



**INTERNATIONAL JOURNAL OF
PHARMACEUTICAL SCIENCES**
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: <https://www.ijpsjournal.com>



Research Paper

Green Exploration of *Persea americana* Seed: A Potential Source of Natural Antioxidants and Antimicrobial Compounds

Miller Samson S.*, Vetrivel V., Ilashreyal S., Muthuselvi S., Veerapagu M.

Department of Microbiology, Srinivasan College of Arts and Science, Perambalur - 621212

ARTICLE INFO

Published: 24 Mar 2026

Keywords:

Avocado seed; *Persea americana*; Phytochemical screening; Antioxidant activity; Antimicrobial activity; TLC; FTIR.

DOI:

10.5281/zenodo.19201843

ABSTRACT

Medicinal plants are an important source of bioactive compounds with therapeutic potential. The increasing resistance of pathogenic microorganisms to conventional antibiotics has encouraged the exploration of plant-derived antimicrobial agents. The present study investigated the phytochemical constituents, antioxidant activity, and antimicrobial potential of *Persea americana* (avocado) seed extracts. Fresh avocado seeds were collected, dried, powdered, and extracted using aqueous and ethanolic solvents. Preliminary phytochemical screening was carried out to identify bioactive compounds. Thin Layer Chromatography (TLC), UV-Visible spectroscopy, and Fourier Transform Infrared (FTIR) spectroscopy were used for phytochemical characterization. Antioxidant activity was evaluated using DPPH and hydrogen peroxide scavenging assays. Antibacterial activity was determined using the agar well diffusion method against *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas* species. Phytochemical analysis revealed the presence of alkaloids, tannins, phenols, saponins, steroids, and glycosides in the extracts. TLC analysis indicated the presence of phenolic compounds with R_f values of 0.52 and 0.81. Spectroscopic analysis confirmed the presence of functional groups such as amines, nitriles, alkenes, and nitro compounds. The extracts exhibited significant antioxidant activity in a concentration-dependent manner. Antimicrobial results showed the highest zone of inhibition against *E. coli*. These findings indicate that avocado seed extracts possess significant phytochemical, antioxidant, and antimicrobial properties and may serve as a potential natural source for developing therapeutic agents.

INTRODUCTION

Medicinal plants have long been used as an important source of therapeutic agents for the

treatment of various human diseases. Plant-derived compounds have gained increasing attention due to their effectiveness, low toxicity, and wide availability. According to global health

*Corresponding Author: Miller Samson S.

Address: Department of Microbiology, Srinivasan College of Arts and Science, Perambalur - 621212

Email ✉: millermdu@gmail.com

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



estimates, nearly 80% of the world's population relies on traditional plant-based medicines for primary healthcare ^[12].

Plants synthesize numerous secondary metabolites such as alkaloids, flavonoids, tannins, phenolics, and terpenoids, which contribute to their biological activities including antimicrobial, antioxidant, and anti-inflammatory properties. These compounds play an important role in plant defense mechanisms against pathogens and environmental stress ^[2] ^[1]. The emergence of antibiotic-resistant microorganisms has created an urgent need for the development of alternative antimicrobial agents. Natural products derived from medicinal plants are considered promising candidates because they often act through mechanisms different from conventional antibiotics ^[11]. *Persea americana* (avocado), belonging to the family Lauraceae, is widely cultivated in tropical and subtropical regions. While the pulp of avocado fruit is commonly consumed for its nutritional value, the seed is often discarded as waste despite containing several bioactive compounds such as phenolics, flavonoids, tannins, and glycosides ^[3] ^[6].

Previous studies have reported that avocado seed extracts exhibit significant antioxidant and antimicrobial activities. The presence of high levels of phenolic compounds and flavonoids contributes to their biological activity against various microbial pathogens ^[7] ^[3]. Therefore, the present study aimed to evaluate the phytochemical constituents, antioxidant activity, and antimicrobial potential of avocado seed extracts.

MATERIALS AND METHODS

Collection of Plant Material

Fresh seeds of *Persea americana* were collected from local markets in Tiruchirappalli, Tamil Nadu, India. The collected samples were authenticated based on morphological characteristics. The seeds

were washed thoroughly with distilled water to remove adhering impurities and air-dried under sterile conditions.

Preparation of Seed Powder

The cleaned seeds were cut into small pieces and shade dried at room temperature (25–30°C) for two weeks until a constant weight was obtained. The dried material was pulverized into fine powder using a mechanical grinder and stored in sterile, airtight containers at room temperature until further use.

Extraction of Plant Material

Approximately 10 g of powdered material was extracted with 100 mL of solvent (distilled water and ethanol separately) using a rotary shaker at 150 rpm for 24 hours at room temperature. The extracts were filtered through Whatman No.1 filter paper and concentrated if necessary. The filtrates were stored at 4°C for subsequent analysis.

Phytochemical Screening

Preliminary phytochemical analysis was carried out to detect the presence of alkaloids, flavonoids, tannins, phenols, saponins, steroids, terpenoids, and glycosides using standard qualitative methods. Each test was performed in triplicate to ensure reproducibility.

Thin Layer Chromatography (TLC)

TLC analysis was performed using silica gel-coated plates as the stationary phase. The mobile phase consisted of ethanol:chloroform:water in the ratio of 5:4:1. The samples were spotted on the plates and developed in a TLC chamber. The spots were visualized under UV light (254 nm) and further confirmed using anisaldehyde–sulphuric acid reagent.



The retention factor (R_f) was calculated using the formula:

$$R_f = \frac{\text{Distance travelled by compound}}{\text{Distance travelled by solvent}}$$

UV–Visible Spectroscopy

UV–Visible spectroscopic analysis of the extracts was performed in the wavelength range of 300–1100 nm using a UV–Vis spectrophotometer. The absorbance values were recorded to identify characteristic peaks corresponding to bioactive compounds.

FTIR Analysis

Fourier Transform Infrared (FTIR) spectroscopy was carried out to identify functional groups present in the extracts. The dried extract was mixed with potassium bromide (KBr) and pressed into pellets. The samples were scanned in the range of 4000–400 cm⁻¹ and the spectral data were recorded.

Antioxidant Activity

DPPH Radical Scavenging Assay

The antioxidant activity was determined using the DPPH radical scavenging method. Various concentrations of the extract were prepared and mixed with DPPH solution. The reaction mixture was incubated in the dark for 30 minutes and absorbance was measured at 517 nm using a spectrophotometer. The percentage inhibition was calculated.

Hydrogen Peroxide Scavenging Assay

Hydrogen peroxide scavenging activity was evaluated by mixing the extract with hydrogen peroxide solution. After incubation, absorbance was measured at 230 nm. The percentage inhibition was calculated based on control values.

Antimicrobial Activity

Antibacterial activity was assessed using the agar well diffusion method. Test organisms included *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas* species. Sterile Mueller-Hinton agar plates were inoculated with bacterial cultures (adjusted to 0.5 McFarland standard). Wells were created using a sterile cork borer, and different concentrations of the extract were added. Plates were incubated at 37°C for 24 hours. The zone of inhibition was measured in millimeters. All experiments were performed in triplicate.

Statistical Analysis

All experiments were conducted in triplicate and results were expressed as mean ± standard deviation (SD). Statistical analysis was performed using standard methods.

RESULTS AND DISCUSSION

PHYTOCHEMICAL SCREENING

The preliminary phytochemical analysis of aqueous and ethanolic extracts of *Persea americana* seed revealed the presence of several bioactive compounds (Table 1). The aqueous extract showed the presence of alkaloids, tannins, phenols, saponins, steroids, coumarins, and glycosides, whereas the ethanolic extract exhibited comparatively fewer constituents.

Table 1. Phytochemical screening of aqueous and ethanolic extracts of *Persea americana* seed

S.No	Phytochemical	Water Extract	Alcohol Extract
1	Alkaloids	+	-
2	Flavanoids	-	-
3	Steroids	+	+
4	Tannins	+	-
5	Terpanoids	-	-
6	Quinine	-	-



7	Cumarins	+	-
8	Glycosides	+	+
9	Saponins	+	+
10	Phenols	+	+

The higher number of phytochemicals detected in the aqueous extract suggests that polar solvents are

more effective in extracting bioactive compounds from plant materials. Secondary metabolites such as phenols, tannins, and alkaloids are well known for their antimicrobial and antioxidant properties. The presence of these compounds indicates the potential therapeutic value of the seed extract [2].

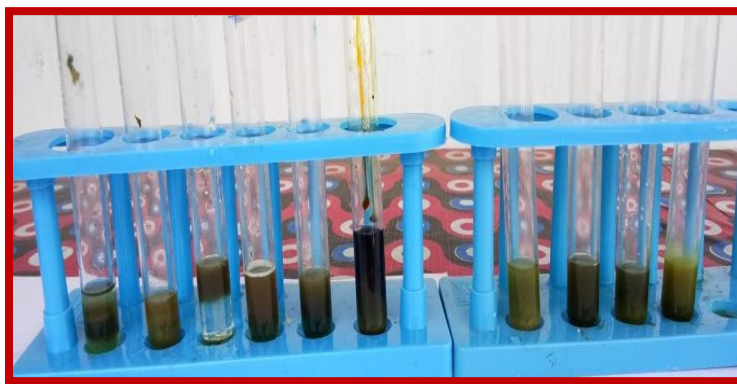


Figure 1. Phytochemical screening results of aqueous extract

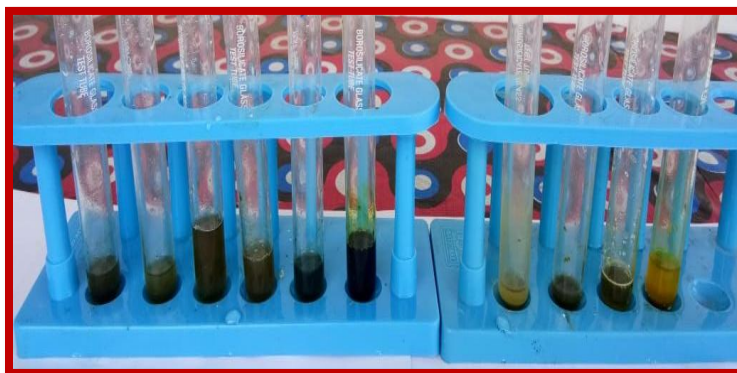


Figure 2. Phytochemical screening results of ethanolic extract

These findings are consistent with earlier reports indicating that *Persea americana* seeds are rich in phenolic compounds and other secondary metabolites responsible for biological activity [3].

THIN LAYER CHROMATOGRAPHY (TLC)

Table 2. TLC analysis of avocado seed extract showing R_f values

S.No	Extracts	Spot	R _f Value
1	Crude water	Brown Spot	0.52
2	Crude alcohol	Green Spot	0.81

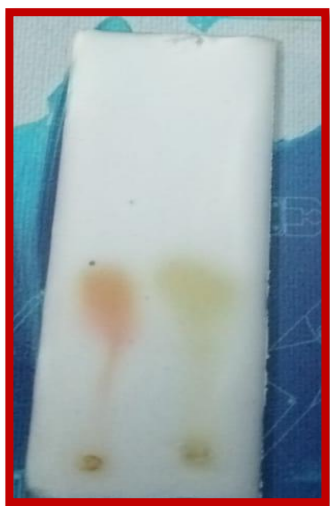


Figure 3. TLC chromatogram of avocado seed extract

TLC analysis of the extracts demonstrated distinct spots corresponding to different phytochemical constituents (Table 2). The aqueous extract exhibited a spot with an Rf value of 0.52, while the

ethanolic extract showed a spot at 0.81. The variation in Rf values indicates the presence of compounds with different polarities. The observed chromatographic separation confirms the complexity of phytochemical composition in the extracts. TLC serves as a rapid and effective preliminary technique for identifying plant metabolites [4]. Similar chromatographic profiles have been reported in earlier studies, supporting the presence of phenolic and flavonoid compounds in avocado seed extracts [10].

UV-VISIBLE SPECTROSCOPY

Table 3. UV-Visible absorption peaks of avocado seed extract

S.No	Wave Length	Absorbance
1	675.7	0.280

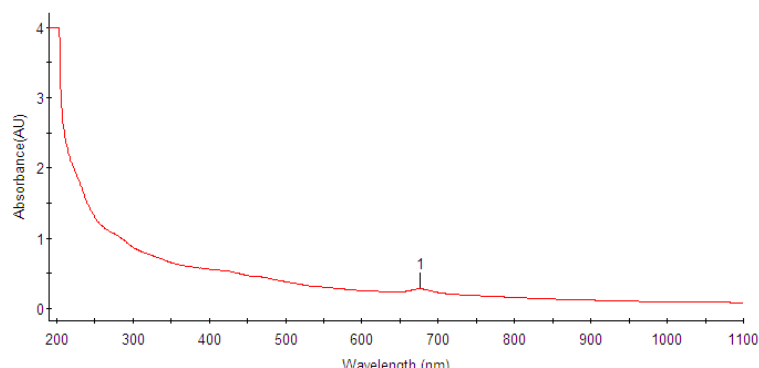


Figure 4. UV-Visible spectrum of avocado seed extract

The UV-Visible spectroscopic analysis revealed an absorption peak at 675.7 nm (Table 3), indicating the presence of chromophoric compounds. Absorption in this region is typically associated with conjugated systems and aromatic compounds, including phenolics and flavonoids. These compounds contribute significantly to

antioxidant activity due to their ability to donate electrons and neutralize free radicals [4]. The observed spectral pattern is consistent with previous studies on plant extracts rich in antioxidant phytochemicals [5].

FTIR ANALYSIS

Table 4. FTIR functional group identification of avocado seed extract

S.NO	FREQUENCY RANGE	TYPE OF BOND	TYPE AND GROUP
1	3367	N-H Stretch	1°,2° amines, amides
2	2129	C-N Stretch	Nitriles
3	1640	-C = C- Stretch	Alkenes
4	1289	N-O Symmetric Stretch	Nitro compounds
5	682	C - Br Stretch	Alkyl halides

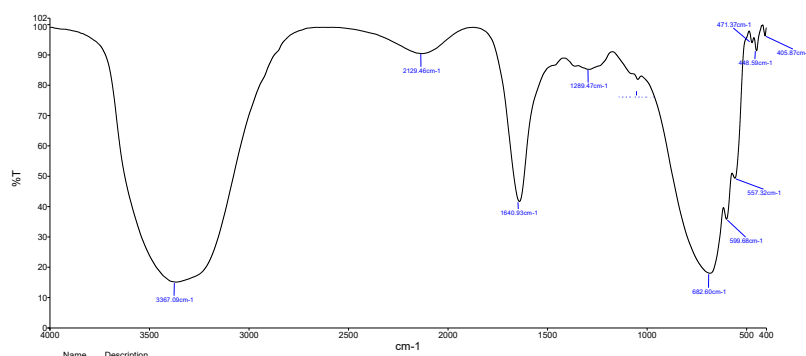


Figure 5. FTIR spectrum of avocado seed extract

FTIR analysis of the extract revealed several characteristic absorption bands corresponding to different functional groups (Table 4). The peaks observed at 3367 cm^{-1} (N–H stretching), 2129 cm^{-1} ($\text{C}\equiv\text{N}$ stretching), 1640 cm^{-1} ($\text{C}=\text{C}$ stretching), 1289 cm^{-1} (N–O stretching), and 682 cm^{-1} (C–Br stretching) indicate the presence of amines, nitriles, alkenes, nitro compounds, and alkyl halides, respectively. The identification of these functional groups confirms the presence of diverse bioactive compounds in the extract. Functional groups such as amines and alkenes are commonly associated with biologically active molecules, which may contribute to the observed

antioxidant and antimicrobial properties. FTIR spectroscopy is widely used to identify functional groups and confirm the presence of phytochemicals in plant extracts [5].

ANTIOXIDANT ACTIVITY (DPPH ASSAY)

Table 5. DPPH radical scavenging activity of avocado seed extract

Test	Concentration ($\mu\text{g/ml}$)	% of inhibition of extract
DPPH	500	40.25
	750	50.91
	1000	73.67



Figure 6. DPPH antioxidant activity of avocado seed extract

The DPPH assay demonstrated a concentration-dependent increase in antioxidant activity. The percentage inhibition increased from 40.25% at 500 $\mu\text{g/mL}$ to 73.67% at 1000 $\mu\text{g/mL}$. The increasing radical scavenging activity with increasing concentration indicates the strong antioxidant potential of the avocado seed extract. This activity may be attributed to the presence of phenolic compounds, flavonoids, and tannins detected in the phytochemical screening. These compounds can donate hydrogen atoms to neutralize free radicals, thereby preventing oxidative damage. Previous studies have also

reported high antioxidant activity in avocado seed extracts due to their rich phenolic content ^[3]^[10].

HYDROGEN PEROXIDE SCAVENGING ACTIVITY

Table 6. Hydrogen peroxide scavenging activity of avocado seed extract

Test	Con of Plant extract	% of inhibition
H₂O₂ Assay	500	35.95
	750	56.21
	1000	78.37



Figure 7. H₂O₂ scavenging activity of avocado seed extract

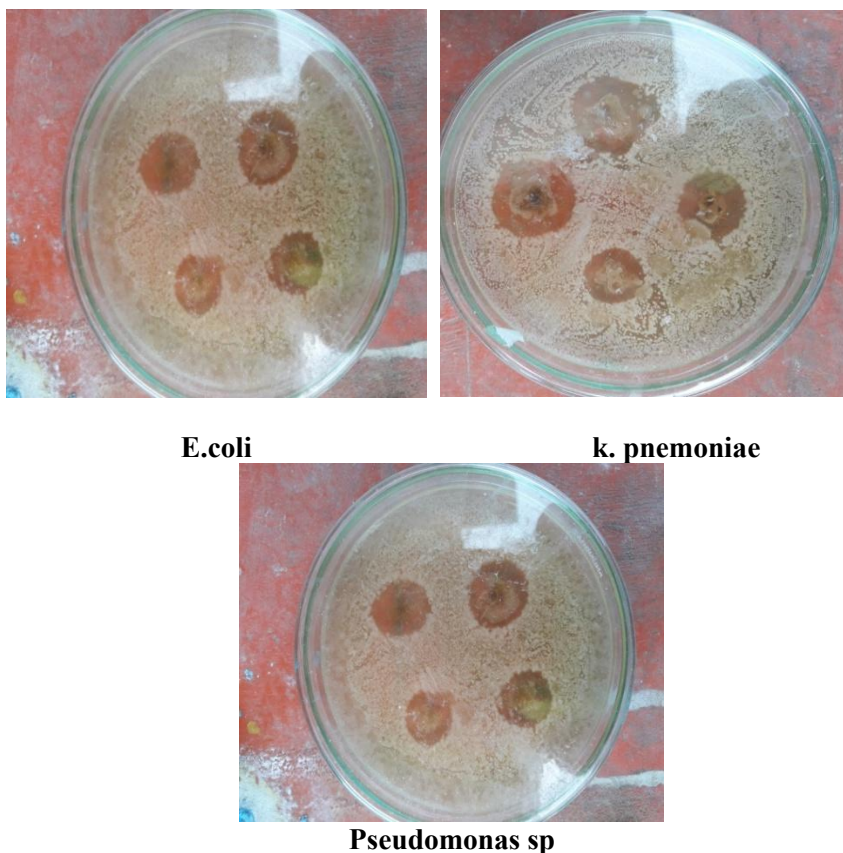
The DPPH radical scavenging assay demonstrated a concentration-dependent increase in antioxidant activity of the extract (Table 5). The percentage inhibition increased from 40.25% at 500 $\mu\text{g/mL}$ to 73.67% at 1000 $\mu\text{g/mL}$. The increase in radical scavenging activity with concentration indicates the strong antioxidant potential of the extract. This activity may be attributed to the presence of phenolic compounds, tannins, and other

phytochemicals capable of donating hydrogen atoms to stabilize free radicals ^[9]. Similar findings have been reported in avocado seed extracts, where high phenolic content contributed to significant antioxidant activity ^[3].

ANTIMICROBIAL ACTIVITY

Table 7. Antibacterial activity of avocado seed extract against pathogenic bacteria

S. No	Organisms	Concentration of extract in μg / zone of inhibition in mm		
		200	400	600
1	<i>E.coli</i>	11.5	12.5	12.8
2	<i>K.pneumoniae</i>	10.5	10.5	10.7
3	<i>Pseudomonas sp</i>	10.8	11.5	9.8

**Figure 8. Antibacterial activity (zone of inhibition) of avocado seed extract**

The antibacterial activity of *Persea americana* seed extract was evaluated against *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas* species using the agar well diffusion method (Table 7). The results showed that the extract exhibited inhibitory activity against all tested organisms. The maximum zone of inhibition was observed against *Escherichia coli* (12.8 mm) at 600 $\mu\text{g/mL}$, followed by *Pseudomonas* species and *Klebsiella pneumoniae*. The antimicrobial activity may be attributed to the presence of phytochemicals such

as phenols, alkaloids, and tannins, which are known to disrupt microbial cell membranes and interfere with metabolic processes [2]. Previous studies have also reported antibacterial activity of *Persea americana* seed extracts against pathogenic microorganisms, supporting the findings of the present study [8].

CONCLUSION

The present study demonstrated that avocado seed extracts contain significant phytochemical

constituents including alkaloids, tannins, phenols, and saponins. Spectroscopic analyses confirmed the presence of various functional groups associated with bioactive compounds. The extracts exhibited considerable antioxidant activity in DPPH and hydrogen peroxide assays. Furthermore, the antimicrobial results showed inhibitory activity against pathogenic bacteria, particularly *E. coli*. These findings suggest that avocado seed, often considered an agricultural waste product, may serve as a valuable source of natural antimicrobial and antioxidant compounds. Further research involving isolation and characterization of active compounds is necessary to explore their pharmaceutical applications.

REFERENCES

1. Balunas MJ, Kinghorn AD. Drug discovery from medicinal plants. *Life Sci.* 2005;78(5):431–441.
2. Cowan MM. Plant products as antimicrobial agents. *Clin Microbiol Rev.* 1999;12(4):564–582.
3. Dabas D, Elias RJ, Ziegler GR, Lambert JD. Avocado (*Persea americana*) seed as a source of bioactive phytochemicals. *J Agric Food Chem.* 2011;59:5625–5635.
4. Harborne JB. *Phytochemical methods: A guide to modern techniques of plant analysis.* London: Chapman and Hall; 1998.
5. Kumar S, Pandey AK. Chemistry and biological activities of flavonoids. *Sci World J.* 2017;2017:162750.
6. Okorie NH, Omorevbarhia O, Umerie SC, Aniefuna EL, Ujam NT, Ali IJ. Proximate, phytochemical, mineral composition and antioxidant effects of methanol extract of *Persea americana* seed. *FUDMA J Sci.* 2024;8(3):166–174.
7. Rodrigues FA, et al. Antibacterial activity of *Persea americana* seed extract. *J Ethnopharmacol.* 2021.
8. Rodrigues FA, et al. Methanol extract from the seeds of *Persea americana* displays antibacterial and wound healing activities. *J Ethnopharmacol.* 2021.
9. Santos MA, et al. Antioxidant activity of plant extracts. *Food Chem.* 2014;152:498–506.
10. Soong YY, Barlow PJ. Antioxidant activity and phenolic content of selected fruit seeds. *Food Chem.* 2004;88:411–417.
11. Ventola CL. The antibiotic resistance crisis: Causes and threats. *Pharm Ther.* 2015;40(4):277–283.
12. World Health Organization. *WHO traditional medicine strategy 2014–2023.* Geneva: WHO Press; 2013.

HOW TO CITE: Miller Samson S., Vetrivel V., Ilashreyal S., Muthuselvi S., Veerapagu M., Green Exploration of *Persea americana* Seed: A Potential Source of Natural Antioxidants and Antimicrobial Compounds, *Int. J. of Pharm. Sci.*, 2026, Vol 4, Issue 3, 2987-2995 <https://doi.org/10.5281/zenodo.19201843>

