Observation of efflux pump inhibition activity of naringenin, quercetin, and umbelliferone on some multidrug-resistant microorganisms

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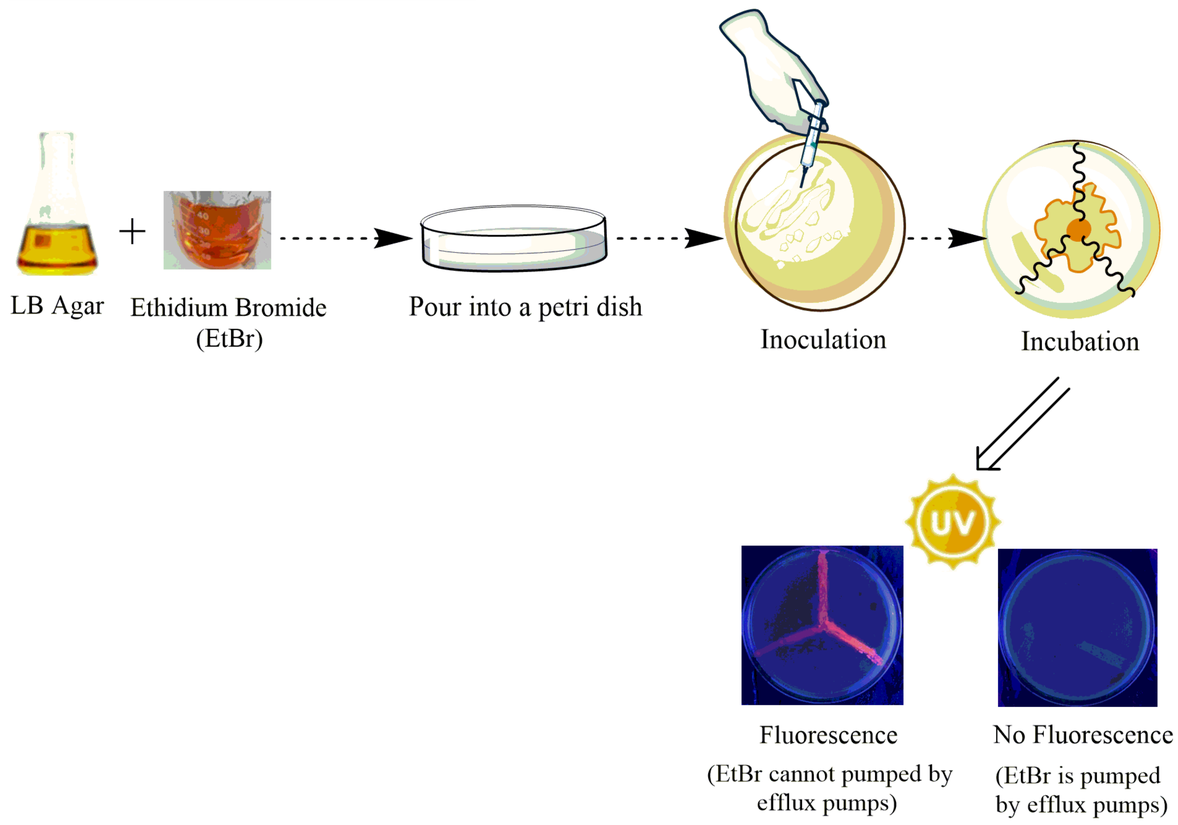
Abstract

Microorganisms affect every aspect of our lives. Especially pathogenic and resistant microorganisms are microorganisms that prevent us from living a healthy life. As a result of the unnecessary use of antibiotics, bacterial resistance has emerged. One of the bacterial resistance mechanisms is efflux pumps. In this *in vitro* study, it was aimed to observe the inhibition of the efflux pumps by testing 3 compounds on a total of 8 strains, including *Klebsiella pneumoniae, Providencia rustigianii, Shigella flexneri*, 4 clinically isolated *Escherichia coli*, and *E. coli* ATCC 25922 having active efflux pumps. The plant derived compounds used were naringenin, quercetin and umbelliferone. Cartwheel method was applied by using MIC/2 concentrations of the compounds. At the end of the test, UV light was used to observe the efflux pump inhibition activities of phytochemicals. According to the results of the study; the efflux pump inhibition activity was observed only for naringenin. A further study is recommended to determine the interaction mechanisms of naringenin with specific efflux pump families.

Graphical Abstract

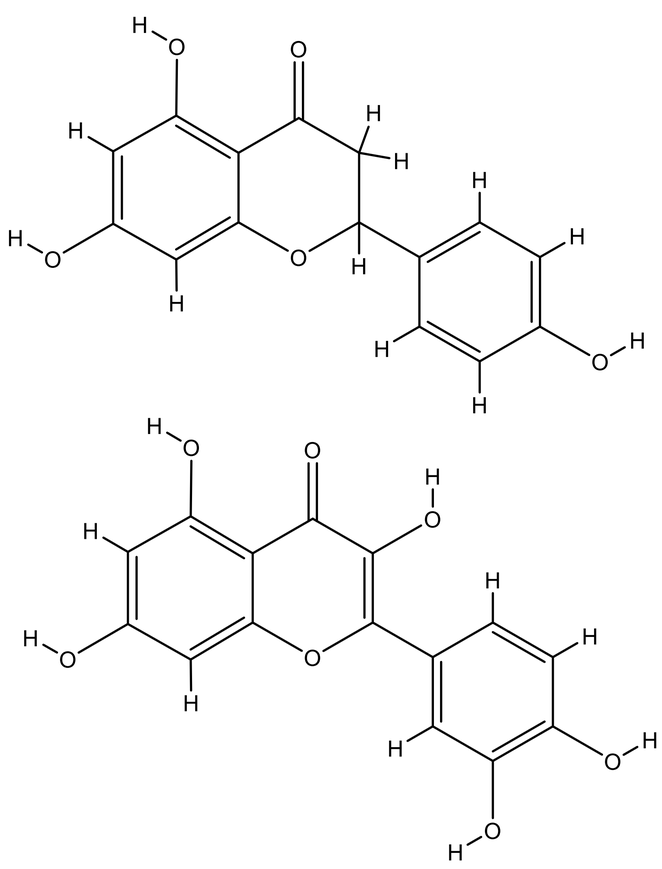


Introduction

Infectious diseases have been going on for many years and can result in death [1]. Antibiotics have been used to cure infectious diseases. The drugs used have gained resistance to microorganisms over time and have reduced or destroyed the effectiveness of the drug. Efflux pumps are one of these resistance mechanisms and are very important.

Efflux pumps are known as important transport proteins that allow toxic substances to be thrown from inside the cell to the outside of the cell. These pumps are also found in all cells, prokaryotic and eukaryotic [2]. The 5 most defined classes of efflux pump families are: Master Facilitator (MF), Multi-Drug and Toxic Compound Extrusion (MATE), Resistance-Nodulation-Fission (RND), Small Multi-Drug Resistance (SMR), and ATP Binding Cassette (ABC) [3].

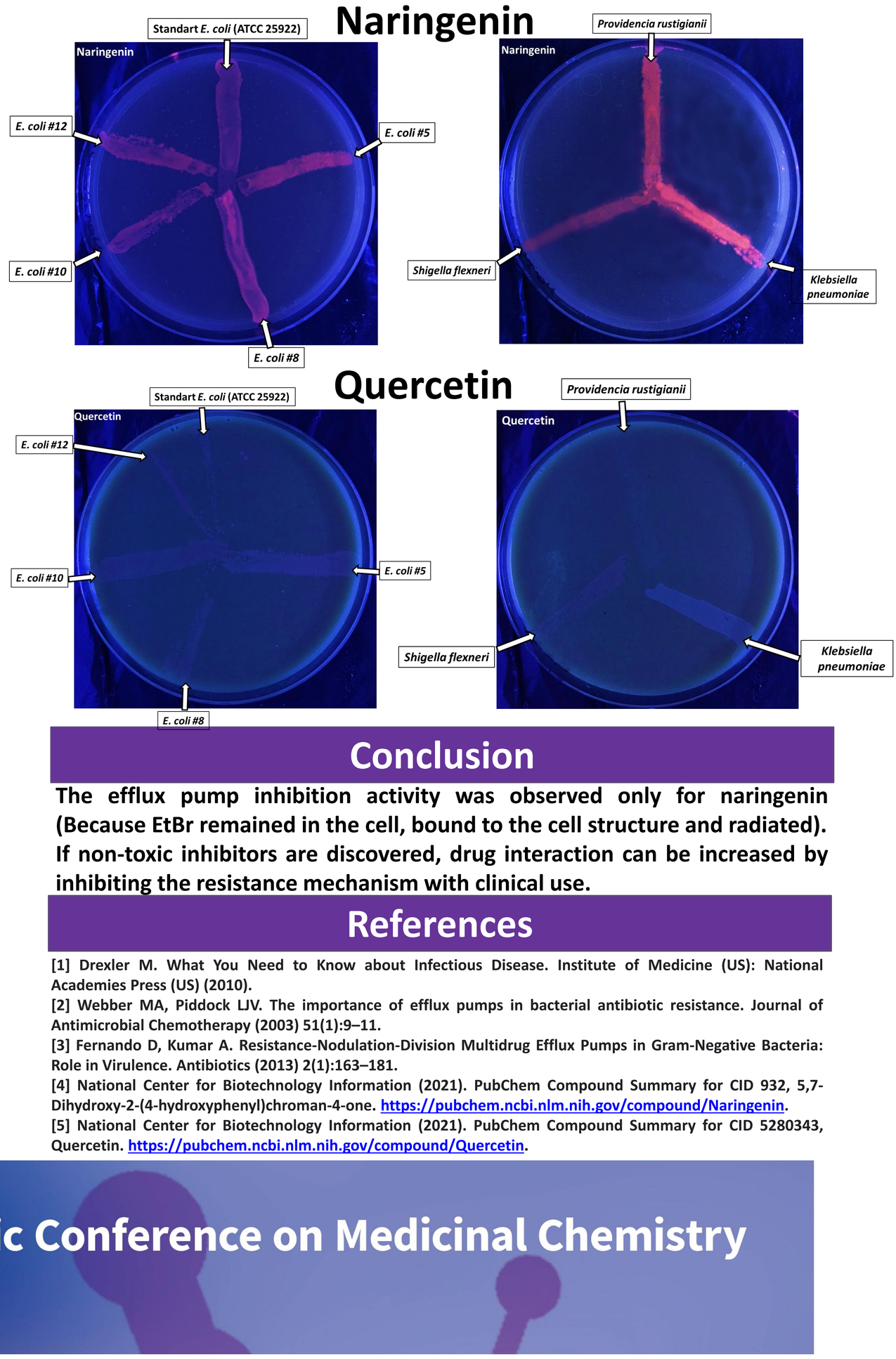
The chemical structures of naringenin and quercetin, which were tested as inhibitors in the study, are given below.



Naringenin 2D Structure [4]

Quercetin 2D Structure [5]

Results



Conclusion

The efflux pump inhibition activity was observed only for naringenin (Because EtBr remained in the cell, bound to the cell structure and radiated). If non-toxic inhibitors are discovered, drug interaction can be increased by inhibiting the resistance mechanism with clinical use.

References

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[5] National Center for Biotechnology Information (2021). PubChem Compound Summary for CID 5280343, Quercetin. https://pubchem.ncbi.nlm.nih.gov/compound/Quercetin.

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