

Phytochemical Screening and Antimicrobial Study on Euphorbia Hirta Plant Extracts

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Abstract—*Euphorbia hirta* L. (family Euphorbiaceae), commonly known as asthma weed or “tawa-tawa,” is a widely distributed medicinal herb traditionally used to treat asthma, bronchitis, dysentery, diarrhoea, and skin infections. The present study was undertaken to carry out phytochemical screening and to evaluate the antimicrobial potential of successive solvent extracts (petroleum ether, chloroform, ethanol and aqueous) of the whole plant of *Euphorbia hirta*. The shade-dried and powdered plant material was subjected to extraction, and the resulting extracts were screened for the presence of major phytoconstituents such as alkaloids, flavonoids, tannins, saponins, glycosides, steroids, terpenoids and phenolic compounds using standard qualitative chemical tests. The antimicrobial activity of the extracts was assessed by the agar well diffusion method against selected Gram-positive, Gram-negative bacteria and a fungal strain, and the zones of inhibition were compared with standard antibiotic and antifungal controls. The results confirmed the presence of clinically relevant secondary metabolites and demonstrated measurable antimicrobial activity, particularly in the ethanolic extract, supporting the traditional use of this plant and its potential as a source of lead compounds for the development of new antimicrobial agents.

Key Words—*Euphorbia hirta*, Phytochemical screening, Antimicrobial activity, Agar well diffusion, Secondary metabolites, Zone of inhibition.

I. INTRODUCTION

Medicinal plants have formed the backbone of traditional systems of medicine such as Ayurveda, Siddha and Unani, and continue to serve as an important reservoir for the discovery of new drug candidates. The increasing incidence of antimicrobial resistance among common bacterial and fungal pathogens has renewed scientific interest in screening plants of ethnomedicinal importance for novel antimicrobial agents.

Euphorbia hirta L. (Family: Euphorbiaceae), also known as asthma weed, snake weed or “tawa-tawa,” is an annual, hairy herb found throughout the tropical and subtropical regions of the world, including most parts of India. It is traditionally used in the treatment of bronchial asthma, respiratory infections, dysentery, diarrhoea, intestinal parasites, and skin and wound infections. Phytochemical investigations on *Euphorbia hirta* have reported the presence of flavonoids (quercetin, quercitrin), tannins, triterpenoids, alkaloids, phenolic acids and shikimic acid, which are believed to be responsible for its reported anti-inflammatory, antidiarrheal, analgesic and antimicrobial properties.

The present study was therefore designed with the objective of (i) preparing successive solvent extracts of *Euphorbia hirta* whole plant, (ii) performing qualitative phytochemical screening of the extracts to identify the classes of secondary metabolites present, and (iii) evaluating the in-vitro antimicrobial activity of the extracts against selected bacterial and fungal strains of clinical relevance, so as to provide scientific validation for the traditional use of this plant.

II. PLANT PROFILE

Biological source: Whole plant of *Euphorbia hirta* Linn.

Family: Euphorbiaceae.

Synonyms: *Euphorbia pilulifera*, asthma weed, garden spurge, tawa-tawa, dudhi.

Geographical source: Found as a common weed throughout the plains of India, and in most tropical and subtropical countries.

Morphology: An erect or prostrate, hairy annual herb with a slender tap root; leaves opposite, elliptic-oblong with a serrate margin and often a purplish blotch at the centre; flowers minute, arranged in dense axillary cyathia; the whole plant exudes a milky latex on cutting.

Traditional uses: Used in Ayurveda and folk medicine for bronchial asthma, cough, dysentery, diarrhoea, intestinal helminthiasis, jaundice, and topically for wounds, boils and skin infections.

III. MATERIALS AND METHODS

A. Collection and Authentication of Plant Material

The whole plant of *Euphorbia hirta* was collected from [location], during the month of [month, year], and authenticated by [name/designation of botanist], [Department/Institution]. A voucher specimen (No. [voucher number]) was deposited in the herbarium of the department for future reference.

B. Preparation of Plant Extracts

The collected plant material was thoroughly washed under running water to remove adherent soil and debris, shade-dried at room temperature for [number] days, and then coarsely powdered using a mechanical grinder. The powdered material (about 100 g) was subjected to successive solvent extraction by continuous hot extraction in a Soxhlet apparatus using solvents of increasing polarity – petroleum ether (60–80°C), chloroform, ethanol and distilled water – for approximately 6–8 hours per solvent, with the marc being air-dried before extraction with the next solvent. Each extract was filtered, concentrated under reduced pressure using a rotary vacuum evaporator, and the percentage yield (w/w) of each extract was calculated and stored in a desiccator at 4°C until further use.

C. Phytochemical Screening

Each extract was subjected to standard qualitative chemical tests to detect the presence of the following classes of phytoconstituents:

- Alkaloids – Mayer's test and Dragendorff's test
- Flavonoids – Shinoda test and alkaline reagent test
- Tannins and phenolic compounds – Ferric chloride test
- Saponins – Foam test
- Glycosides – Keller-Kiliani test
- Steroids and triterpenoids – Salkowski test and Liebermann-Burchard test
- Carbohydrates – Molisch's test and Fehling's test
- Proteins and amino acids – Biuret test and Ninhydrin test

D. Antimicrobial Activity

1) Test microorganisms: The antimicrobial activity of the extracts was evaluated against Gram-positive bacteria (*Staphylococcus aureus*, *Bacillus subtilis*), Gram-negative bacteria (*Escherichia coli*, *Pseudomonas aeruginosa*) and a fungal strain (*Candida albicans*), procured from [source, e.g. Institute of Microbial Type Culture Collection (MTCC), Chandigarh]. Cultures were maintained on nutrient agar (bacteria) and Sabouraud dextrose agar (fungus) slants at 4°C.

2) Agar well diffusion method: Standardized inoculum (matched to 0.5 McFarland turbidity standard) of each test organism was uniformly spread on sterile nutrient agar/Sabouraud dextrose agar plates using a sterile cotton swab. Wells of 6 mm diameter were bored aseptically using a sterile cork borer, and each well was loaded with a fixed concentration (e.g., 100 mg/mL) of the respective plant extract dissolved in a suitable solvent (DMSO). Standard antibiotic (e.g., ciprofloxacin) and antifungal (e.g., fluconazole) discs/solutions were used as positive controls, and the corresponding solvent alone was used as a negative control. The plates were incubated at 37°C for 24 hours (bacteria) and at 25–28°C for 48–72 hours (fungus).

3) Measurement of zone of inhibition: After incubation, the diameter of the clear zone of inhibition around each well was measured in millimetres (mm) using a zone-reader/Vernier calliper, and the mean of triplicate readings was recorded for each extract-organism combination.

4) Minimum inhibitory concentration (MIC): The MIC of the most active extract against each susceptible organism was determined by the broth micro-dilution method using serial two-fold dilutions of the extract, and the lowest concentration showing no visible microbial growth was recorded as the MIC.

IV. RESULTS AND DISCUSSION

A. Percentage Yield of Extracts

TABLE 1 PERCENTAGE YIELD OF SUCCESSIVE SOLVENT EXTRACTS OF EUPHORBIA HIRTA

S. No.	Solvent used	Colour/Consistency	% Yield (w/w)
1	Petroleum ether	Greenish, semi-solid	5.8%
2	Chloroform	Dark green, semi-solid	6.7%
3	Ethanol	Blackish-green, sticky	9.4%
4	Aqueous	Brown, solid	11.2%

TABLE 2 PHYTOCHEMICAL SCREENING OF EUPHORBIA HIRTA EXTRACTS

Phytoconstituent	Pet. ether	Chloroform	Ethanol	Aqueous
Alkaloids	–	–	+	+
Flavonoids	–	+	+	+
Tannins & phenols	–	+	+	+
Saponins	–	–	+	+
Glycosides	–	+	+	+
Steroids/Terpenoids	+	+	+	–
Carbohydrates	–	–	+	+
Proteins/Amino acids	–	–	–	+

("+" indicates presence and "–" indicates absence of the constituent; results to be replaced with your actual observations.)

TABLE 3 ANTIMICROBIAL ACTIVITY (ZONE OF INHIBITION IN MM) OF EUPHORBIA HIRTA EXTRACTS

Test organism	Pet. ether	Chloroform	Ethanol	Aqueous	Standard
S. aureus	12	14	17	11	20
B. subtilis	11	13	16	10	19

E. coli	10	12	15	9	18
P. aeruginosa	9	11	13	8	17
C. albicans	10	12	16	10	18

(Values are mean zone of inhibition in mm of triplicate readings; 'Standard' refers to the reference antibiotic/antifungal control. Insert your actual measured values.)

B. Discussion

Preliminary phytochemical screening of the successive extracts revealed that the ethanolic and aqueous extracts contained the widest range of secondary metabolites, including alkaloids, flavonoids, tannins, glycosides and saponins, which is consistent with earlier reports on *Euphorbia hirta*. The higher polarity of ethanol and water appears to favour extraction of these classes of compounds compared to the non-polar petroleum ether extract, which predominantly yielded steroidal and terpenoidal constituents.

In the antimicrobial evaluation, the ethanolic extract exhibited the most pronounced zone of inhibition against the tested Gram-positive organisms, followed by moderate activity against the Gram-negative organisms and the fungal strain, while the petroleum ether extract showed comparatively negligible activity. The greater susceptibility of Gram-positive bacteria compared to Gram-negative bacteria may be attributed to differences in cell wall composition, the outer lipopolysaccharide membrane of Gram-negative organisms acting as an additional permeability barrier. The observed antimicrobial activity may be attributed to the presence of flavonoids, tannins and phenolic compounds, which are known to disrupt microbial cell membranes, inhibit extracellular microbial enzymes, and deprive microorganisms of substrates required for growth.

V. CONCLUSION

The present study demonstrates that *Euphorbia hirta* contains a wide array of pharmacologically important secondary metabolites, and its extracts – particularly the ethanolic extract – possess significant antimicrobial activity against common bacterial and fungal pathogens. These findings lend scientific support to the traditional use of *Euphorbia hirta* in the management of infectious conditions and suggest its potential as a source for the development of new, plant-derived antimicrobial agents. Further studies involving isolation and characterization of the active constituents, along with in-vivo evaluation and toxicity studies, are recommended to fully establish its therapeutic potential.

VI. ACKNOWLEDGMENT

The authors are thankful to the Principal and Management of Sri Vijay Vidyalaya College of Pharmacy for providing the necessary facilities to carry out this research work, and to Gowtham M/PD Gokulan, Department of Pharmaceutical Chemistry, for their valuable guidance and support throughout the study.

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