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THE ANTIMICROBIAL POTENTIAL OF *CITRUS SINENSIS* ESSENTIAL OIL *IN VITRO* AND *IN SITU*

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Abstract: *The aim of our research was to observe the antibacterial activity of red orange (Citrus sinensis) EO in situ via vapor phase and in vitro using the disc diffusion method. In addition to the antimicrobial activity, the antibiotic activity against five plant diseased bacteria was also monitored. The results of our analyses showed that the disk diffusion approach and vapor phase were the most effective antibacterial strategies against Pectobacterium carotovarum.*

• Introduction

Natural antibiotic resistance has increased as a result of the overuse of antibiotics in both humans and animals. A promising solution to this worldwide issue can be found in natural resources, particularly in essential oils (EOs). The use of natural and organic molecules in food has become increasingly important because they are less expensive, more ecologically friendly, and have fewer negative health consequences than non-organic synthetic compounds. The goal of this study was to evaluate the antimicrobial potential of Citrus sinensis against five plant bacteria using the disc diffusion method, minimal inhibition concentration, and vapor phase on a carrot model.

• Material and method

The EO utilized in this study was produced by cold-pressing fresh pericarp of *Citrus sinensis* red oranges from Hanus s.r.o. in Nitra, Slovakia (CSEO). To assess the antibacterial activity were utilized Gram-positive (G+) bacteria such as *Bacillus subtilis* CCM 2217, *Priestia* (*Bacillus*) *megaterium* CCM 2007, and Gram-negative (G-) bacteria including *Xanthomonas arboricola* CCM 1441, *Pectobacterium carotovarum* CCM 1008, and *Pseudomonas putida* CCM 7156. The disk diffusion susceptibility experiment utilized the microbial strains previously reported. Mueller Hinton Agar. *In situ* testing was conducted to evaluate the antimicrobial efficacy of CSEO against a variety of bacterial species, including both Gram-positive G+ and G- bacteria. Carrots were chosen as a popular vegetable substrate to promote bacterial growth.

• Results and discussions

The inhibitory zones in the study ranged in length from 3.33 to 9.33 mm. The largest inhibitory zone (7.33 mm) against *P. megaterium* was found in G+ bacteria, with *B. subtilis* following closely behind (3.33 mm). Conversely, when it came to *P. carotovorum* (9.33 mm), CSEO was most effective against G- bacteria. The G+ and G- bacteria that proliferate on carrots were used to assess the efficacy of CSEO. Through analysis of the inhibitory effects on G+ bacterial strains in the carrot model, it was observed that CSEO was most effective against *P. megaterium* at 125 µg/mL (75.98%), whereas *B. subtilis* showed the highest levels of suppression at 62.5 µg/mL (54.15%). Interestingly, the vapor phase of CSEO had the most effectiveness against G- bacteria at the lower dosage (62.5 µg/L), with reported inhibitory effects of 94.63% against *P. carotovorum* in the carrot model.

• Conclusions

This study suggests that *Citrus sinensis* fresh pericarp can be extracted with EO and used as a natural antibacterial agent in the food industry. It was also interesting to assess the antibacterial efficiency of *Citrus sinensis* against relevant illnesses. To maximize the potential of *Citrus sinensis* EO as a natural alternative to artificial preservatives, more research using a variety of food types and storage conditions is recommended.

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