AROC in Natural Product Research
Volume 01, issue 01; pp 044-051
Arocjournal.com

Research Article

Phytochemical compositions, antimicrobial activities, and thin layer chromatography analysis of aqueous, and methanol extracts of *Tectona grandis* leaf

Hadiza Muhammed[1*], Lare H. Abdullahi[1], Fatima G. Mayaki[1], Usman H. Boko[1]

Department of Biochemistry, Faculty of Natural Science, Ibrahim Badamasi Babangida University Lapai, P.M.B. 11 Lapai, Niger State, Nigeria

Corresponding author* Hadiza Muhammed**;** cutedeeja@gmail.com

Received: 21 May, 2021, Revised: 20 June 2021, Published: 25 June 2021

AROC in Natural Product Research, 01(01); 044–051

Abstract

Background: Teak (*Tectona grandis*) from the family *Verbenaceae/Lamiaceae is* indigenous to India, other tropical countries, and one of the naturally discovered plants to be known by scientists due to its high potential and effectiveness in disease preventive and curative action. The present study evaluated the phytochemical composition, anti-microbial activity of methanol and aqueous extract of *Tectona grandis* leaf, and characterized the extracts using thin-layer chromatography (TLC). **Methods:** The phytochemical, anti-microbial activity thin layer chromatography (TLC) analysis was conducted using established protocols. **Results:** The results revealed that the methanol extract of teak plant leaves contains steroids, tannins, saponin, coumarin, protein, carbohydrates, alkaloids, diterpenes, phytosterol, phlobatannin while the aqueous extract contains tannins, saponin, coumarin, protein, carbohydrate, alkaloid, diterpenes, phytosterol, and phlobatannins. The methanol extract of *Tectona grandis* showed the highest activity on *S. epidermasis* (14mm) and against S.aureus (10mm) at a concentration of 40mg/ml followed by the activities of aqueous extract of teak plant leaf against Candida Albicans (8mm) at a concentration of 40mg/ml. The extract had no inhibitory effect at all other concentrations. **Conclusion:** The result confirmed that *Tectona grandis* contain several bioactive phytochemicals that can be explored for the treatment of pathogenic microorganism.

Keyword: *Tectona grandis*; phytochemical; thin layer chromatography; antimicrobial

Citations: Muhammed, H., Abdullahi, L.H., Mayaki, F.G., and Boko, U.H. (2021). Phytochemical compositions, antimicrobial activities, and thin layer chromatography analysis of aqueous, and methanol extracts of *Tectona grandis* leaf. AROC in Natural Product Research, 01(01); 044–051

1.0 Introduction

Medicinal In recent times, microbial resistance to existing antibiotics has increased, turning researchers' attention to natural antimicrobial compounds in medicinal plants[1]. This Increased opposition by microorganisms to industrial antibiotics is due to drug use and misuse [2]. Consequently, scientists have increasingly recognized plant remedies as a very important affordable substitute to industrially produced antibiotics for treating opportunistic and pathogenic bacterium infections and others[3-6].

Nature has provided a remedy store to heal all mankind's ailments Plants are valuable sources of a vast ascendancy of

chemical compounds synthesized and accumulated in different parts of the plant body [7]. Scientists have conducted so much research on the natural product in search of a replacement and more affordable remedies to the problem. In recent years, primary health care has steadily increased throughout the world. Traditional plant medicines serve as a source of different types of active principles, and the WHO estimates that 70% of the world's population still relies on herbal medicines [8].

Of the 2,25,000 plant species in total, only less than 10% have been studied for medicinal purposes to date [9,10]. Plant phytochemicals target the biochemical pathway and are therefore safer than synthetic drugs. In developing countries where infectious diseases are endemic and mother health facilities and care services inadequate, medicinal plants are of great value [11].

Teak, botanically known as *Tectona grandis* from the Verbenaceae/Lamiaceae family, is indigenous to India and other tropical countries and also one of the naturally discovered plants to be known by scientists due to its high potential and effectiveness in disease preventive and curative action [12,13]. These plants are used for treating chronic infections such as bronchitis, hyperacidity, dysentery, diabetes, leprosy, astringent, anthelmintic, and dysentery [14].

Furthermore, the plant has been reportedly used in traditional medicine against bilious headaches and swelling. these are used to treat inflammatory swelling as well [15]. Teak is well known for its durability and opposition to insects from ancient times. The present study aims to evaluate the phytochemical composition, anti-microbial activity of methanol and aqueous extract of *Tectona grandis* leaf and characterized the extracts using thin layer chromatography (TLC).

2.0 Materials and methods

2.1 Test organisms

Stock cultures of pure isolate were obtained from the microbiology laboratory of Ibrahim Badamasi Babangida University Lapai (IBBUL) Niger state. The bacteria used for this study includes: Staphylococcus epidermides and Staphylococcus aureus, while the fungi species used is candida ablicans.

2.2 Sample collection and preparation.

The teak plant *(Tectona grandis*) leaf was collected from Dendo Secondary School, Agaie, Niger State, Nigeria and was identified at NCRI Badeggi during the period of June-July 2019.The teak leaf was washed under running water, air-dried for three weeks, and then ponded by mortal and pistol until smooth powder was obtained. The sample was stored in an airtight container for further study.

2.3 Solvent extraction

The leaf extract was prepared by adding 50g of powdered sample each to 500ml of methanol and water and kept at room temperature for 72 hr. The filtrate was collected by filtering the mixture using what man filter paper No.1 and the methanol extract was concentrated using a rotary evaporator, and stored in the fridge at 4^{o}C. The aqueous extract was evaporated in on a steam bath at 93^{o}C. After drying, the extract was packed in a container and stored in the fridge at 4^{o}C for further uses.

2.4 Phytochemical screening

The crude methanol extract and aqueous extract of the teak plant leaves were evaluated for phytochemical composition including the steroids, tannins, saponin, coumarin, protein, carbohydrates,

alkaloids, diterpenes, phytosterol, phlobatannin, anthocyanine, emodin and amino acid using the standard protocols [16-20].

2.5 Analysis of antimicrobial activity

The antimicrobial activities of crude methanol extract and aqueous extract of the teak plant leaves were evaluated using agar well diffusion method as described by Yusuf et al.[21] The antibacterial activity was expressed as the mean zone of inhibition diameters (mm) produced by the plant fractions.

2.6 Thin layer chromatography TLC

The thin layer analysis of the crude methanol extract and aqueous extract of the teak plant leaves were conducted as described in previous study [22]. The TLC were conducted with solvent mixture of ratio (8:2:1) of hexane:chloroform:methanol and were observed under the flourescence.

2.7 Data analysis.

All analysis was conducted in triplicate and analyzed using statistical package for social science (SPSS) version 16 and presented as means value.

3.0 Results

3.1 Characteristic of the extract

Table 1 shows the percentage yield of the extract. The methanol solvent produced the highest yield (9.64%) compared to the aqueous extract (9.06%). The characteristic of the extract including the color and texture of each extract are also presented in table 1.

Table 1: Percentage yield and characteristic of the plant extract

Plant extract	Weight of plant sample (g)	Weight of extract (g)	Yield (%)	Colour	Texture
Methanol extract	50g	4.82g	9.64%	Dark red(maroon)	Sticky
Aqueous extract	50g	4.53g	9.06	Deep dark red(maroon)	Not sticky

3.2 Phytochemical composition

The phytochemical composition of the aqueous and methanol extract of teak plant leaves is presented in table 2. The methanol extract of teak plant leaves contains steroids, tannins, saponin, coumarin, protein, carbohydrates, alkaloids, diterpenes, phytosterol, phlobatannin while Anthocyanine, emodin, amino acid were absent. The aqueous extract contains tannins, saponin, coumarin, protein, carbohydrate, alkaloid, diterpenes, phytosterol, phlorotannins while steroid, anthocyanin, emodins, amino acid, and phytosterol, were absent.

3.3 Antimicrobial activity

The anti-microbial activities of methanol and aqueous extract of *Tectona grandis* leaf are shown in Table 3. The methanol extract of *Tectona grandis* showed the highest activity on *S.epidermasis* (14mm) and against S.aureus (10mm) at a concentration of 40mg/ml followed by the activities of aqueous extract of teak plant leaf against Candida Albicans (8mm) at a concentration of 40mg/ml. The extract had no inhibitory effect at all other concentrations.

Citations: *Muhammed, H., Abdullahi, L.H., Mayaki, F.G., and Boko, U.H. (2021). Phytochemical compositions, antimicrobial activities, and thin layer chromatography analysis of aqueous, and methanol extracts of Tectona grandis leaf. AROC in Natural Product Research. AROC in Natural Product Research, 01(01); 044–051*

Table 2: Phytochemical constituent of both methanol and aqueous extract of teak plant leaves

Phytochemical	Methanol extract	Aqueous extract
Steroid	+	_
Tannin	+	+
Saponin	++	+
Anthocyanine	_	_
coumarin	+	+
Emodins	_	_
Protein	+	+
Amino acid	_	_
Carbohydrate	+	++
Phytosterol	++	++
Alkaloid	+	+
Diterpenes	++	+
Phlobatannins	++	++

Key: +=positive. - =negative. ++= highly positive

3.4 Thin Layer Chromatography

The thin layer chromatography of the extract is shown in figure 1. with a solvent mixture of ratio (8:2:1) of hexane:chloroform: methanol, several bands representing different bioactive compounds were observed. The bands were visualized under the florescence light. The bands were scraped reconstituted and processed for future characterization

Table 3: Zone of inhibition(mm) of methanol and aqueous extract of *Tectona grandis* leaf on the test organism.

Test	**M.E.T.P.L (mg/ml)**				**A.E.T.P.L (mg/ml)**			
Organism	40	20	10	5	40	20	10	5
S.epidermasis	14mm	_	_	_	_	_	_	_
S.aureus	10mm	_	_	_	_	_	_	_
C.ablicans	_	_	_	_	8mm	_	_	_

Key:(-) =No zone of inhibition, mm: millimeter, M.E.T.P.L; methanol extract of *Tectona grandis* leaf A.E.T.P.L; aqueous extract of *Tectona grandis* leaf

Citations: *Muhammed, H., Abdullahi, L.H., Mayaki, F.G., and Boko, U.H. (2021). Phytochemical compositions, antimicrobial activities, and thin layer chromatography analysis of aqueous, and methanol extracts of Tectona grandis leaf. AROC in Natural Product Research. AROC in Natural Product Research, 01(01); 044–051*

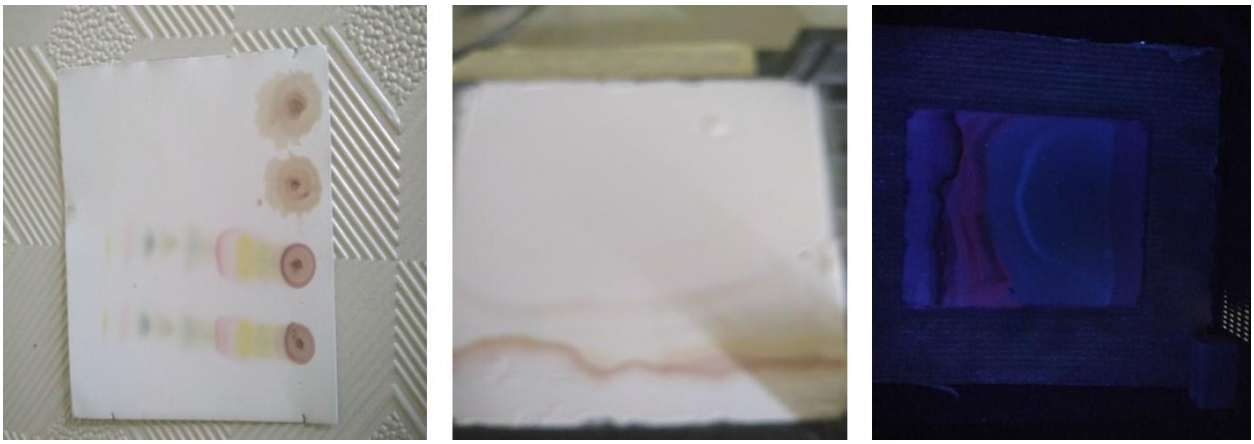

Figure 1: The thin layer chromatography of the extract

4.0 Discussion

The result of phytochemicals screening of methanol and aqueous extract indicated the presence of tannins, saponin, coumarin, protein, carbohydrates, alkaloid, diterpenes, phytosterol, phlorotannins with steroid been present in methanol extract but absent in aqueous extract. The presence of these phytochemicals in the methanol and aqueous extracts of *Tectona grandis* may suggest that the antimicrobial activity may be due to those components, which are well known for their interactions with proteins and enzymes of microbial cell membrane [23].

They are also active in destroying the structure of cell membranes thereby inhibiting various cell functions leading to death of the microbes [23]. Alkaloid and flavonoid have also been reported for antioxidant, antimicrobial, and antiparasitic activities [24-28]. Therefore, it can be explained why these plants have common usage as a remedy to cure some ailments. This study will, hopefully, lead to further research with *Tectona grandis* and the identification of more biologically active compounds.

These compounds are found to be biologically active and therefore, aid in the antimicrobial activities. These secondary metabolites exert antimicrobial activity by different mechanisms; tannins have been found to react with proline-rich protein to from irreversible complexes [29], resulting in the inhibition of cell protein synthesis. Herbs that have tannins as their major components are astringent in nature and are used for treating intestinal disorders such as diarrhea and dysentery [30].

Therefore, these observations could support the use of this plant in herbal cure remedies. The presence of saponins lend credence to the use of this plant in managing inflammation [31]. Flavonoids have also exhibited a wide range of biological activities; such as antimicrobial, antioxidant, anti-inflammatory, analgesic, anti-allergic and cytostatic properties [32]. Antimicrobial activity Both the methanol and aqueous extracts showed varying degree of antimicrobial activity against the test organisms (Table 3).

These phytochemicals might be the reason for their antimicrobial activities. Some studies also reveal that *Tectona grandis* possess anti-inflammatory, antipyretic, antidiabetic, antiulcerogenic, antioxidant, antidiuretic, antimicrobials,

antiasthmatic, antitumor, and anti-glycemic properties. *Tectonna grandis* is also known to be useful for the treatment of hyperacidity, bronchitis, leprosy, biliousness, diabetes, fever relief, and dysentery all of which may be due to their high level of phytochemical constituent. These results also show that the phytochemical constituent of *Tectona grandis* is the backbone of the effectiveness for their mode and mechanism of action in disease curing and preventing properties.

5.0 Conclusion

Conclusively this research indicates that methanol and aqueous extract of teak plant leaf (*Tectona grandi)* contain antimicrobial properties the test isolate and the result obtained shows that the isolate(microorganism) responded to the extract at different concentration. The result also confirmed that *Tectona grandis can* be explored for the treatment of pathogenic microorganism.

Consent for publication: Not applicable

Availability of data and material: All data are presented in the manuscript

Competing interests: The authors declared no conflict of interest exist

Funding: None

References

1. Ríos, J.L.; Recio, M.C. Medicinal plants and antimicrobial activity. *J Ethnopharmacol* **2005**, *100*, 80-84, doi:10.1016/j.jep.2005.04.025.

2. Zaman, S.B.; Hussain, M.A.; Nye, R.; Mehta, V.; Mamun, K.T.; Hossain, N. A Review on Antibiotic Resistance: Alarm Bells are Ringing. *Cureus* **2017**, *9*, e1403, doi:10.7759/cureus.1403.

3. Ajboye, T.O.; Yakubu, M.; Salau, A.K.; Oladiji, A.T.; Akanji, M.A.; Okogun, J. Antioxidant and drug detoxification potential of aqueous extract of Annona senegalensis leaves in carbon tetrachloride-induced hepatocellular damage. *Pharmaceutical Biology* **2010**, *48*, 1361 - 1370.

4. Ibrahim, J.; Kabiru, A.Y.; Abdulrasheed-Adeleke, T.; Lawal, B.; Adewuyi, A.H. Antioxidant and hepatoprotective potentials of curcuminoid isolates from turmeric (Curcuma longa) rhizome on CCl4-induced hepatic damage in Wistar rats. *Journal of Taibah University for Science* **2020**, *14*, 908-915.

5. Tsado, N.A.; Lawal, B.; Kontagora, G.N.; Muhammad, B.M.; Yahaya, M.A.; Gboke, J.A.; Muhammad, U.A.; Hassan, M.K. Antioxidants and antimicrobial-activities of methanol leaf extract of senna occidentalis. *Journal of Advances in Medical and Pharmaceutical Sciences* **2016**, 1-7.

6. Umar, S.I.; Lawal, B.; Mohammed, B.A.; Obiekezie, C.I.; Adewuyi, A.H.; Babalola, S.B.; Ariyeloye, S.D. Antioxidant and antimicrobial activities of naturally occurring flavonoids from M. heterophylla and the safety evaluation in Wistar rats. *Iranian Journal of Toxicology* **2019**, *13*, 39-44.

7. Njeru, S.; Matasyohb, J.; Mwanikic, C.; Maina, M.; Kobiad, G. A Review of some Phytochemicals commonly found in Medicinal Plants. *International Journal of Medicinal Plants. Photon 105 (2013) 135-140* **2013**, 135-140.

8. Petrovska, B.B. Historical review of medicinal plants' usage. *Pharmacogn Rev* **2012**, *6*, 1-5, doi:10.4103/0973-7847.95849.

Citations: *Muhammed, H., Abdullahi, L.H., Mayaki, F.G., and Boko, U.H. (2021). Phytochemical compositions, antimicrobial activities, and thin layer chromatography analysis of aqueous, and methanol extracts of Tectona grandis leaf. AROC in Natural Product Research. AROC in Natural Product Research, 01(01); 044–051*

9. Chojnacka, K.; Witek-Krowiak, A.; Skrzypczak, D.; Mikula, K.; Młynarz, P. Phytochemicals containing biologically active polyphenols as an effective agent against Covid-19-inducing coronavirus. *Journal of functional foods* **2020**, *73*, 104146, doi:10.1016/j.jff.2020.104146.

10. Ahmad, T.; Shahabuddin. The Uses of Medicinal Plants in the Treatment of Diseases. *EUROPEAN ACADEMIC RESEARCH* **2013**, *1*, 1850-1853.

11. Mahady, G.B. Medicinal plants for the prevention and treatment of bacterial infections. *Current pharmaceutical design* **2005**, *11*, 2405-2427, doi:10.2174/1381612054367481.

12. Lanka, S. ANTIMICROBIAL ACTIVITIES OF TECTONA GRANDIS LEAF AND BARK EXTRACTS. *EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH* **2017**, *4*, 245-248.

13. Pérez, D.; Kanninen, M. Stand growth scenarios for Tectona grandis plantations in Costa Rica. *Forest Ecology and Management* **2005**, *210*, 425-441, doi:https://doi.org/10.1016/j.foreco.2005.02.037.

14. Adetola, O. Comparative analysis of mineral elements of green and withered brown leaves of Tectona grandis Linn in Nigeria. **2019**.

15. Palanisamy, K.; Hegde, M.; Yi, J.-S. Teak (Tectona grandis Linn. f.): A Renowned Commercial Timber Species. *Journal of Forest and Environmental Science* **2009**, *25*.

16. Sofowora, A. Research on medicinal plants and traditional medicine in Africa. *Journal of alternative and complementary medicine (New York, N.Y.)* **1996**, *2*, 365-372, doi:10.1089/acm.1996.2.365.

17. Hagerman, A.E.; Riedl, K.M.; Jones, G.A.; Sovik, K.N.; Ritchard, N.T.; Hartzfeld, P.W.; Riechel, T.L. High Molecular Weight Plant Polyphenolics (Tannins) as Biological Antioxidants. *Journal of agricultural and food chemistry* **1998**, *46*, 1887-1892, doi:10.1021/jf970975b.

18. Trease, G. Trease and Evans. *Pharmacognosy, A Physician's Guide to Herbal Medicine* **1989**, *13*, 912.

19. Makkar, H.P.S.; Blümmel, M.; Borowy, N.K.; Becker, K. Gravimetric determination of tannins and their correlations with chemical and protein precipitation methods. *Journal of the Science of Food and Agriculture* **1993**, *61*, 161-165, doi:10.1002/jsfa.2740610205.

20. Midkiff, V.C. The history of feed analysis, as chronicled in the development of AOAC official methods, 1884-1984. *Journal - Association of Official Analytical Chemists* **1984**, *67*, 851-860.

21. Yusuf, A.A.; Lawal, B.; Abubakar, A.N.; Berinyuy, E.B.; Omonije, Y.O.; Umar, S.I.; Shebe, M.N.; Alhaji, Y.M. In-vitro antioxidants, antimicrobial and toxicological evaluation of Nigerian Zingiber officinale. *Clinical Phytoscience* **2018**, *4*, 1-8.

22. Sherma, J. Thin-layer chromatography in food and agricultural analysis. *Journal of Chromatography A* **2000**, *880*, 129-147, doi:https://doi.org/10.1016/S0021-9673(99)01132-2.

Citations: *Muhammed, H., Abdullahi, L.H., Mayaki, F.G., and Boko, U.H. (2021). Phytochemical compositions, antimicrobial activities, and thin layer chromatography analysis of aqueous, and methanol extracts of Tectona grandis leaf. AROC in Natural Product Research. AROC in Natural Product Research, 01(01); 044–051*

23. Mostafa, A.A.; Al-Askar, A.A.; Almaary, K.S.; Dawoud, T.M.; Sholkamy, E.N.; Bakri, M.M. Antimicrobial activity of some plant extracts against bacterial strains causing food poisoning diseases. *Saudi journal of biological sciences* **2018**, *25*, 361-366, doi:10.1016/j.sjbs.2017.02.004.

24. Adesina, D.A.; Adefolalu, S.F.; Jigam, A.A.; Lawal, B. Antiplasmodial effect and sub-acute toxicity of alkaloid, flavonoid and phenolic extracts of Sida acuta leaf on Plasmodium berghei-infected animals. *Journal of Taibah University for Science* **2020**, *14*, 943-953, doi:10.1080/16583655.2020.1790912.

25. Jigam, A.A.; Mahmood, F.; Lawal, B. Protective effects of crude and alkaloidal extracts of Tamarindus indica against acute inflammation and nociception in rats. *Journal of Acute Disease* **2017**, *6*, 78.

26. Bashir, L.; Shittu, O.; Sani, S.; Busari, M.; Adeniyi, K. African natural products with potential antitrypanosoma properties: A review. *Int J Biochem Res Rev* **2015**, *7*, 45-79.

27. Lawal, B.; Shittu, O.K.; Kabiru, A.Y.; Jigam, A.A.; Umar, M.B.; Berinyuy, E.B.; Alozieuwa, B.U. Potential antimalarials from African natural products: A reviw. *J Intercult Ethnopharmacol* **2015**, *4*, 318.

28. Lawal, B.; Shittu, O.K.; Oibiokpa, F.I.; Berinyuy, E.B.; Mohammed, H. African natural products with potential antioxidants and hepatoprotectives properties: a review. *Clinical Phytoscience* **2016**, *2*, 23, doi:10.1186/s40816-016-0037-0.

29. Shimada, T. Salivary Proteins as a Defense Against Dietary Tannins. *Journal of Chemical Ecology* **2006**, *32*, 1149-1163, doi:10.1007/s10886-006-9077-0.

30. Muetzel, S.; Becker, K. Extractability and biological activity of tannins from various tree leaves determined by chemical and biological assays as affected by drying procedure. *Animal Feed Science and Technology* **2006**, *125*, 139-149, doi:https://doi.org/10.1016/j.anifeedsci.2005.05.018.

31. Desai, S.; Desai, D.G.; Kaur, H. Saponins and their biological activities. *Pharma Times* **2009**, *41*, 13-16.

32. Srivastava, J.K.; Gupta, S. Extraction, Characterization, Stability and Biological Activity of Flavonoids Isolated from Chamomile Flowers. *Mol Cell Pharmacol* **2009**, *1*, 138, doi:10.4255/mcpharmacol.09.18.

Citations: *Muhammed, H., Abdullahi, L.H., Mayaki, F.G., and Boko, U.H. (2021). Phytochemical compositions, antimicrobial activities, and thin layer chromatography analysis of aqueous, and methanol extracts of Tectona grandis leaf. AROC in Natural Product Research. AROC in Natural Product Research, 01(01); 044–051*