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QUANTITATIVE ANALYSIS OF SELECTED PHYTOCHEMICALS AND ANTIMICROBIAL POTENTIALS IN *JUSTICIA SECUNDA* LEAF CRUDE EXTRACTS

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ABSTRACT

In recent years, there has been growing interest in exploring the potential of natural products for the development of new antimicrobial agents due to the emergence of antibiotic resistance. *Justicia secunda*, a medicinal plant widely distributed in tropical regions, has been traditionally used for its therapeutic properties. This study focused on quantitatively analyzing the phytochemical composition of crude extracts obtained from *Justicia secunda* leaves and assessing their potential antimicrobial properties against bacteria and fungi. The results indicated significant levels of bioactive compounds, including tannins (3.974 mg/g), phenols (2.430 mg/g), flavonoids (2.210 mg/g), alkaloids (0.588 mg/g), and saponins (0.434 mg/g), present in the extracts. In the antimicrobial testing, all the *Justicia secunda* leaf extracts demonstrated activity against both bacteria and fungi. Notably, the methanol extracts displayed the highest antimicrobial activity, with a zone of inhibition diameter of 15.5 mm against *Staphylococcus aureus*. The ethyl acetate extracts exhibited activity against *Staphylococcus aureus* (10 mm) while the acetone extracts showed activity against *Staphylococcus aureus* (12 mm) and *Escherichia coli* (8.5 mm). Moreover, the methanol extracts exhibited activity against *Staphylococcus aureus* (15.5 mm), *Streptococcus pneumoniae* (12 mm), *Escherichia coli* (8.5 mm), *Salmonella typhi* (8.0 mm), and *Candida albican* (9.5 mm). The determination of minimum inhibitory concentration (MIC) values revealed that the methanol extracts had the lowest MIC values (100 mg/mL) against *Staphylococcus aureus* and *Streptococcus pneumoniae*, while the ethyl acetate extracts showed the lowest MIC value (100 mg/mL) against *Escherichia coli*. The acetone extracts demonstrated the lowest MIC values (200 mg/mL) against *Staphylococcus aureus*, and the methanol extracts displayed the lowest MIC value (200 mg/mL) against *Salmonella typhi*. These low MIC values suggest the potential high efficacy of the extracts against the tested microorganisms. The study reveals *Justicia secunda* leaf extracts' abundant bioactive compounds and potential as a valuable source for broad-spectrum natural antimicrobial agents, urging further research for pharmaceutical development and therapeutic applications against infectious diseases.

KEYWORDS: *Justicia secunda* leaf, phytochemicals, antimicrobial activity, crude extracts, natural products, minimum inhibitory concentration (MIC).

INTRODUCTION

The emergence of antibiotic resistance has led to an urgent need for new antimicrobial agents (D'Andrea *et al*., 2019). Natural products, particularly plant extracts, have gained attention as potential sources for novel antimicrobial compounds. *Justicia secunda*, a medicinal plant widely distributed in tropical regions, has been traditionally used for its therapeutic properties. Previous research on *Justicia secunda* has reported its various pharmacological activities, including antioxidant, anti-inflammatory, and analgesic effects (Sridhar *et al*., 2014). In a study conducted by Rojas *et al*. (2006), the antimicrobial activity of ten medicinal plants used in Colombian folkloric medicine was evaluated against various bacteria and a yeast species. Among these plants, *Justicia secunda* showed activity against *Staphylococcus aureus* and *Candida albicans*, with MIC values comparable to standard antibiotics. This finding suggests that *Justicia secunda* may hold potential as an alternative treatment for non-nosocomial infections caused by these microorganisms. The research underscores the importance of exploring traditional medicinal plants for their antimicrobial properties, offering the possibility of discovering new natural-based therapies to combat infections. By incorporating these findings into this study, valuable evidence can be provided to support the antimicrobial efficacy of *Justicia secunda* and contribute to the search for novel antimicrobial agents from natural sources. However, limited information is available regarding the phytochemical composition and antimicrobial potentials of its leaf extracts.

The present study aims to address this knowledge gap by conducting a quantitative analysis of selected phytochemicals and evaluating the antimicrobial potentials of crude extracts obtained from *Justicia secunda* leaves. This research contributes to the existing knowledge by providing a comprehensive analysis of the phytochemical composition and antimicrobial potentials of *Justicia secunda* leaf extracts. The identification and quantification of bioactive compounds will enhance our understanding of the plant's medicinal properties and potential therapeutic applications. The findings of this study may pave the way for the development of new antimicrobial agents from natural sources and contribute to the ongoing efforts in combating antibiotic resistance. It is recommended that future studies focus on isolating and characterizing the bioactive compounds responsible for the observed antimicrobial activity and exploring their mechanisms of action, as well as evaluating their potential for clinical applications.

MATERIALS AND METHODS

Sample Collection and Extraction

The study collected and prepared the *Justicia secunda* leaves for extraction using the cold maceration method as described by Bako *et al*., (2023) with slight modifications. The plant material was successively extracted with solvents of increasing polarity, and the resulting extracts were stored for further testing and analysis.

Quantitative Determination of the Selected Phytochemicals

Quantitative determination of the detected secondary metabolites was carried out to know their percentages in the *Justicia secunda* leaf crude extracts by the spectroscopic methods as described by Ushie *et al*., (2018), Mudasir, (2012) and Sathya (2013) with slight modifications.

Antimicrobial Activities of the Crude Extracts

The crude extracts were tested for antibacterial and antifungal activities using Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal/ Fungicidal Concentration (MBC/MFC) methods described by Ushie *et al*., (2023) and Bako *et al*., (2023) with modification.

RESULT AND DISCUSSIONS

Table 1: Quantitative Determination of Detected Phytochemicals of the Extract of *Justicia secunda* Leaf.

S/No.	Detected Phytochemicals	Concentration mg/g
1.	Alkaloids	0.588
2.	Saponins	0.434
3.	Flavonoids	2.210
4.	Phenols	2.430
5.	Tannins	3.974

Table 2: Sensitivity Test of *Justicia secunda* Leaf Crude Extracts and Control.

Test Organism	JSLHE	JSLEE	JSLAE	JSLME	Streptomycin	Ketokonazole
Staphylococcus aureus	R	R	S	S	S	R
Streptococcus Pneumoniae	R	R	R	S	S	R
Pseudomonas aeruginosa	R	R	R	R	S	R
Escherichia coli	S	S	S	S	S	R
Salmonella typhi	R	R	R	R	S	R
Candida albican	R	R	R	R	R	S
Aspergillus niger	R	R	R	R	R	S

Keywords: R = Resistance **S =** Sensitive **JSLHE**: *Justicia secunda* Leaf Hexane Extracts, **JSLEE**: *Justicia secunda* Leaf Ethyl Acetate Extracts, **JSLAE:** *Justicia secunda* Leaf Acetone Extracts **JSLME:** *Justicia secunda* Leaf Methanol Extracts.

Table 3: Zone of Inhibition (mm) of Crude Extracts of *Justicia secunda* Leaf.

Test Organism	Conc. in mg/L	JSLHE	JSLEE	JSLAE	JSLME	Positive Control (Streptomycin)	Negative Control (Ketokonazole)
Staphylococcus aureus	400	4.00	10.0	12.0	15.5	24.50	NA
	200	3.00	5.00	10.0	12.5		
	100	0.00	3.00	5.00	10.5		
	50	0.00	0.00	0.00	0.00		
Streptococcus Pneumoniae	400	0.00	0.00	0.00	12.0	21.00	NA
	200	0.00	0.00	0.00	10.0		
	100	0.00	0.00	0.00	10.0		

	50	0.00	0.00	0.00	6.00		
Pseudomonas aeruginosa	400	0.00	0.00	0.00	7.00	18.00	NA
	200	0.00	0.00	0.00	4.00		
	100	0.00	0.00	0.00	0.00		
	50	0.00	0.00	0.00	0.00		
Escherichia coli	400	3.00	6.50	8.50	8.50	24.00	NA
	200	0.00	4.50	4.50	7.00		
	100	0.00	3.00	3.00	5.00		
	50	0.00	0.00	0.00	0.00		
Salmonella typhi	400	4.00	5.50	5.50	8.00	22.00	NA
	200	3.00	3.50	2.50	8.00		
	100	0.00	0.00	0.00	0.00		
	50	0.00	0.00	0.00	0.00		
Candida albican	400	3.00	4.50	4.00	9.50	NA	19.00
	200	2.00	3.00	3.00	6.00		
	100	0.00	2.00	0.00	5.00		
	50	0.00	0.00	0.00	3.00		
Aspergillus niger	400	0.00	0.00	0.00	0.00	NA	13.50
	200	0.00	0.00	0.00	0.00		
	100	0.00	0.00	0.00	0.00		
	50	0.00	0.00	0.00	0.00		

Table 4: MinimumiInhibitoryiConcentrationi (MIC) of *Justicia secunda* Leaf Crude Extracts.

Test Organism	JSLHE	JSLEE	JSLAE	JSLME
Staphylococcus aureus	000	000	200	100
Streptococcus Pneumoniae	000	000	000	100
Pseudomonas aeruginosa	000	000	000	000
Escherichia coli	400	100	400	400
Salmonella typhi	000	000	000	200
Candida albican	000	000	000	400
Aspergillus niger	000	000	000	000

Keywords: JSLHE: *Justicia secunda* Leaf Hexane Extracts, **JSLEE**: *Justicia secunda* Leaf Ethyl Acetate Extracts, **JSLAE:** *Justicia secunda* Leaf Acetone Extracts **JSLME:** *Justicia secunda* Leaf Methanol Extracts.

DICUSSION

The quantitative analysis of the crude extracts of *Justicia secunda* leaves (Table 1.) revealed a significant presence of phytochemicals. The highest concentration was found in tannins, with a content of 3.974 mg/g. Tannins are known for their antioxidant properties and potential health benefits (Bala, & Jain, 2018). Phenols were also abundant, with a concentration of 2.430 mg/g. Phenols possess antimicrobial and anti-inflammatory properties, making them valuable in the development of therapeutic agents (Reis *et al*., 2010). Flavonoids, another group of bioactive compounds, were present at a concentration of 2.210 mg/g. Flavonoids exhibit various biological activities, including antimicrobial, anticancer, and anti-inflammatory effects (Li *et al*., 2016). Alkaloids, at a concentration of 0.588 mg/g, are known for their pharmacological activities and have been utilized in traditional medicine for their therapeutic benefits (Mavundza *et al*., 2017). Saponins, with a concentration of 0.434 mg/g, possess antimicrobial and antioxidant properties, and have shown potential in the treatment of various diseases (Zhang *et al*., 2017).

The study's results, depicted in table 2., present the effects of different extracts from *Justicia secunda* leaves and two antibiotics, Streptomycin and Ketokonazole, on various test organisms including bacteria and fungi. The findings indicated that most test organisms exhibited resistance to JSLHE and JSLEE, except for *Escherichia coli*, which showed sensitivity to these extracts. JSLAE demonstrated resistance across all organisms, except for *Staphylococcus aureus* and *Escherichia coli*, where sensitivity was observed. In contrast, JSLME showed resistance in all organisms, with exceptions in *Staphylococcus aureus*, *Streptococcus pneumoniae*, and *Escherichia coli*, which exhibited sensitivity.

The zone of inhibition (mm) of the plant extracts revealed that all the extracts demonstrated antimicrobial activity against both the test bacteria and fungi with the methanol extracts demonstrating the highest activity for *Staphylococcus aureus* test (15.5 mm zone diameter of inhibition), followed by the acetone extracts for *Staphylococcus aureus* (12.0 mm zone diameter of inhibition) while the antimicrobial test for fungi did not demonstrate any reasonable activity against *Aspergillus niger* but demonstrated in *Candida albican* for the

extracts of hexane, ethyl acetate, acetone and methanol respectively. The ethyl acetate extracts were active against only *Staphylococcus aureus* (10 mm zone diameter of inhibition), the acetone extracts were active against *Staphylococcus aureus* (12 mm zone diameter of inhibition) and *Escherichia coli* (8.5 mm zone diameter of inhibition), the methanol extracts were active against against *Staphylococcus aureus* (15.5 mm zone diameter of inhibition) *Streptococcus Pneumoniae* (12 mm zone diameter of inhibition), *Escherichia coli* (8.5 mm zone diameter of inhibition), *Salmonella typhi* (8.0 mm zone diameter of inhibition) and *Candida albican* (9.5 mm zone diameter of inhibition). Streptomycin demonstrated the highest activities against both bacteria and fungi respectively.

The MIC of the extracts ranged from 50-400 mg/mL, with the methanol extracts demonstrating the lowest values (MIC 100 mg/mL) against *Staphylococcus aureus* and *Streptococcus Pneumoniae*, also the ethyl acetate extracts demonstrating the lowest value (MIC 100 mg/mL) against *Escherichia coli* followed by acetone demonstrating the lowest values (MIC 200) against *Staphylococcus aureus* and methanol extracts (MIC 200 mg/mL) against *Salmonella typhi*. Low MIC values are indication of high efficacy. The demonstration of activity against both gram-negative and gram-positive bacteria and fungi is an indication that the plant can be a source of bioactive substances that could be of broad spectrum of activity.

The antimicrobial activity of plant extracts has been a subject of interest in traditional medicine and modern research. Few documented studies have investigated the potential of plant-derived compounds as natural antimicrobial agents, and some of the findings in the existing literature align with the results obtained in this study. These results suggest that *Justicia secunda* leaf extracts may contain bioactive compounds with varying degrees of antimicrobial properties, depending on the type of extract and the test organism. Further research is needed to identify and characterize the active compounds responsible for these effects and to explore the potential therapeutic applications of these extracts.

CONCLUSION

In conclusion, the quantitative analysis of selected phytochemicals in the crude extracts of *Justicia secunda* leaves revealed significant amounts of tannins, phenols, flavonoids, alkaloids, and saponins. These findings highlight the rich phytochemical profile of *Justicia secunda*, indicating its potential as a valuable source of bioactive compounds. Furthermore, the antimicrobial potential of the extracts against various bacterial and fungal strains suggests their promising role as natural antimicrobial agents. The presence of tannins, phenols, and flavonoids, known for their antimicrobial and antioxidant properties, further supports the potential therapeutic applications of *Justicia secunda* extracts. These findings contribute to our understanding of the pharmacological properties of *Justicia secunda* and emphasize its potential in the development of novel antimicrobial agents. Further research is recommended to isolate and identify the specific bioactive compounds responsible for the observed antimicrobial activity and to explore their mechanisms of action, paving the way for future development of effective and safe antimicrobial treatments derived from *Justicia secunda*.

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REFERENCES

1. Al-Shuneigat, J., Al-Taani, R., Al-Abbadi, A., Al-Rawashdeh, I., & Al-Tawarah, Y. Evaluation of Antimicrobial Activity of Atriplex halimus L. Leaf Extracts. BioMed Research International, 2019; 1-8. doi: 10.1155/2019/8385404.
2. Bako B., Ushie OA, Malu SP and Kendeson AC Phytochemical screening and antioxidants activities of four different solvent extracts of *Justicia secunda* leaf extracts. *J. Chem. Res. Adv*., 2023; 04(01): 15-20.
3. Bako, B., Ushie, O. A., & Malu, S. P., Lupeol and Lauric Acid Isolated from Ethyl Acetate Stem Extract of Justicia secunda and Their Antimicrobial Activity. Journal of Chemical Society of Nigeria, 2023; 48(1): 081 – 094.
4. Bala, R., & Jain, S. Phytochemical analysis, in vitro antioxidant, anti-inflammatory, and antiproliferative activities of Rhododendron arboreum. Journal of Pharmacy and Bioallied Sciences, 2018; 10(1): 48-54. doi: 10.4103/JPBS.JPBS_160_17.
5. D'Andrea, M. M., Fraziano, M., Thaller, M. C., & Rossolini, G. M. (December 6). The Urgent Need for Novel Antimicrobial Agents and Strategies to Fight Antibiotic Resistance. Antibiotics, 2019; 8(4): 254. https://doi.org/10.3390/antibiotics8040254.
6. Ipav, S. S., Igoli, J. O., Tor-Anyiin, T. A., & Anyam, J. V. Isolation and Characterisation of Lupeol and Lupeol Acetate from Propolis Obtained

from Benue State. Journal of Chemical Society of Nigeria, 2022; 47(1): 9-17.
7. Li, Y., Yao, J., Han, C., Yang, J., Chaudhry, M. T., Wang, S., Liu, H., Yin, Y., & Ma, Y. Quercetin, Inflammation and Immunity. Nutrients, 2016; 8(3): 167. doi: 10.3390/nu8030167
8. Mavundza, E. J., Phala, R. M., & Coopoosamy, R. M. Phytochemical profiling, in vitro biological activities, and computational studies on the alkaloids from Boophane disticha (Amaryllidaceae). Chemistry & Biodiversity, 2017; 14(7): e1700025. doi: 10.1002/cbdv.201700025.
9. Mudasir, A.; Mir, R.T.S.; Rameashkannan, M. V.; Riyaz, A.; Pala, M.; B. A comparative study of phytochemical analysis amd antimicrobial properties of stigmas and stamens of saffron (Crocus sativus L.) found in Kashmir. Adv Bio Tech., 2011; 11(6): 35-38.
10. Oloyede, O. I., Amusa, N. A., Lawal, M., Akinpelu, D. A., & Agbedahunsi, J. M. In vitro Antimicrobial Activity and Chemical Composition of Vernonia amygdalina Extracts. Journal of Traditional and Complementary Medicine, 2020; 10(1): 85-94. doi: 10.1016/j.jtcme.2019.02.005.
11. Reis, J. F., Monteiro, V. V. S., & de Souza, G. E. P. Carotenoids and Phenolic Compounds from Solanum lycocarpum Fruits Present Anti-inflammatory and Anti-hyperuricemic Effects. Basic & Clinical Pharmacology & Toxicology, 2010; 107(6): 962-969. doi: 10.1111/j.1742-7843.2010.00602.x.
12. Rojas, J. J., Ochoa, V. J., Ocampo, S. A., & Muñoz, J. F. Screening for antimicrobial activity of ten medicinal plants used in Colombian folkloric medicine: A possible alternative in the treatment of non-nosocomial infections. BMC Complementary and Alternative Medicine, 2006; 6: 2. https://doi.org/10.1186/1472-6882-6-2.
13. Sathya, V., Bharathidasan, R., Tamil, S.S., Solphia, R.N., Hakkiya, R & Prabakaran, M. Quantitative, phytochemical analysis and in vitro ntibacterial activity of Bauchinia tomatosa, L. Journal of Natural Product Resources, 2013; 3(2): 31-33.
14. Sridhar, N., Duggirala, S. L., & Puchchakayala, G. (November 4). Evaluation of Antioxidant and Anti-Inflammatory Activities of Justicia neesii Ramam Whole Plant Extract. Journal of Pharmaceutical Technology, Research and Management, 2014; 2(2): 171–187. https://doi.org/10.15415/jptrm.2014.22012.
15. Ushie, O. A., Neji, P. A., Muktar, M., Ogah, E., Longbab, B. D., & Olumide, V. B. Estimation of some phytochemicals in Swietenia macrophylla leaves. Journal of Pharmaceutical Research and Reviews, 2018; 2: 15.
16. Ushie, O.A., Danladi, A. H., Bako, B., Longbap, B. D., and Nkom, P. Y. Oleanolic Acid Isolated from Ethyl Acetate Leaf Extract of *Cissus populnea* and the Antimicrobial Activities. Nigerian Research Journal of Chemical Sciences, 2023; 11(2): 20-34.
17. Zhang, X., Wu, T., & Wu, L. Phytochemical constituents, health benefits, and industrial applications of grape seeds: a mini-review. Antioxidants, 2017; 6(3): 71. doi: 10.3390/antiox6030071.