



Paper ID: NSALS '26-074 (Oral)

Detecting Microplastic's Bioaccumulation in Red Earthworm *Eisenia fetida* (Savigny, 1826) via FTIR Assay

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Microplastics (MPs) are smaller than 5 mm in size and recognized as emerging persistent pollutants in agro-ecosystems through leaked sewage sludge, plastic mulching, and compost. The effects of MPs on earthworms remain inadequately understood. This study investigates the bioaccumulation of MPs and their effects on *Eisenia fetida* using Fourier Transform Infrared (FTIR) assay. Twelve 10 kg capacity bins, each containing 2 kg of cow dung slurry and 1 kg teak leaves (2:1) were used for the experiment. Four treatments were established: T1 (control, without MPs), T2 (5 g MPs), T3 (10 g) and T4 (50 g) respectively. A total of 100 earthworms were carefully weighted and released into each treatment. The treatments were arranged in completely randomized design. Collected data were subjected to ANOVA and Duncan's multiple range test for mean separation using SAS 9.4 version. Weight of earthworms were recorded every 14 days for 45 days. Earthworms' samples 5% were collected from each treatment and subjected to FTIR analysis to quantify the bioaccumulated MPs. The initial mean weight across the treatment was 2.15 ± 0.10 mg. After 45 days, control group showed significantly increased biomass of $130 \pm 0.06\%$ (2.81 ± 0.08 mg), whereas in T2 (5 g MPs) showed biomass decrease of $13 \pm 0.09\%$ (1.89 ± 0.11 mg) at $P < 0.05$. In contrast, highly significant weight loss occurred in T3 (10 g) and T4 (50 g) treatments, with average biomass loss of $25 \pm 1.09\%$ and $35 \pm 0.79\%$, respectively, in comparison to initial body weight at $P < 0.05$. Further, MPs reduced composting efficiency by extended composting period. The FTIR analysis showed similar absorption peaks centered at approximately 720/cm and 1460/cm, suggesting a predominance of polyethylene like polymeric compounds. T1 showed very weak peaks, suggesting minimal or no polymer presence in the gut while T2 and T3 exhibited moderate peaks, indicating uptake and retention of MPs. T4 showed highest absorbance values, reflecting greater MPs accumulation in gut samples. This study highlights the ecological risk of microplastics in soil ecosystems and suggests the need for regulating plastic waste disposal and monitoring compost input to ensure sustainable vermicomposting.

Keywords: Bioaccumulation; earthworms; *Eisenia fetida*; microplastics; vermicompost