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# Counteract antimicrobial resistance with Essential Oils from Sicilian citrus by-products

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**Background.** Antimicrobial resistance (AMR) is a major threat to global Public Health, caused by microorganisms' ability to survive antimicrobial drugs [1]. Excessive and sometimes inappropriate use of antibiotics in medical and agricultural settings undermines therapies effectiveness and increases morbidity and mortality. Alternative or adjunctive strategies are under investigation, including natural compounds such as Essential Oils (EOs). Lately, EOs attracted a lot of interest due to their broad biological activity and mechanisms of action, such as destabilization of bacterial cell membranes, and interference with metabolism [2-3]. Valorization of agro-food products offers a sustainable source of bioactive compounds with low environmental impact. This study evaluates the antibacterial activity of EOs extracted from the peels of four citrus fruits grown in Sicily, namely sweet blond orange, tangerine, lemon and bergamot.

**Material And Methods.** Four EOs were tested: lemon, bergamot, yellow tangerine, and sweet blond orange. Their antimicrobial activity was assessed against selected Gram-negative (Escherichia coli, Pseudomonas aeruginosa, and Klebsiella pneumoniae) and Gram-positive (Staphylococcus aureus, Staphylococcus haemolyticus, and Micrococcus luteus) strains of clinical interest. This activity was evaluated by Kirby-Bauer disk diffusion method, broth dilution to determine the Minimum Inhibitory Concentration (MIC) over a concentration range of 1–20% (v/v), and spectrophotometric reading followed by agar plating to determine the Minimal Bactericidal Concentration (MBC).

**Results.** All tested EOs exhibited significant antimicrobial activity exclusively against Gram-positive bacteria. A 20% concentration (v/v) was identified as the MIC value, which fully inhibited microbial growth; at this same concentration, the initial inoculum was reduced by more than 99%, confirming also its bactericidal effect (MBC). Lower concentrations showed a dose-dependent response.

**Conclusions.** Our results assess the potential antibacterial activity of EOs from Sicilian citrus by-products, showing promising activity against Gram-positive pathogens. This efficacy may be due to the greater permeability of Gram-positive cell membranes to lipophilic components of EOs. Currently confined only to experimental studies, EOs require further research to extend their therapeutic and applicative prospects. Further studies will extend this testing to additional bacterial strains while investigating the molecular mechanisms, safety and potential synergy between EOs and conventional antibiotics.

**References.** Tang KWK, Millar BC, Moore JE. Antimicrobial Resistance (AMR). Br J Biomed Sci. 2023 Jun 28; 80:11387. de Sousa DP, Damasceno ROS, Amorati R, Elshabrawy HA, de Castro RD, Bezerra DP, Nunes VRV, Gomes RC, Lima TC. Essential oils: chemistry and pharmacological activities. Biomolecules 2023; 13:1144. Noui Mehidi I, Ait Ouazzou A, Tachoua W, Hosni K. Investigating the antimicrobial properties of essential oil constituents and their mode of action. Molecules 2024; 29:4119.