

## **Comparison of the antibacterial activity between essential oils of *Citrus crenatifolia* and *Citrus sinensis* against *Staphylococcus aureus*, *Bacillus cereus* and *Escherichia coli***

W.A.H.C.B. Weerakoon<sup>1,2\*</sup>, W.A.D.L. Wettasinghe<sup>1,2</sup>, C.I. Amarasekara<sup>1,2</sup>,  
S.S. Denagamage<sup>1,2</sup>, V. Udalamaththa<sup>2</sup>, & S.R. Karunarathne<sup>2</sup>

<sup>1</sup>*School of Applied Sciences, Edinburgh Napier University, Scotland, UK*

<sup>2</sup>*Spectrum Institute of Science & Technology, Colombo 06, Sri Lanka*

**\*Corresponding author:** [e20hansa@mysist.com](mailto:e20hansa@mysist.com)

### **Abstract**

The emergence of antimicrobial resistance and the frequent side effects of antibiotics has become a major global health concern. To combat this, natural plant-based products are considered to play a key role. This study aimed to determine the antibacterial activity of *Citrus crenatifolia* and *Citrus sinensis* essential oils and to investigate the synergism or antagonism of their combinations against *Staphylococcus aureus*, *Bacillus cereus*, and *Escherichia coli* bacterial species. The leaves of *C. crenatifolia* and *C. sinensis*, collected from Yakkaduwa Herbal Garden, were cut into small pieces and subjected to hydrodistillation using a Clevenger-type apparatus. The Kirby-Bauer Disk Diffusion method was used to test the antimicrobial susceptibility of pure essential oils of the two citrus plants and their combination (1:1 ratio). As positive controls, 0.1mg/mL for *B. cereus* and 0.01mg/mL of Amoxicillin for *S. aureus* and *E. coli* were used. According to the results, *C. crenatifolia* demonstrated statistically significant results against *B. cereus* ( $p = 0.0072974$  vs *S. aureus* and  $p = 0.042552$  vs *E. coli*). *E. coli* was the most susceptible bacterial strain for *C. sinensis* and the *C. crenatifolia* – *C. sinensis* combination. These could be due to the interaction of various bioactive compounds binding specifically to different cellular targets in the bacterial cell wall and possible synergistic or antagonistic effects. *S. aureus* was the least susceptible bacterial strain except for *C. sinensis* indicating antibacterial resistance. In conclusion, all three bacterial strains were susceptible to *C. crenatifolia*, and the combination was most effective against *E. coli* compared to Amoxicillin.

**Keywords:** *Antibacterial activity, Citrus crenatifolia, Citrus plants, Citrus sinensis, Essential oils*