# ANTicipate: Engineering a Camponotus Enzyme-Functionalized Aerobic Microbe for Simultaneous CO2 Mitigation and Fertile Compost Production From MSW Landfill Food Waste

Nagendra, Ananya (School: Plano East Senior High School)

Food waste accounts for 58% of methane emissions from municipal solid waste landfills (MSWLF), one of the top three sources of greenhouse gas emissions globally. Over 96% of MSWLFs lack decomposition mechanisms due to high replacement asset values, digestate leaks, labor intensity, and SO2/NO2 pollution from conventional digesters. To address this, research developed ANTicipate, a novel bio-hybrid system engineering a Camponotus enzyme-functionalized aerobic microbe for food waste decomposition. Per the Journal of Animal Ecology, ants perform over 61% of scavenging worldwide, making them a natural substrate for food waste decomposition. Last year, four ant genera were microdosed with food waste, metabolic rates tested via allometric scaling and Warburg respirometry, and methane reduction modeled. This year, Camponotus enzymes were extracted via PBS homogenization, quantified via Bradford assay, and confirmed via DNS amylase assay, then surface-conjugated onto Bacillus subtilis using EDC/NHS crosslinking and verified via wash supernatant binding efficiency. COD assays across three groups — enzyme alone, microbe alone, and conjugate — confirmed synergistic activity via one-way ANOVA and Tukey HSD ($p < 0.05$). A paired t-test confirmed significantly lower CO2 emissions versus control ($p < 0.05$), with time-series analysis demonstrating 97.14% CO2 reduction validated by 99% CI. All compost parameters met benchmarks: 12:1 C:N ratio, pH 6.5, 3/8–1 inch particle size, 74°C incubation, 13.98 ppm phosphorus, and 640 ppm potassium, confirmed via VIS-NIR spectrometry and mechanical sieve analysis. ANTicipate establishes the first-of-its-kind Camponotus enzyme-functionalized aerobic microbe, capable of 97.14% CO2 reduction while sequestering carbon into fertile compost.

**Awards Won:**
Fourth Award of $600