

CURE OR POISON? QUANTIFICATION OF HEAVY METALS AND MICROPLASTICS IN THAI BEE PROPOLIS

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Abstract

Environmental pollution has become a global issue, with contaminants such as heavy metals and microplastics (MPs) entering ecosystems and food chains. These pollutants accumulate in air, soil, water, and plants, and can even be detected in bee products, raising concerns for pollinator health and human consumers. Among these products, propolis is a resinous hive material collected by foraging bees from several plant species and is well-known for its antimicrobial, antioxidant, and immunomodulatory properties. Propolis reflects the environmental conditions of the habitats where bees forage, making it an important topic for both health-related and ecological research. Our study aimed to assess heavy metal content (cadmium, Cd, and lead, Pb) in propolis of the western honey bee (*Apis mellifera*) and stingless bee (*Tetragonula pagdeni*) collected from different regions of Thailand. MPs were identified using a stereomicroscope and a micro-Fourier transform infrared (FTIR) spectroscopy. Additionally, the biological activities of propolis, including total phenolic content (TPC), total flavonoid content (TFC), and antioxidant activity (EC₅₀) were analyzed. The results showed that Cd and Pb were below the limit of detection (LOD = 0.0019 and 0.0344 mg/mL, respectively) in all samples, whereas polypropylene (PP) fiber and polyethylene (PE) fragment MPs were observed with a primarily blue color. Propolis exhibited wide variation in TPC (18.33 ± 1.36 to 116.56 ± 5.83 mg GAE/g), TFC (4.68 ± 0.10 to 113.63 ± 5.86 mg QE/g), and EC₅₀ (30.61 ± 0.43 to 1.01 ± 0.11 mg/mL). These findings demonstrate that propolis remains a valuable natural product with strong bioactive properties. At the same time, its contamination with microplastics highlights its role as a bioindicator of pollution, making it an excellent tool for addressing concerns of environmental contamination, pollinator decline, and food safety.