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INHIBITORY POTENTIAL OF BUTTERFLY PEA FLOWER (CLITORIA TERNATEA L) DECOCTION AGAINST ESCHERICHIA COLI BACTERIA

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ABSTRACT

This study aimed to determine the inhibitory potential of butterfly pea flower (Clitoria ternatea L.) decoction against the growth of Escherichia coli. The research addressed whether different concentrations of the decoction, prepared as a simple aqueous extract, were capable of producing measurable inhibition zones when tested using a standard microbiological assay. An experimental design was applied using the Kirby–Bauer disk diffusion method on E. coli cultured on Mueller Hinton Agar. Decoctions were prepared at concentrations of 40%, 50%, and 60%, followed by phytochemical screening and pH assessment. Six replications were performed for each treatment group, and inhibition zones were measured after 24 hours of incubation. The findings showed that all concentrations of the decoction failed to produce inhibition zones, indicating the absence of antibacterial activity against E. coli. Although phytochemical screening confirmed the presence of flavonoids, saponins, and tannins, these compounds did not demonstrate inhibitory effects when extracted through boiling. The lack of activity was likely associated with the limited extraction efficiency of water and the resistance characteristics of Gram-negative bacteria. In conclusion, butterfly pea flower decoction at concentrations of 40–60% does not exhibit inhibitory effects against Escherichia coli, suggesting that aqueous

boiling is not an effective method for obtaining antibacterial constituents from this plant.

ABSTRAK

Penelitian ini bertujuan untuk mengetahui potensi daya hambat rebusan bunga telang (Clitoria ternatea L.) terhadap pertumbuhan Escherichia coli serta menilai efektivitas tiga konsentrasi larutan yang digunakan. Fokus penelitian diarahkan untuk menjawab apakah rebusan bunga telang dapat menghasilkan zona hambat ketika diuji menggunakan prosedur standar pada bakteri uji. Metode penelitian menggunakan rancangan eksperimental dengan uji difusi cakram Kirby–Bauer pada media Mueller Hinton Agar. Rebusan bunga telang disiapkan dalam konsentrasi 40%, 50%, dan 60%, kemudian diuji melalui enam kali replikasi pada setiap kelompok perlakuan. Pengamatan dilakukan setelah inkubasi untuk menentukan ada atau tidaknya zona hambat. Hasil penelitian menunjukkan bahwa seluruh konsentrasi rebusan tidak menghasilkan zona bening, sehingga tidak terdapat aktivitas antibakteri terhadap E. coli. Meskipun skrining fitokimia menunjukkan adanya flavonoid, saponin, dan tanin, senyawa tersebut tidak memberikan efek penghambatan melalui proses perebusan air. Temuan ini mengindikasikan bahwa metode ekstraksi air kurang efektif untuk menghasilkan komponen aktif yang mampu menghambat bakteri. Kesimpulannya, rebusan bunga telang pada konsentrasi 40–60% tidak memiliki daya hambat terhadap Escherichia coli.

INTRODUCTION

Escherichia coli is a common intestinal bacterium that functions as part of the normal microbiota but includes pathogenic strains capable of causing gastrointestinal infections with significant public health implications. Increasing antimicrobial resistance among pathogenic E. coli strains has become a major concern, as the reduced effectiveness of commonly used antibiotics limits available treatment options and increases the risk of complications(Pokharel et al., 2023; Russo & Johnson, 2003). This situation has prompted growing interest in identifying alternative antimicrobial agents derived from natural sources. One potential candidate is the butterfly pea flower (Clitoria ternatea L.), a medicinal plant traditionally used for various purposes and known to contain bioactive compounds such as flavonoids, saponins, and tannins, which have been reported to exhibit antimicrobial properties(Dubey et al., 2023; Islam et al., 2023; Maia et al., 2025).

Despite extensive studies on extracts of Clitoria ternatea using organic solvents, limited evidence is available regarding the antimicrobial effects of its aqueous decoction.

This gap is important because decoction represents the most common form of traditional preparation consumed by the public, yet the extraction efficiency of water toward active compounds remains uncertain. Therefore, investigating whether a simple water-based preparation can inhibit E. coli growth is essential for evaluating its practical relevance and contribution to scientific knowledge.

Based on these considerations, this study aims to determine whether butterfly pea flower decoction at different concentrations (40%, 50%, and 60%) demonstrates inhibitory activity against E. coli using the disk diffusion method. The research question addressed is: Does butterfly pea flower decoction exhibit measurable antibacterial activity against E. coli?* The findings are expected to provide scientific evidence regarding the feasibility of using this plant as a natural antibacterial agent and offer insights for future research on extraction methods and formulation development.

METHODS

This study employed an experimental laboratory design to evaluate the antibacterial potential of butterfly pea flower (Clitoria ternatea L.) decoction against Escherichia coli. The methodological framework was developed based on previous research demonstrating that plant-derived metabolites such as flavonoids, saponins, and tannins may exert inhibitory effects on various pathogenic bacteria when extracted under appropriate conditions(Arifannisa et al., 2023; Yun & Paee, 2022). Prior studies using organic-solvent extracts of C. ternatea reported significant antibacterial activity; however, evidence regarding water-based decoctions remains limited, thus providing a scientific rationale for the present investigation.

Fresh butterfly pea flowers were collected, sorted, washed, and processed into a decoction by boiling at standardized conditions. Three concentrations of the decoction (40%, 50%, and 60%) were prepared to evaluate potential dose–response differences. Phytochemical screening was conducted to confirm the presence of major secondary metabolites. Pure cultures of E. coli were standardized using the McFarland 0.5 turbidity benchmark before inoculation onto Mueller Hinton Agar plates.

The antibacterial activity was assessed using the Kirby–Bauer disk diffusion method. Sterile blank disks were impregnated with each concentration of the decoction and placed on inoculated agar plates. All treatments were performed in six replications. Plates were incubated at 35–37°C for 24 hours, and inhibition zones were measured in millimeters using cross-sectional measurement.

Data were analyzed descriptively by comparing the presence or absence of inhibition zones across treatment groups. Based on theoretical and empirical evidence from prior studies, the research hypothesis formulated was: Butterfly pea flower decoction exhibits inhibitory activity against Escherichia coli in a concentration-dependent manner. The findings of this study serve to confirm or reject this hypothesis and to provide insights into the effectiveness of aqueous extraction for obtaining antibacterial plant constituents.

RESULTS AND DISCUSSION

The experimental results showed that the butterfly pea flower (Clitoria ternatea L.) decoction at concentrations of 40%, 50%, and 60% did not produce inhibition zones against Escherichia coli. Measurements taken after 24 hours of incubation revealed no clear zones surrounding any of the treatment disks, indicating the absence of antibacterial activity. These findings are summarized in the study's data table, which shows uniform results across all concentrations, with all replications demonstrating a zero-millimeter inhibition zone. This outcome suggests that the aqueous extraction method used in this study did not yield active compounds in sufficient quantities to inhibit bacterial growth.

Phytochemical screening confirmed the presence of flavonoids, saponins, and tannins—compounds widely recognized for their antimicrobial potential ((Dubale et al., 2023; Hayat et al., 2020; Khair et al., 2024). However, the absence of antibacterial activity in this study may be attributed to the limited ability of water, a highly polar solvent, to extract key bioactive constituents responsible for antimicrobial action. This interpretation is consistent with previous research showing that Clitoria ternatea exhibits significant antibacterial activity only when extracted using organic solvents such as ethanol or methanol, which have higher efficiency in isolating phenolic compounds and secondary metabolites(Maia et al., 2025; Mutiara et al., 2025). The decoction process—high-temperature boiling—may also degrade thermolabile compounds, diminishing antibacterial potency(Mungwari et al., 2025; Patra et al., 2022).

Another important factor in interpreting these results is the intrinsic resistance of Gram-negative bacteria. E. coli possesses an outer membrane rich in lipopolysaccharides, which forms a selective permeability barrier and limits the penetration of many plant-derived compounds(Peng et al., 2020). This structural characteristic explains why numerous plant extracts are effective against Gram-positive bacteria but show reduced or no activity against Gram-negative species(Vaou et al., 2021; Zouine et al., 2024). Thus, even if active metabolites were present in the decoction, their ability to exert antibacterial effects against E. coli would be inherently constrained.

The results raise several methodological considerations. First, traditional decoction may not be an appropriate method for extracting antibacterial compounds from C. ternatea, as supported by literature indicating superior extraction efficiency of organic solvents(Jeyaraj et al., 2021). Second, the absence of activity highlights the need for comparative studies using different extraction methods—such as maceration, Soxhlet extraction, or ultrasonic-assisted extraction—to evaluate the influence of solvent polarity and extraction temperature on the antibacterial properties of the flower. Third, evaluating the plant against Gram-positive bacteria may offer clearer insights, as such organisms are often more susceptible to phenolic compounds and flavonoids(El Baakili et al., 2023).

From a theoretical standpoint, the findings confirm that solvent selection and bacterial cell wall structure are critical determinants of antibacterial outcomes in plant-based research. Practically, the study suggests that butterfly pea flower decoction should not be recommended as an antibacterial agent against E. coli, and future investigations

should focus on optimizing extraction parameters and testing fractions or purified compounds to better evaluate the plant's antimicrobial potential.

CONCLUSION

This study demonstrated that butterfly pea flower (Clitoria ternatea L.) decoction at concentrations of 40%, 50%, and 60% exhibited no inhibitory activity against Escherichia coli, as indicated by the absence of inhibition zones across all treatment groups. Despite the presence of phytochemicals such as flavonoids, saponins, and tannins, the aqueous boiling method used in this study did not extract sufficient antibacterial compounds to produce a measurable effect. The findings are consistent with the structural resistance of Gram-negative bacteria and the limited extraction efficiency of water for bioactive metabolites.

The results imply that the decoction form of C. ternatea, commonly used in traditional practices, is not suitable for antibacterial applications against E. coli. More effective extraction methods may be required to isolate the active constituents responsible for antimicrobial activity. Future studies are recommended to explore solvent-based extraction techniques, evaluate activity against Gram-positive bacteria, and investigate the stability and concentration of bioactive compounds under varying extraction conditions. These directions may provide a more comprehensive understanding of the plant's antibacterial potential and its relevance in natural-product development.

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