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Influence of *Tanacetum argyrophyllum* Essential Oil on ATPase Activity and Proton Flux of *E. coli* K-12, Kanamycin-Resistant *E. coli* pARG-25

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ABSTRACT

The growing prevalence of antibiotic-resistant bacteria necessitates the search for alternative antimicrobial agents. This study explores the antibacterial and antifungal properties of essential oil (EO) derived from *Tanacetum argyrophyllum* (*T. argyrophyllum*), a plant traditionally used in Armenian medicine. The EO was extracted via hydro-distillation, and its chemical composition was analyzed using GC-MS, identifying major constituents such as caryophyllene oxide, β-eudesmol, camphor, and terpinen-4-ol. Antimicrobial activity was evaluated against Gram-positive and Gram-negative bacteria, as well as yeast strains, using the disk diffusion method. The EO exhibited notable inhibitory effects, particularly against *Escherichia coli* K-12, kanamycin-resistant *E. coli* pARG-25. Treatment with the EO reduced bacterial viability, leading to a 30% decrease in colony-forming units for both *E. coli* strains, while their specific growth rates declined by approximately 50% and 60%, respectively. Additionally, the EO affected membrane-associated functions, including proton (H^+) flux and ATPase activity, in both resistant and non-resistant *E. coli* strains. In the control strain, the EO inhibited total H^+ flux—especially the DCCD-sensitive component—by 4.5-fold. In the pARG-25 strain, DCCD-sensitive H^+ flux was reduced by 1.7-fold. Correspondingly, ATPase activity, particularly its DCCD-sensitive fraction, decreased 1.5-fold in both strains. These studies indicate that *T. argyrophyllum* EO may disrupt bacterial proton transport and ATP synthesis, underscoring its potential as a natural antimicrobial agent, especially against drug-resistant pathogens.

Keywords: kanamycin-resistant *E. coli*, antibacterial activity, proton flux, ATPase activity, colony forming unit, specific growth rate, DCCD-sensitive flux, DCCD-sensitive ATPase

References:

1. Gevorgyan, H.; Trchounian, A.; Trchounian, K. Formate and Potassium Ions Affect *Escherichia coli* Proton ATPase Activity at Low pH During Mixed Carbon Fermentation. *IUBMB Life* **2020**, *72*, 915–921. DOI:10.1002/iub.2219
2. Nazzaro, F.; Fratianni, F.; De Martino, L.; et al. Effect of Essential Oils on Pathogenic Bacteria. *Pharmaceuticals* **2013**, *6*, 1451–1474. DOI:10.3390/ph6121451
3. Paronikyan, A.E.; Eliazyan, G.A.; Nanagulyan, S.G.; et al. Biodeteriorations of the Manuscript Fund of Matenadaran and Its Conservation with Herbal Biocides. *Electron. J. Nat. Sci.* **2015**, *25*, 16–19.
4. Sahakyan, N.; Petrosyan, M.; Trchounian, A. The Activity of *Alkanna* Species in vitro Culture and Intact Plant Extracts Against Antibiotic Resistant Bacteria. *Curr. Pharm. Des.* **2019**, *25*, 1861–1865. DOI:10.2174/1381612825666190716112510

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