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PHYTOCHEMICAL PROFILING AND ANTICANCER POTENTIAL OF AN UNDEREXPLORED MEDICINAL PLANT FROM THE ACANTHACEAE FAMILY: IN VITRO AND IN SILICO EVALUATION AGAINST MCF-7 CELL LINES

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ABSTRACT

Cancer remains one of the leading causes of mortality worldwide, necessitating the exploration of safer and more effective therapeutic alternatives. Medicinal plants, particularly those belonging to the family Acanthaceae, are a promising source of bioactive phytochemicals with potential anticancer properties. This review focuses on the phytochemical profiling and evaluation of the anticancer activity of Ecbolium viride (Acanthaceae) against MCF-7 breast cancer cell lines using both in vitro and in silico approaches. Phytochemical investigations revealed the presence of flavonoids, alkaloids, terpenoids, and phenolic compounds. GC–MS analysis identified several bioactive constituents, notably beta-sitosterol, lupeol, and stigmasterol. The ethanolic leaf extract exhibited significant, dose-dependent inhibition of MCF-7 cell viability. Molecular docking studies demonstrated strong binding affinities of these phytoconstituents against breast cancer target proteins (3ERT, 1M17, and 1A28). Toxicity predictions suggested non-toxic and safe properties. Collectively, the evidence highlights Ecbolium viride as a promising source of anticancer compounds, warranting further research and development in cancer therapeutics.

KEYWORDS: Ecbolium viride, Acanthaceae, phytochemicals, anticancer, MCF-7, molecular docking.

INTRODUCTION

Cancer continues to be a major global health burden with breast cancer ranking among the most prevalent malignanciaes affecting women. Despite advances in treatment, challenges such as drug resistance, recurrence, and adverse effects remain significant. Hence, there is growing interest in plant- derived natural products as safer, cost-effective, and efficacious therapeutic alternatives. The Acanthaceae family, rich in diverse bioactive phytoconstituents, has attracted attention for its pharmacological potential. Among its members, Ecbolium viride has remained underexplored, with traditional usage hinting at medicinal value.

PHYTOCHEMICAL CONSTITUENTS OF ECBOLIUM VIRIDE

Phytochemical investigations have demonstrated the presence of flavonoids, alkaloids, terpenoids, phenolic compounds, and steroids in Ecbolium viride. GC–MS analysis revealed compounds including beta-sitosterol, stigmasterol, and lupeol, all of which are associated with anticancer properties. These phytoconstituents play crucial roles in regulating oxidative stress, apoptosis, and immune modulation.

ANTICANCER POTENTIAL – IN VITRO EVIDENCE

Ethanolic extracts of Ecbolium viride have shown cytotoxicity against MCF-7 breast cancer cell lines. The MTT assay revealed a dose-dependent inhibition of cancer cell proliferation, with an IC50 value of 61.24 g/mL. These results indicate significant antiproliferative effects, suggesting possible applications in breast cancer therapy.

IN SILICO EVALUATION

Molecular docking provided deeper mechanistic insights into the anticancer activity of Ecbolium viride phytoconstituents. Docking results demonstrated high binding affinity of beta-sitosterol, stigmasterol, and lupeol with breast cancer-related target proteins, including estrogen receptor (3ERT), epidermal growth factor receptor kinase (1M17), and caspase-3 (1A28). These interactions suggest potential modulation of apoptosis and cell proliferation pathways.

MECHANISMS OF ACTION

The anticancer potential of Ecbolium viride can be attributed to multiple mechanisms, including induction of apoptosis, inhibition of angiogenesis, cell cycle arrest, and modulation of signaling pathways such as PI3K/Akt and MAPK. The synergy between different phytochemicals enhances their pharmacological efficacy.

FUTURE PROSPECTS AND CHALLENGES

While the evidence underscores the therapeutic promise of Ecbolium viride, several challenges must be addressed. These include standardization of extracts, detailed mechanistic studies, and preclinical/clinical validation. Furthermore, in-depth pharmacokinetic and toxicological studies are required to ensure safety and efficacy before translation into therapeutic applications.

CONCLUSION

Ecbolium viride represents a rich source of bioactive phytoconstituents with significant anticancer potential. Both in vitro and in silico studies confirm its activity against MCF-7 breast cancer cell lines. Future research integrating molecular biology, pharmacology, and clinical trials could establish Ecbolium viride as a novel phytotherapeutic agent in oncology.