DOI: 10.46991/JISEES.2025.SI1.011

Antibiotic Activity of Plant Metabolites and Possibilities of Their Application

Aram Aramyan[1*], Silvard Tadevosyan[1,2], Alvard Minasyan[1,2], Anush Babayan[1,2], Naira Sahakyan[1,2]

[1] Research Institute of Biology, Faculty of Biology, Yerevan State University, Yerevan, Armenia
[2] Department of Biochemistry, Microbiology & Biotechnology, Faculty of Biology, Yerevan State University, Yerevan, Armenia

ABSTRACT

The growing evidences of antibiotic-resistance requires the search for new alternatives to already known antimicrobial agents. In this study we aimed to investigate the antibacterial potential of four known natural flavonoids (catechin, gallic acid, rutin and quercetin) and one sugar alcohol – *myo*-inositol. These metabolites are abundant in the extracts of plants used in Armenian folk medicine. The applied bacterial strains were different gram-negative and gram- positive bacteria: *Escherichia coli* K12, ampicillin-resistant *E. coli* DH5a-pUC18, kanamycin- resistant *E. coli* pARG25, *Salmonella typhimurium* MDC 1754, *Bacillus subtilis* WT-A1 and *Staphylococcus aureus* MDC 5233. The disc-diffusion method was employed to assess the preliminary antimicrobial activity. Catechin, gallic acid, and quercetin exhibited no inhibitory effect on any tested bacteria in this test. In contrast, *myo*-inositol formed bacterial growth inhibition zones ranging in size: 7.0-9.0 mm in case of *E. coli* K12, 11.0-18.0 mm for *B. subtilis*, and 12.0-21.0 mm for *S. aureus*, while rutin exhibited inhibition zones of 12.0-15.0 mm in case of *B. subtilis* and 15.0-16.0 mm – *S. aureus*. MTT-assay was performed to evaluate bacterial susceptibility to antibiotics after the treatment with plant metabolites. The results indicated that catechin and inositol had no significant antibacterial effect on kanamycin-resistant *E. coli*, while gallic acid, rutin, and inositol showed no effect on ampicillin-resistant *E. coli*. However, the quercetin (0.25 mg/mL) reduced the MIC of kanamycin for *E. coli* pARG25 fourfold, and the MIC of ampicillin for *E. coli* DH5a-pUC18 halved under the influence of quercetin (0.25 mg/mL). Similarly, gallic acid and rutin each reduced the MIC of kanamycin for *E. coli* pARG25 twofold, and catechin reduced the MIC of ampicillin for *E. coli* DH5a-pUC18 twofold. Our results indicate the potential of flavonoid-based antibacterial agents. Warranting further research to explain their mechanisms of action and potential clinical applications.

Keywords: flavonoids, antibiotic-resistant bacteria, antibacterial activity, *Escherichia coli*

References:

1. Sahakyan, N.; Bartoszek, A.; Jacob, C.; et al. Bioavailability of Tannins and Other Oligomeric Polyphenols: a Still to Be Studied Phenomenon. *Curr. Pharmacol. Rep*. **2020**, *6*, 131–136. DOI:10.1007/s40495-020-00217-6
2. Ginovyan, M.; Tadevosyan, S.; Shirvanyan, A.; et al. The potential of blackcurrant, fig, and grape leaf extracts in the development of new preparations for overcoming antibiotic resistance and enhancing the efficacy of chemotherapeutic agents. *BMC Complement Med Ther.* **2025**, *25*, 148. DOI:10.1186/s12906-025-04859-1
3. Jomova, K.; Alomar, S.Y.; Valko, R.; Liska, J.; Nepovimova, E.; Kuca, K.; et al. Flavonoids and their role in oxidative stress, inflammation, and human diseases. *Chem. Biol. Interact.* **2025**, *413,* 111489. DOI:10.1016/j.cbi.2025.111489
4. Tarabishi, A.A.; Mashhoud, J.; Tahan, Z.S.; Quercetin and rutin as a dual approach to antibacterial and anti-biofilm activity via iron chelation mechanism. *Discover Food* **2024**, *4*, 189. DOI:10.1007/s44187-024-00265-7

[*]Corresponding Author:

Aram Aramyan, Research Institute of Biology, Faculty of Biology, Yerevan State University, 1 Alex Manoogian str.,Yerevan, 0025, Armenia.
Email: aram_aramyan@ysu.am