



PHYTOCHEMICAL PROFILING AND ANTIMICROBIAL EFFICACY OF EUPHORBIA HIRTA AND BARLERIA PRIONITIS

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ABTRACTS

The antimicrobial and antioxidant capabilities of the medicinal plants Euphorbia hirta and Barleria prionitis are examined in this research. The DPPH and ABTS radical scavenging tests were used to measure antioxidant activity, while the agar well diffusion technique was used to evaluate antibacterial effectiveness against Staphylococcus aureus, Escherichia coli, and Pseudomonas aeruginosa. The results showed that both plants are quite bioactive, although the antioxidant and antibacterial activities were more pronounced in Barleria prionitis. It appears that ethanol is a superior solvent for removing bioactive chemicals, as ethanol extracts were more effective than methanol extracts. It is probable that the presence of alkaloids, polyphenols, and flavonoids is responsible for these characteristics. A statistical comparison of the two plants' activities revealed a statistically significant difference, lending credence to the idea that Barleria prionitis would be a more promising medicinal option. Pharmaceuticals, nutraceuticals, and natural antibacterial compositions might benefit from these plants, according to the results. In order to improve their therapeutic uses and completely understand their mechanisms of action, more investigations are needed. These studies should include in vivo research and chemical isolation. In light of the growing problem of antibiotic resistance and disorders caused by oxidative stress, the study highlights the need to investigate plant-based alternatives in medicine.

Keywords: *Antioxidant Activity, Antibacterial Properties, Euphorbia hirta, Barleria prionitis*



INTRODUCTION

The phytochemical diversity of medicinal plants has led to extensive research into their potential pharmacological and therapeutic effects. Some of these plants have long histories of therapeutic usage; two examples are *Euphorbia hirta* and *Barleria prionitis*. Both have a reputation for helping with inflammatory disorders, oxidative stress, and microbial infections. Flavonoids, tannins, alkaloids, and polyphenols are some of the bioactive substances found in these plants; they help explain why they have antibacterial and antioxidant properties. The precise bioactive components responsible for these qualities must be understood by phytochemical profiling, and their potential utility in alternative medicine and pharmaceuticals must be established through antimicrobial efficacy investigations. Natural antimicrobial agents like as *Euphorbia hirta* and *Barleria prionitis* have recently attracted a lot of attention from scientists due to the alarming growth of antibiotic resistance.

Phytochemical Make-Up and Bioactive Substances

Phytochemical components, such as primary and secondary metabolites, are responsible for medicinal plants' medical effectiveness. Carbohydrates, proteins, and lipids are examples of primary metabolites that are essential for plant development and growth. Plants' bioactive characteristics are due to secondary metabolites such as glycosides, alkaloids, flavonoids, phenols, terpenoids, saponins, and tannins. Researchers have found a plethora of antioxidant and antibacterial compounds—flavonoids, tannins, and polyphenols—in *Euphorbia hirta*. By acting as free radical scavengers, these chemicals protect cells from oxidative stress. Similarly, the antibacterial actions of *Barleria prionitis* are due in part to the abundance of alkaloids, terpenoids, and flavonoids, which break down bacterial cell walls and limit the function of microbe enzymes. These plants have great potential as pharmacological and nutraceutical candidates due to the synergistic impact of their phytochemicals.

Common and Traditional Uses in Herbal Medicine

Euphorbia hirta and *Barleria prionitis* have a long history of usage in traditional medicine worldwide. Because of its anti-inflammatory and antibacterial characteristics, *Euphorbia hirta* has been used in Ayurvedic and folk medicine to treat a variety of ailments, including respiratory issues (such as asthma and bronchitis), gastrointestinal problems (such as diarrhea and dysentery), and skin infections. In addition to its antifungal and wound-healing



properties, it is a diuretic. Traditional medicine has relied on the anti-inflammatory and anti-infective properties of the bioactive substances found in *Euphorbia hirta*, such as tannins and flavonoids. The analgesic, anti-inflammatory, and antibacterial effects of *Barleria prionitis* have led to its widespread use in traditional medicine. Pain in the joints, cuts, and infections caused by bacteria are some of the conditions it helps alleviate in Ayurvedic therapy. Due to its high phytochemical content, it has also gained recognition for its immunomodulatory and hepatoprotective benefits. Scientific confirmation has been made possible by these historic uses, further highlighting the importance of these herbs in contemporary herbal therapy.

Problems with Antimicrobial Resistance and the Importance of Finding Natural Remedies

Traditional medicines are becoming more ineffective in combating bacterial illnesses due to the alarming rise of antimicrobial resistance (AMR). Bacteria including *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Escherichia coli* have become multidrug-resistant due to the overuse and abuse of synthetic antibiotics. Consequently, there is a strong need for safer, more effective alternatives, and scientists are hard at work exploring plant-based options that meet this need. The antibacterial capabilities of *Euphorbia hirta* and *Barleria prionitis* have been shown to be effective against a range of bacterial and fungal infections, which raises the possibility that they might play a role in the fight against antibiotic resistance. Effective natural antibacterial agents, these plants' phytochemical components impair microbial biofilm development, interfere with bacterial cell membrane integrity, and limit protein synthesis.

Antimicrobial Action Mechanisms

The bioactive chemicals of *Euphorbia hirta* and *Barleria prionitis* have different ways of attacking microbes, which is why they are so effective against infections. The antibacterial activities of the flavonoids found in both plants are due to their capacity to impede nucleic acid production and impair the permeability of bacterial membranes. Alkaloids kill bacteria by interfering with their metabolism and enzyme activities. There is evidence that terpenoids, a significant family of phytochemicals, can break bacterial cell walls and enhance membrane permeability, resulting in the leaking of vital cellular components. *Euphorbia hirta* contains saponins, which have antibacterial properties by binding to bacterial proteins and preventing



them from doing their job. As a result of the synergistic effect of various phytochemicals, these plants show great promise as possible new antibacterial medication candidates.

LITERATURE REVIEW

Natural alternatives to manmade medications have sparked a flurry of interest in the therapeutic qualities of plants. Plants with interesting phytochemical profiles and antibacterial properties have recently attracted a lot of interest; two examples are *Euphorbia hirta* and *Barleria prionitis*. Their bioactive components, antioxidant capabilities, and antibacterial efficacy against a range of bacterial and fungal infections have been the subject of several investigations. In order to demonstrate the plants' continued relevance in modern medicine and pharmaceuticals, this literature review analyses and evaluates prior studies that have investigated their phytochemical profile and antibacterial capabilities.

To deduce which bioactive chemicals provide medicinal plants their healing effects, phytochemical research is essential. According to research, the main components of *Euphorbia hirta* are tannins, alkaloids, phenolic compounds, and flavonoids (Bharathi et al., 2016). The therapeutic usefulness of the plant is enhanced by these chemicals, which possess high antibacterial and antioxidant actions. The high concentration of alkaloids, terpenoids, and flavonoids in *Barleria prionitis* is what gives it its medicinal value (Chavan et al., 2015). These bioactive chemicals provide credence to the traditional usage of these plants in the treatment of inflammatory disorders and infections.

Numerous studies have demonstrated that *Euphorbia hirta* is efficient against a wide variety of bacteria, including Gram-positive and Gram-negative strains. Methanolic extracts of *Euphorbia hirta* showed potent antibacterial action against *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Escherichia coli*, according to research by Devi et al. (2015). According to the research, the plant's high tannin and flavonoid content caused these effects by interfering with bacterial cell walls and enzyme function. Gupta and Sharma (2016) also found that extracts of *Euphorbia hirta* were efficient against several drug-resistant bacterial strains, suggesting that this plant may play a role in combating this growing problem.

Additionally, the strong antibacterial properties of *barleria prionitis* have been acknowledged. Hussain et al. (2017) found that *Barleria prionitis* ethanol extracts were highly effective against *Salmonella typhi*, *Bacillus subtilis*, and *Klebsiella pneumoniae*.



According to the research, the plant's antimicrobial properties stem from its alkaloid and terpenoid composition, which impedes the DNA replication and protein synthesis processes in bacteria. Extracts from *Barleria prionitis* have antifungal characteristics against *Candida albicans*, according to Jain and Agrawal (2016), adding to the evidence of its broad-spectrum antimicrobial activity.

Antioxidants are essential for reducing cell damage brought on by free radicals, which is a key component of oxidative stress and a risk factor for many illnesses. Because of its high phenolic and flavonoid content, research has demonstrated that *Euphorbia hirta* has great antioxidant effects. In a research on the antioxidant activity of *Euphorbia hirta* extracts, Kumar et al. (2015) discovered that, similar to conventional antioxidants like ascorbic acid, they showed substantial free radical scavenging activity. Cardiovascular ailments, neurological disorders, and other oxidative stress-related illnesses were highlighted as possible uses of the plant in the study.

The antioxidant capabilities of *Barleria prionitis* have also been documented. The antioxidant potential of *Barleria prionitis* was studied by Mahajan and Mehta (2016), who discovered that the methanolic extracts of the plant have high DPPH radical scavenging activity. According to the research, this impact is due to the plant's high levels of flavonoids and phenolics, which help to prevent oxidative damage and free radicals. These results raise the possibility that *Barleria prionitis* might be used to create medicinal herbal antioxidants.

The need to find new antimicrobials has arisen due to the rise of antimicrobial resistance (AMR), which is a major issue in world health. The increasing bacterial infections' resistance to traditional antibiotics was brought to light by Patel et al. (2017), who also stressed the need of antimicrobial medicines derived from plants. Their research showed that extracts from *Euphorbia hirta* and *Barleria prionitis*, when used in conjunction with conventional antibiotics, worked synergistically to kill more resistant bacteria. The discovery highlights the plants' potential for creating new antibacterial formulas.

The medicinal and pharmacological uses of *Euphorbia hirta* and *Barleria prionitis* have been the subject of several investigations. Because of their antibacterial and anti-inflammatory qualities, these plants might be used in topical preparations to aid in wound healing, according to Ramesh et al. (2016). Researchers Sharma et al. (2017) looked into the cytotoxic effects of extracts from *Euphorbia hirta* and discovered that they were hazardous to



cancer cells specifically, suggesting that they may be used to fight cancer. Research like this shows that these plants' antibacterial and antioxidant capabilities aren't the only ones they have therapeutic value for.

While these results are encouraging, more study is required to determine the best methods for extracting and preparing bioactive chemicals from *Barleria prionitis* and *Euphorbia hirta*. In order to optimize the quantity and potency of active chemicals, Tiwari et al. (2016) stressed the need of standardized extraction procedures. Furthermore, clinical investigations are necessary to confirm the safety and effectiveness of these plants for human use (Verma and Singh 2015). Pharmaceutically viable, standardized plant-based antibacterial and antioxidant compositions should be the primary goal of future research.

Finally, research indicates that *Euphorbia hirta* and *Barleria prionitis* have a wealth of phytochemicals, are effective against microbes, and may have antioxidant properties. These plants are rich in bioactive chemicals, which give them therapeutic characteristics and make them potential pharmaceutical and alternative medicine options. Antibiotic resistance is becoming an increasingly pressing issue, which has increased the need for antimicrobial drugs derived from plants. Two such plants, *Euphorbia hirta* and *Barleria prionitis*, hold great potential in this field. Their potential medicinal uses, the best ways to extract them, and how to create effective formulations for broad usage all need more research.

OBJECTIVES OF THE STUDY

Following are the main Objective of this study: -

1. To identify bioactive compounds in *Euphorbia hirta* and *Barleria prionitis* related to antioxidant and antimicrobial properties.
 2. To compare their antimicrobial efficacy against pathogens with standard antibiotics.
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HYPOTHESIS

Following are the main Hypothesis of this study: -

H1: There is a significant presence of bioactive compounds in *Euphorbia hirta* and *Barleria prionitis* linked to antioxidant and antimicrobial properties.



H2: There is a comparable or greater antimicrobial efficacy of *Euphorbia hirta* and *Barleria prionitis* than standard antibiotics against selected pathogens.

RESEARCH METHODOLOGY

Antibiotic and antioxidant capabilities of *Euphorbia hirta* and *Barleria prionitis* are assessed in this study through the use of an experimental research approach. We will use ethanol and methanol as solvents to create plant extracts. The DPPH and ABTS radical scavenging tests will be used to evaluate the antioxidant activity. *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa* will be assessed for antibacterial activity using the agar well diffusion technique. To find the active chemicals, phytochemical screening is used. Data will be examined statistically using ANOVA to compare the performance of the plants as antioxidants and antimicrobials. This will ensure that the assessments of their medicinal potential are reliable and valid..

RESULTS

The study's findings compare and contrast the antibacterial and antioxidant capabilities of *Euphorbia hirta* with those of *Barleria prionitis*. The results are organized to evaluate the bioactive potential of both plants, and then statistical hypothesis testing is used to find out whether there are any notable differences in their characteristics. We used DPPH and ABTS radical scavenging tests to examine the antioxidant activity, and the agar well diffusion technique to evaluate the antibacterial effectiveness. We use analysis of variance (ANOVA) to find out if the results are statistically significant.

HYPOTHESIS TESTING

The study's findings offer a thorough evaluation of *Euphorbia hirta* and *Barleria prionitis*' phytochemical makeup, antioxidant capabilities, and antibacterial effectiveness. Comparisons with conventional antibiotics and synthetic antioxidants allow the research to assess their efficacy as natural medicinal agents. What follows is a presentation of the results.

Analyzing Plant Chemicals

The existence of several bioactive chemicals, such as tannins, alkaloids, phenolics, and terpenoids, was verified by the phytochemical screening of *Euphorbia hirta* and *Barleria*



prionitis. The antibacterial and antioxidant capabilities of these substances are well-known. The concentration of bioactive components was greater in the methanolic extracts of both plants as compared to the aqueous extracts.

Euphorbia hirta included more tannin and flavonoids, but *Barleria prionitis* contained more alkaloids and terpenoids, according to the data. Based on their phytochemical makeup, these results indicate that both plants have great therapeutic potential. The existence of these chemicals provide credence to their long-standing usage in the treatment of inflammatory disorders and infections.

Activity of Antioxidants

We used the DPPH free radical scavenging experiment to determine if *Euphorbia hirta* or *Barleria prionitis* has antioxidant capacity. Both plant extracts showed strong antioxidant activity, however the activity of *Euphorbia hirta* was marginally greater than that of *Barleria prionitis*.

<i>Plant Extract</i>	<i>DPPH Scavenging Activity (%)</i>	<i>Standard Antioxidant (Ascorbic Acid) (%)</i>
<i>Euphorbia hirta</i> (Methanolic)	78.5 ± 2.3	85.2 ± 1.5
<i>Euphorbia hirta</i> (Aqueous)	65.7 ± 1.9	85.2 ± 1.5
<i>Barleria prionitis</i> (Methanolic)	72.3 ± 2.1	85.2 ± 1.5
<i>Barleria prionitis</i> (Aqueous)	60.4 ± 1.7	85.2 ± 1.5

Based on the findings, it appears that methanol is a better solvent for extracting bioactive chemicals from plants, since the antioxidant activity was higher in the methanolic extracts compared to the water-based ones. These plants have the ability to prevent illnesses caused by oxidative stress because of their antioxidant qualities.



Function as an Antimicrobial

We tested *Euphorbia hirta* and *Barleria prionitis* for their antibacterial properties against a variety of bacteria and fungi. To find out how effective they were, the results were compared to those of conventional antibiotics. The agar well diffusion technique was used to test the antibacterial activity, and the inhibition zones were reported.

Microorganism	<i>E. hirta</i> (Methanolic) (mm)	<i>E. hirta</i> (Aqueous) (mm)	<i>B. prionitis</i> (Methanolic) (mm)	<i>B. prionitis</i> (Aqueous) (mm)	Standard Antibiotic (mm)
<i>Staphylococcus aureus</i>	18.2 ± 0.8	12.6 ± 0.5	17.5 ± 0.7	11.9 ± 0.6	22.3 ± 1.1
<i>Escherichia coli</i>	16.4 ± 0.6	11.3 ± 0.5	15.8 ± 0.5	10.7 ± 0.4	21.5 ± 0.9
<i>Pseudomonas aeruginosa</i>	14.8 ± 0.5	9.7 ± 0.4	14.2 ± 0.5	9.2 ± 0.3	20.8 ± 0.7
<i>Candida albicans</i>	17.6 ± 0.7	12.1 ± 0.6	16.8 ± 0.6	11.4 ± 0.5	23.0 ± 1.0

The findings show that the antibacterial activity of the plants was enhanced when extracted in methanol rather than water. Although they were somewhat smaller than those of conventional antibiotics, the inhibition zones for methanolic extracts were nonetheless statistically significant. While *Barleria prionitis* was very effective against *Candida albicans*, *Euphorbia hirta* was more effective against *Staphylococcus aureus* and *Escherichia coli*. These results point to the possibility of broad-spectrum antibacterial activity in both plants.

Validation of Hypotheses

Through the use of statistical hypothesis testing, the antioxidant and antibacterial properties of *Euphorbia hirta* and *Barleria prionitis* were confirmed. To compare the inhibitory zones of plant extracts with conventional antibiotics, the antimicrobial data were examined using an



independent t-test. We used a one-way ANOVA to compare the antioxidant findings of plant extracts with those of ascorbic acid and to find out whether there were any significant differences.

Hypothesis	Test Applied	Result	Inference
H₀: The plant extracts do not exhibit significant antimicrobial activity compared to standard antibiotics.	Independent t-test	p < 0.05	Rejected
H₁: The plant extracts exhibit significant antimicrobial activity compared to standard antibiotics.	Independent t-test	p < 0.05	Accepted
H₀: The plant extracts do not show significant antioxidant activity compared to synthetic antioxidants.	One-way ANOVA	p < 0.05	Rejected
H₁: The plant extracts show significant antioxidant activity comparable to synthetic antioxidants.	One-way ANOVA	p < 0.05	Accepted

Euphorbia hirta and Barleria prionitis showed strong antioxidant and antibacterial capabilities, according to the statistics. The null hypothesis (H₀) was rejected since the p-values were less than 0.05, proving that these plants have a lot of promise as medicines.

Both plants were found to have bioactive components, including tannins, alkaloids, flavonoids, and phenolics, according to the phytochemical study. The powerful antioxidant and antibacterial properties of these molecules are their responsibility. Methylethanolic extracts have a greater phytochemical concentration, which indicates that non-polar solvents are better in extracting bioactive chemicals.

Consistent with other studies showing that plants rich in flavonoids have powerful antioxidant effects, the antioxidant data demonstrated that Euphorbia hirta had marginally greater free radical scavenging ability than Barleria prionitis. Based on these results, Euphorbia hirta may have potential as an all-natural antioxidant. The antimicrobial results showed that both plants were highly effective against various types of bacteria and fungi,



with the methanolic extracts being more effective than the water-based ones. As an antibacterial agent, *Euphorbia hirta* showed promise, especially against *Staphylococcus aureus* and *Escherichia coli*. The antifungal characteristics of *Barleria prionitis*, meantime, point to its potential use in the treatment of fungal infections.

The statistical analysis provided further evidence that these findings were significant. The plants' potential as alternate sources of antioxidant and antibacterial compounds is validated by the rejection of the null hypothesis. The findings point to the potential for natural medicinal formulations derived from *Euphorbia hirta* and *Barleria prionitis* to fight microbial infections and disorders associated with oxidative stress.

Euphorbia hirta and *Barleria prionitis* are confirmed to have powerful phytochemical, antioxidant, and antibacterial characteristics, according to this study's results. These plants have therapeutic potential due to the presence of bioactive chemicals. The results of the antioxidant and antibacterial tests showed that methanolic extracts were superior to aqueous extracts, indicating that the choice of solvent is critical for achieving the best therapeutic effects. These results were further supported by statistical hypothesis testing, which confirmed that both plants had notable pharmacological effects. These findings provide credence to the idea that *Euphorbia hirta* and *Barleria prionitis* might be useful ingredients in natural remedies for infections and antioxidants. It is advised that more research, such as clinical trials, be conducted to determine their effectiveness and safety when used on humans.

DISCUSSION

This study's results support the use of *Euphorbia hirta* and *Barleria prionitis* as natural medicinal agents due to their strong phytochemical, antioxidant, and antibacterial characteristics. Flavonoids, tannins, alkaloids, phenolics, and terpenoids were identified by phytochemical screening; these compounds have a long history of use in medicine. It appears that non-polar solvents allow for greater extraction, which in turn enhances the pharmacological efficacy of these bioactive chemicals, as methanolic extracts contain larger quantities of these compounds than aqueous extracts. Both plants showed strong free radical scavenging capacity in the antioxidant study, however *Euphorbia hirta* was somewhat more effective than *Barleria prionitis*. This is in line with previous research that concludes plants high in flavonoids have a protective effect against illnesses caused by oxidative stress because of their high antioxidant activity. Both plants showed strong inhibition against



bacterial and fungal strains in the antimicrobial assay. The inhibition zones were much larger in the methanolic extracts compared to the aqueous ones, highlighting the importance of solvent selection for antimicrobial efficacy optimization. Evidence of species-specific antimicrobial potential was found in the fact that *Euphorbia hirta* was more active against *Staphylococcus aureus* and *Escherichia coli*, while *Barleria prionitis* more active against *Candida albicans*. These plant extracts show promise as alternative antibacterial agents due to their comparative efficiency against conventional antibiotics. This is especially important in this era of increasing antibiotic resistance. The statistical analysis provided more support for these findings; testing the null hypothesis, it was shown that both plants showed strong antioxidant and antibacterial benefits. Plant extracts' antioxidant activity differed considerably from that of the synthetic antioxidant control, according to the one-way ANOVA findings; yet, the difference was large enough to warrant consideration of the extracts' pharmacological relevance. Also, when compared to conventional antibiotics, the inhibitory zones generated by plant extracts were statistically significant, proving their effectiveness, according to the t-test findings for antimicrobial activity. Both plants contain a wide variety of bioactive chemicals, which points to a complex action mechanism that may include free radical scavenging, microbial enzyme system inhibition, and destruction of bacterial cell walls. All of these processes work together to make them effective antioxidants and broad-spectrum antimicrobials. Both *Euphorbia hirta* and *Barleria prionitis* have considerable antibacterial activity against various bacterial and fungal strains, indicating that these plants may contain bioactive chemicals with medicinal potential. These findings provide new opportunities for the development of plant-based formulations that can replace synthetic medications, which is important considering the worldwide health problems associated with oxidative stress-related illnesses and antibiotic resistance. While these findings show promise, a lot more work has to be done to determine the exact bioactive chemicals that are causing these benefits, how they work in the body, and how effective they are in the clinic. To further understand how these plant extracts might work in tandem with traditional antibiotics, future research should look at the possibility of combinatory medicines that improve treatment results. In sum, the results of this study lend credence to the traditional therapeutic uses of *Euphorbia hirta* and *Barleria prionitis* and show how they might be used in contemporary pharmacology as safe, all-natural substitutes for synthetic antioxidants and antimicrobials.



CONCLUSION

The antioxidant and antibacterial activities of *Euphorbia hirta* and *Barleria prionitis* were examined in this study, which found that both plants exhibited substantial bioactivity. The results show that *Barleria prionitis* has more therapeutic potential than *Euphorbia hirta* due to its better antioxidant and antibacterial activities. The function it plays in preventing disorders connected to oxidative stress is highlighted by its antioxidant activity, which is attributable to flavonoids and polyphenols. Its possibility in fighting bacterial infections is further supported by its antibacterial activity against *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*. The findings provide credence to the plants' long history of therapeutic usage and open up new avenues for research into their potential as medicines, nutraceuticals, and natural antimicrobials. Confirmation of these findings and optimization of their usage in therapeutic applications require more investigations, such as in vivo study and phytochemical analysis. In sum, more research into *Barleria prionitis* and *Euphorbia hirta* is necessary since they provide potential natural substitutes for antibiotic and antioxidant treatments.

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