African Journal of
Clinical Medicine and Pharmacy Research

ISSN : 3434-2990

Index: Harvard, Boston, Sydney University, Dimensions, Lens, ResearchGet Scilit, Semantic, Google Scholar, Base etc

https://doi.org/10.58578/AJCMPR.v1i1.4144

Phytochemicals and Antimicrobial Analysis of *Ixora Coccinea* Flower Extract

Gani J[1*], Nkafamiya I. I[2], Akinterinwa A[3]
[1]Federal University Wukari, Taraba State, Nigeria
[2,3]Modibbo Adama University, Yola, Adamawa State, Nigeria
johnsongani5@gmail.com

Article Info:

Submitted:	Revised:	Accepted:	Published:
Oct 17, 2024	Nov 1, 2024	Nov 14, 2024	Nov 19, 2024

Abstract

Ixora coccinea, also known as jungle geranium, is a flowering plant from the Rubiaceae family. It is a tiny, bushy shrub that produces beautiful scarlet flowers and is commonly grown for its ornamental qualities. In addition to its visual appeal, Ixora coccinea has long been employed in a variety of therapeutic traditions due to its potential health advantages. The aim of this work was to conduct phytochemical screening and antimicrobial analysis on a methanolic extract of the flower of Ixora Coccinea. Phytochemicals are plant-derived bioactive molecules that have been proved to offer a variety of health benefits. The phytochemical screening of the methanolic extract identified alkaloids, glycosides, proteins, tannins, saponins, phenols, terpenoids, and steroids while flavonoids was absent. The antimicrobial results of the investigation demonstrated that Ixora coccinea floral extract had strong antibacterial activity against a variety of pathogens. Minimum inhibitory concentration (MIC) values for the extract ranged from 25 % to 75 % while the minimum bactericidal concentration (MBC) values for active extract ranged from 15 to 37 mg/ml. The extract had inhibitory effects on both Gram-positive and Gram-negative bacteria, as well as fungal strains. These findings indicate that the phytochemicals found in Ixora coccinea have powerful antibacterial activities that could be used for medicinal purposes.

Keywords: Ixora coccinea; Flower extracts, Phytochemical; Antimicrobial; Inhibition

INTRODUCTION

Ixora coccinea, also known as jungle geranium, is a flowering plant from the Rubiaceae family. This plant is native to Asia and is commonly grown for its ornamental qualities. In addition to its visual appeal, Ixora coccinea has long been employed in a variety of therapeutic traditions due to its potential health advantages. The phytochemical content of Ixora coccinea is an important factor in its therapeutic qualities (Smith and Jones 2021).

Phytochemicals are plant-derived bioactive molecules that have been proved to offer a variety of health benefits. These substances include alkaloids, tannins, saponins and phenolic compounds, among others. Studies have demonstrated that phytochemicals found in Ixora coccinea have antioxidant, anti-inflammatory, and antibacterial properties (Brown and White 2020).

The flower of the plant I. Coccinea are commonly used as a dye, astringent, antibacterial, stomachic, and sedative. Flowers have traditionally been used to treat diarrhea, dysentery, gonorrhea, loss of appetite, hiccups, fever, sores, and chronic ulcers. Flowers are commonly used for dysmenorrhea, leucorrhoea, haemoptysis, dysentery, and catarrhal bronchitis. A decoction of flowers or bark is used to treat eye problems. (Khare 2007). Preclinical research have demonstrated that the plant has anti-inflammatory, antibacterial, anti-oxidant, anti-ulcerogenic, antidiarrheal, anti-nociceptive, anti-mutagenicity, hepatoprotective, and hypolipidemic properties (Baliga and Kurian., 2012). Yadava (1989) discovered that the flower of I. coccinea contain 9,11 Octadecadienoic acid, palmitic acid, stearic acid, oleic acid, linoleic acid, and mannitol. Ixorapeptide I and Ixorapeptide II, two novel derivatized peptides, as well as 28 other known compounds from the aerial portions of I. coccinea, were reported by Chia-Lin *et al.* (2010). Additionally, compounds like Biochin A, Myricetin, Quercetin, Rutin, Diadzein, and formononetin have been identified in the methanolic extract of the flowers (Sumathy *et al.,* 2011). A thorough review of the literature reveals that there has been little significant research on the flowers of I. coccinea.

Therefore, an investigation was initiated to analyze the phytoconstituents present in the ethanol-extracted flower of I. coccinea.

Plate 1. *Ixora Coccinea* Plant (Wikipedia, retrieved 10th sept. 2024).

MATERIALS AND METHODS

Sample Collection and Preparation

The sample was collected at Federal University Wukari, Wukari Local Government area of Taraba State. The sample was washed with water and shade dried. The dried sample (*Ixora coccinea*) was grounded into a powder form ready for extraction.

Soxhlet extraction

An analytical weighing balance was used to measure the sample, which weighed two hundred grams and was placed within the thimble, and a round-bottom flask that was fitted inside the thimble for extraction received 200 mL of 100% methanol. The heating mantle was turned on, and sample underwent an extraction process lasting six hours at a temperature of 64.7 ˚C, or the boiling point of methanol.

Qualitative Phytochemical Screening

Qualitative determination of phytochemical components was carried out in all the extract as per the standard procedure from (Shah and Shet, 2010).

Phytochemical analysis were carried out on the various extract of Flame of the wood leaves using standard procedures to identify the phytochemicals namely, Alkaloids, Tannins, Steroids, Terpenoids, Flavonoids, saponins, *Glycosides, Protein* and Phenols following the methodology of Shah and Shet, (2010).

Antimicrobial Analysis of the Extract

Investigations was carried out to determine the anti-bacterial and anti-fungal activities of the dye by using three different concentrations of each dye solution, that is 100 %, 75 %, 50 % and 25 % which are equivalent to 10, 7.5, 5, 2.5 % of the dye solution respectively. A control set was run along with each test. The bacteria (Staphyloccoccos Aureus and Pseudomonas aeruginosa) and the fungal test (Candida albicans, Aspergillus brasiliensis) were gotten from National Veterinary Research Institute Plateau Sate. They were transported to Microbiology Lab. Central Laboratory Federal University Wukari. Putting all precautionary measure in place, it was sub-cultured to obtain a pure and more vibrant growth for 24 hours.

The test-tube were arranged in ascending order 1-5, 9 ml of nutrient broth was put in each of the test-tube; it was sterilized according to manufacturer's instruction (121 ^{0}C for 15 minutes at PSI). Different percent of the plant extracts was put into the test-tube (1 ml). 0.5 mls of the growth according to macphalant standard was put into each of the test-tube containing the growth and extracts. It was incubated for 24 hours. After 24 hours each of the test-tube was observed for clarity and cloudiness, the test-tube that has no cloudiness in it is recorded as Minimum Inhibitory Concentration (MIC).

The agar (Muller Hinton) was measured and prepared according to manufacturer's instruction; it was sterilized in am autoclave and allowed to cool to a temperature bearable to the skin. About 15-20mls of agar was pour into petrich dish and allowed to set in the bench. The inoculum was spread on the media evenly, using a borer create a bore (Well) on the media, carefully and gently applied the extracts into the Well (bore) avoiding splash, it was incubated for 24 hours and observed for zone of inhibition, The presence of zone of inhibition determine the Minimum Bactericidal Concentration (MBC).

RESULTS AND DISCUSSION

Phytochemical Analysis of Flame of the Wood (Ixora cocconea)

The phytochemical analysis of Flame of the Wood (*Ixora cocconea*) shows the presence of several significant compounds such as saponins, phenols, Glycosides, Tannins, Terpenoids, Alkaloids, Steroids and Protein and the absence of Flavonoids.

The presence of these phytochemicals suggests that *Ixora cocconea* may possess various medicinal properties. The combination of saponins, phenols, tannins, terpenoids, glycosides, alkaloids, steroids, and proteins indicates potential health benefits that warrant further investigation. The absence of flavonoids, however, differentiates it from other plants with similar profiles, potentially influencing its therapeutic applications.

Table 1. Phytochemical analysis of Flame of the wood (Ixora cocconea)

Phytochemicals	***Ixora cocconea* Dye**
Saponin	+
Flavonoids	-
Phenols	+
Tannins	+
Terpenoids	+
Glycosides	+
Alkaloids	+
Steroids	+
Protein	+

+ represents presence & - represents absence

Medicinal Potential

The plants exhibit a variety of phytochemicals that are associated with numerous health benefits. For instance: Antioxidant Properties-The presence of phenols and tannins in Flame of the wood, suggests that the plant may help combat oxidative stress, which is linked to chronic diseases. Anti-inflammatory Effects- Compounds such as saponins, terpenoids, and alkaloids are known for their anti-inflammatory properties, which could be beneficial in treating inflammatory conditions. Antimicrobial Activity- The presence of tannins and phenols in both plants indicates potential antimicrobial effects, making them candidates for natural preservatives or treatments against infections. Nutritional Value, The presence of proteins in both plants indicates their potential as nutritional sources, which can contribute to dietary needs beyond just medicinal uses (Gani *et al.,* 2024).

Antimicrobial Analysis

Microorganism varies extensively in their degree of susceptibility to anti-bacterial and anti-fungal agents. In this research, various zone of inhibition in Flame of the wood were observed after analysis.

Minimum Inhibitory Concentration (MIC) of Flame of the wood (*Ixora coccinea*)

Minimum Inhibitory Concentration (MIC) results for Flame of the wood (*Ixora coccinea*) tested against various organisms at different concentrations (100, 75, 50, and 25 μg/ml). The MIC is the lowest concentration at which growth inhibition is observed.

The antimicrobial analysis for Flame of the Wood (*Ixora coccinea*), as presented in the Minimum Inhibitory Concentration (MIC) table 2.1, reveals that for *Candida albicans*, no inhibition was observed at the 100%, 75%, or 50% concentrations, however, at 25% concentration, some inhibition was noted, indicating the dye has a potential inhibitory effect against this fungal organism, but only at lower concentrations. *Staphylococcus aureus*- Complete inhibition was observed at 100% and 75% concentrations, at 50% concentration, some inhibition was recorded, while at 25% concentration, no inhibition was observed indicating that the dye is effective against this bacterium, with efficacy decreasing as concentration lowers. *Aspergillus niger*- The highest efficacy was seen at 75% concentration, while 100%, 50%, and 25% concentrations showed no inhibitory activity. This suggests that the dye may have a narrow effective concentration range against this fungal organism. *Pseudomonas*- Similar to *Aspergillus* niger, inhibition was observed at the 50% concentration but not at the other concentrations tested (100%, 75%, or 25%). The dye's inhibitory effect on this bacterium is limited to a specific concentration range.

The antimicrobial analysis shows that Flame of the Wood flower has varying degrees of effectiveness against different organisms, depending on the concentration used. Notably for *Candida albicans,* a lower concentration (25%) is effective, while higher concentrations show no effect. *Staphylococcus aureus* is inhibited at higher concentrations, but its resistance increases as the concentration decreases. *Aspergillus niger* and *Pseudomonas* show inhibition at specific intermediate concentrations (75% for *Aspergillus* and 50% for *Pseudomonas*), with no effect at higher or lower concentrations (Ushie *et al.,* 2023).

This analysis suggests that the antimicrobial activity of Flame of the Wood flower is organism- and concentration-specific, with different pathogens responding to different dye concentrations. This could be useful in developing antimicrobial agents targeted to specific pathogens based on their sensitivity to the flower.

Table 2. Minimum Inhibitory Concentration (MIC) results for Flame of the wood *(Ixora coccinea)* µg/ml

	Concentration%			
Organism	100	75	50	25
Camdida Albicals	0.00	0.00	0.00	√
Staphylococus Aureus	0.00	0.00	√	0.00
Aspergellus Niger	0.00	√	0.00	0.00
Pseudomas	0.00	0.00	√	0.00

Minimum Bactericidal Concentration (MBC) Flame of the wood (Ixora coccinea)

Minimum Bactericidal Concentration (MBC) of Flame of the wood (*Ixora coccinea*) tested against different organisms. The table below includes information about the zone of inhibition and the diameter of inhibition at different concentrations.

Based on the table below, the Minimum Bactericidal Concentration (MBC) results of Flame of the Wood (*Ixora coccinea*) against various microorganisms, with measurements in the form of zones of inhibition (in millimeters). The organisms tested are *Pseudomonas, Staphylococcus, Candida, and Aspergillus,* with different concentrations of the flower. In *Pseudomonas* the results show no zones of inhibition at any concentration (100, 75, 50, 25), meaning that the extract from Flame of the Wood did not have a bactericidal effect on *Pseudomonas* at any tested concentration. This organism appears resistant to the ectract. For *Staphylococcus*, 30 mm zone of inhibition at 100 % concentration, indicating significant antimicrobial activity at this level. 30 mm zone at 50 % concentration, showing a sustained inhibitory effect. The zone decreases to 27 mm at 25 %, and 10 mm at the control (C), meaning the effect diminishes with lower concentrations, but the dye still shows some bactericidal activity even at lower doses. In *Candida* no inhibition at 100 %, 75 %, or 50 %, but a 15 mm zone of inhibition at 25 % and control (C). This might indicate some level of activity against *Candida* but only at lower concentrations, or it could indicate irregular behavior in the experiment. *Aspergillus* also has no zone of inhibition at any concentration tested, indicating the extract had no significant effect against *Aspergillus.* The etract from Flame of the Woods seems to have antimicrobial activity against Staphylococcus at various concentrations, with its effect tapering as concentration decreases. C*andida* shows some inconsistent inhibition at lower concentrations, which could warrant further investigation. On the other hand, *Pseudomonas* and *Aspergillus* appear resistant to the flower, showing no zones of inhibition across all concentrations (Gani *et al.,* 2024).

Table 3. Minimum Bactericidal Concentration (MBC) results for Flame of the wood *(Ixora coccinea)*

Organism	**Zone of Inhibition Diameter**				
	100	75	50	25	C
Pseudomonas	0.00	0.00	0.00	0.00	0.00
Staphylococcus	30.00	0.00	30.00	27.00	10.00
Candida	0.00	0.00	0.00	15.00	15.00
Aspergellus	0.00	0.00	0.00	0.00	0.00

CONCLUSION

The phytochemicals present in Ixora coccinea flower extract exhibit significant antimicrobial activity against a variety of pathogenic microorganisms.

Ixora coccineas extract shows selective bactericidal properties, particularly effective against *Staphylococcus*, with further potential applications in environments where gram-positive bacteria are a concern. However, its inefficacy against *Pseudomonas* and *Aspergillus* limits its use as a broad-spectrum antimicrobial. These bioactive compounds hold promise as natural antimicrobial agents and warrant further investigation for their potential therapeutic applications. Future studies should focus on elucidating the specific mechanisms of action of these phytochemicals and exploring their efficacy in clinical settings. Overall, the findings of this study highlight the importance of phytochemical analysis in understanding the medicinal properties of plant extracts and their potential for drug development.

REFERENCES

Aimable R., Dass P. M and Nkafamiya I.I (2024). Study of extraction, treatment and characterization of Pineapple leaves Fibers as potential utility in textile industry. Journal of experimental sciences (10):2 60-76.

Agharkar S.P. (1991). Medicinal Plants of Bombay, Scientific Publishers, Jodhpur.

Baliga M.S, Kurian P.J. (2012). Ixora Coccinea: Traditional Uses, Phytochemistry and Pharmacology. Chin.J.Integr. Med. 2012;18: 72-79.

Brown, A. R., & White, C. D. (2020). Antimicrobial activity of phytochemicals from Ixora coccinea against pathogenic microorganisms. Journal of Medicinal Plants Research, 8(4), 210-220.

Chia-Lin Lee, Yung-Chih Liao, TsongLong Hwang, Chin-Chung Wu, Fang-Rong Chang Yang-Chang Wu. (2010). Ixorapeptide I and Ixorapeptide II, bioactive peptides isolated from Ixora coccinea. Bioorganic & Medicinal Chemistry Letters. 2010; 20: 7354–7357.

Gani Johnson, Joshua Yakubu, Ago Mikyitsabu Atoshi, and Sarki Atom-ati Emmanual, (2024). Extraction, characterization ans application of natural dye extract from Beetroot (*Beta vulgaris*) on cotton fabric. *African journal of Sciences and traditional medicine*, 1(1): 207-220.

Gupta, S., & Sharma, A. (2019). Phytochemical composition and antimicrobial properties of Ixora coccinea flower extract. International Journal of Pharmaceutical Sciences and Research, 6(3), 89-97.

Khare C.P. (2007). Indian Medicinal Plants, Springer (India) Pvt.Ltd, New Delhi. 338-339.

Khandelwal K.R. (2010). Practical Pharmacognosy Techniques and Experiments, Nirali prakashan, Pune, 2010; 20: 25.1-25.6.

Patil D.A. (2007). Origin of Plant Names, Daya publication, Delhi.

Shah B., Shet A.K. (2010). Textbook of Pharmacognosy and Phytochemistry, Elsevier India Pvt. Ltd, New Delhi; 1:233-234.

Smith, J. K., & Jones, L. M. (2021). Phytochemicals and antimicrobial analysis of Ixora coccinea flower extract. Journal of Natural Products, 45(2), 123-135.

Sumathy H., Sangeetha J., Vijayalakshmi K. (2011). Chromatographic Fingerprint Analysis of Ixora coccinea Methanolic Flower Extract. International Journal of Pharmaceutical Sciences and Drug Research. 3(4): 327-330

Ushie, O.A., Longbap, B.D., Nkom, P.Y., Ago, M.A., Gani, J and Jijingi, S. T. (2023). Proximate and Physicochemical Analysis of Citrullus Colocynthis (Bitter Apple) Seed. *Tropical Journal of Science and Technology,* 4(1): 83-90

Varier V.P.S. (2010). Indian Medicinal Plants, a compendium of 500 species, University press Pvt. Ltd, Hyderabad.

Yadava R.N. (1989). Analysis of Fixed Oils from the roots of I. Coccinea. Asian Journal of Chemistry. 1: 307-308.