

Antibacterial Activity of *Apis Mellifera* and *Vespula Vulgaris* Venom against Selected Antibiotic – Resistant Pathogens

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Abstract

Objective: The increasing prevalence of antibacterial resistance has necessitated the search for novel antibacterial agents. This study aims to determine the antimicrobial activity of *Apis mellifera* and *Vespula vulgaris* venom against *Staphylococcus aureus*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*. The objectives were to determine the physicochemical properties, antibacterial activity, synergistic effects, Minimum Inhibitory Concentration (MIC), Minimum Bactericidal Concentration (MBC), time-kill assay, and safety of the venoms.

Methodology: Venom was collected from *Apis mellifera* (African Killer Bees) and *Vespula vulgaris* (yellowjacket wasps) using electric impulses. The venom was purified through a multi-step procedure including dissolving, centrifugation, filtration, column chromatography, and high-performance liquid chromatography.

Results: The study revealed that both venoms exhibited distinct physio-chemical characteristics, with *Apis mellifera* venom being colorless, transparent, and odorless with a pH of 4.5, while *Vespula vulgaris* venom was light yellowish/beige with a pH of 5 and a light odor. Both venoms showed varying levels of antibacterial potency against *S. aureus*, *K. pneumoniae*, and *P. aeruginosa*, with *Apis mellifera* venom showing higher activity. The MIC and MBC values for *Apis mellifera* venom were 12.5–25 µg/mL and 50–100 µg/mL, respectively, while *Vespula vulgaris* venom had MIC values of 12.5–50 µg/mL and MBC values of 50–100 µg/mL. The combination of venoms showed significant increased activity against the bacteria isolates, with a p-value of 0.000282. Time-kill assays demonstrated potent bactericidal activity, with *Apis mellifera* venom inhibiting the growth of *S. aureus* by 99.99%, *K. pneumoniae* by 99.8%, and *P. aeruginosa* by 94.06%, while *Vespula vulgaris* venom inhibited the growth of *S. aureus* by 99.99%, *K. pneumoniae* by 92.73%, and *P. aeruginosa* by 90.55%. HPLC analysis revealed distinct active component profiles for each venom, with *Apis mellifera* venom containing Apamine, Phospholipase A, and Melittin, and *Vespula vulgaris* venom containing Antigen 5, Phospholipase A (PLA), and Mastoparan. Biochemical parameters showed significant changes in liver and kidney function tests and inflammation markers, and the estimated LD₅₀ for the synergy group was approximately 0.063 mg/kg, with dose-dependent toxicity and histopathological effects observed in the kidney and liver.

Conclusion: The study provides valuable insights into the physio-chemical properties, antibacterial activity, and acute toxicity of *Apis mellifera* and *Vespula vulgaris* venom, highlighting their potential as natural antimicrobial agents.