brand made from rapeseed having a high concentration of 3.2 mg/ml while Grand brand made from groundnut had the least concentration of 0.12 mg/ml with the Sesame seed oil having the highest concentration of 3.996 mg/ml. As earlier stated, what is important in oil consumption is not the amount of fat but the type of fat. Lichtenstein et al. (1999) showed that consumption of products low in trans fatty acids has beneficial effects on serum lipoproteins. In his review Wilson et al. (2001) opined that transfat is moderately hypercholesterol.

The antibacterial activity was in a concentration dependent manner. *S. aureus* was the most susceptible to the oils with *C. schweinfurthii* having the highest activities of 7.77±0.23mm-14.50±0.25mm, followed by *D. edulis* oil 6.67±0.35mm-9.00±0.00mm and *P. americana* oil had no activity on the test organism. *D. edulis* had the highest activity on *E. coli* 7.47±0.47-10.07±.0.00 followed by *C. schweinfurthii* which had no activity on the test organism and *P. americana*. *D. edulis* also had the highest activity of 6.67±0.33-10.33±0.33 which was significantly different from *C. schweinfurthii* which had no activity and *P. americana* also had no activity on the test organism, therefore at $P<0.05$ there was significant difference in the antibacterial activities of the oils which demonstrated that all of the oils possessed antimicrobial activity on *S. aureus, E. coli,* and *P. aeruginosa.* As reported by Friedman *et al.* (Arpan *et al*., 2013) that edible oils were widely accepted because they possessed unimaginable medicinal and pharmaceuticals properties, such as antimicrobial activity that could be employed against human pathogens, hence the result of this research agrees to this claim. It has also been reported previously that the extracts from several plants such as oregano, cumin, cinnamon, sage, and other spices possessed significant ($p<0.05$) antibacterial and antifungal activities against wide range of food spoilage bacteria (Gram-positive and Gram-negative), as well as yeast and mold (Nassan *et al*., 2015; Liu *et al*., 2017). Therefore, there is no agreement to the above result as there was no antifungal activity of these oil extracts on the selected species of fungi. A study supports previous findings in literature that the antimicrobial activities have a direct relation to increasing the extracts concentration (Bhalodia and Shukla, 2011).

CONCLUSION

From the study carried out, it can be concluded that the oil extract of**,** *Dacryodes edulis.* had the highest percentage yield of oil with 41.71%, while *Persea americana* had the lowest percentage yield of oil with 18.37%. The phytochemical screening showed that *Canarium schweinfurthii***,** *Dacryodes edulis* and *Persea americana* contained some compounds (secondary metabolites) such as Steroids, Terpenes, Tannins, Anthraquinones and Cardiac glycosides. The cholesterol contents were found to be 3223.32mg/ml (3.22%), 3108.69mg/ml (3.11%) and 2760.86mg/ml

(2.76%) respectively in *Persea americana, Dacryodes edulis* and *Canarium schweinfurthii* The antimicrobial screening showed that the oils of *Canarium schweinfurthii, Dacryodes edulis* and *Persea americana* had significant effects on the bacteria that were used (*Escherichia coli, Pseudomonas aeruginosa* and *Staphylococcus aureus)*, but had no significant effects on the fungi that were used (*Aspergillus flavus, fumigatus* and *terreus*). Therefore, there is urgent need to carry out further research to support the use of these oils as therapeutic agents.

RECOMMENDATIONS

Considering the phytochemical components of the oil samples as well as the antimicrobial activities of the oils especially on some bacteria, it is highly recommended that further research should be carried out on other microorganisms and also the molecular characterization of the oil should be carried out to find the mechanism of the action on the microorganisms that the oils have activity on. Also, other species of fungi aside *Aspergillusis* could be used as test organisms, and also considering the cholesterol content of the three oil samples, it is highly recommended that further research be carried out to know if the cholesterol contained in these fruit oils are healthy for consumption or not.

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