Development of Nano-Biopesticides from Mature Mango Leaf and Rambutan Peel Extracts for the Inhibition of *Xanthomonas* sp., the Causal Agent of Citrus Canker in 'Tubtim Siam' Pomelo

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Abstract

'Tubtim Siam' pomelo is a Geographical Indication (GI) product and a major export commodity of Nakhon Si Thammarat Province. Growers currently face citrus canker caused by *Xanthomonas axonopodis*, which produces lesions on the fruit surface and reduces market value. The current control strategies rely on repeated applications of copper-based compounds, leading to pathogen resistance and chemical residue accumulation. This study compared the antibacterial activity of mature mango leaf extract, rambutan peel extract, their combination, and silver nanoparticles synthesized from the most effective extract against *Xanthomonas* sp. Antibacterial activity was evaluated using the disc diffusion method, while the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) were determined. Rambutan peel extract at 50 mg/ml exhibited the highest antibacterial activity, with a statistically significant difference at the 0.05 level, producing an inhibition zone of 11.76 ± 0.02 mm. The MIC and MBC values were 6.25 mg/ml and >50 mg/ml, respectively. The combination of mature mango leaf and rambutan peel extracts at a 2:1 ratio showed the highest antibacterial activity among the combinations, producing an inhibition zone of 6.18 ± 0.02 mm ($p < 0.05$). Biogenic silver nanoparticles synthesized from rambutan peel extract exhibited the strongest antibacterial activity, producing an inhibition zone of 15.70 ± 0.02 mm. The MIC decreased to 0.3125 mg/ml, while the MBC was >20 mg/ml. These findings suggest that plant-derived biogenic silver nanoparticles provide an environmentally friendly alternative to copper-based compounds for controlling citrus canker in pomelo orchards.

Keywords: Canker disease**,** Mangiferin, Phenolic compounds, Silver Nanoparticles