Sustainable Recovery of Critical Metals from PCBs via Integrated Bioleaching

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Introduction

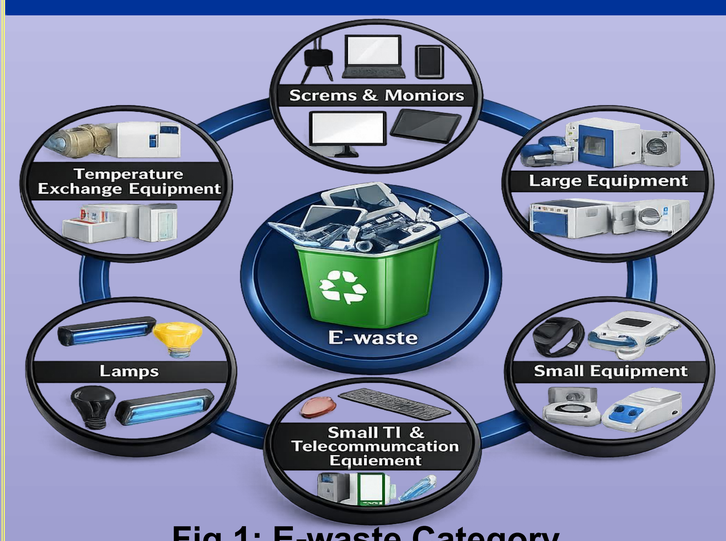


Fig.1: E-waste Category

- Rapid electronic usage has increased global e-waste generation.
- Informal recycling causes pollution and health risks.
- PCBs contain valuable metals like Cu, Ag, Au, and Pt.
- Conventional recovery methods are costly and environmentally hazardous.
- Bioleaching is a sustainable microbial metal recovery method.
- Bioleaching reduces chemical use, pollution, and energy demand.
- Existing bioleaching LCA studies lack experimental validation.
- This study evaluates three novel bacterial strains and their environmental impacts using LCA.

Materials & Methods

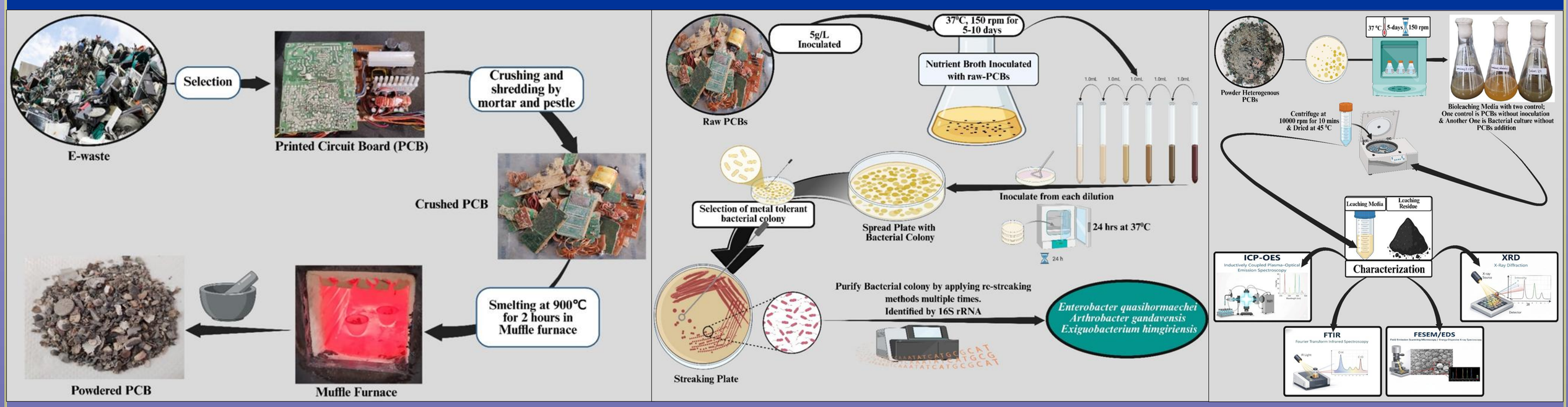
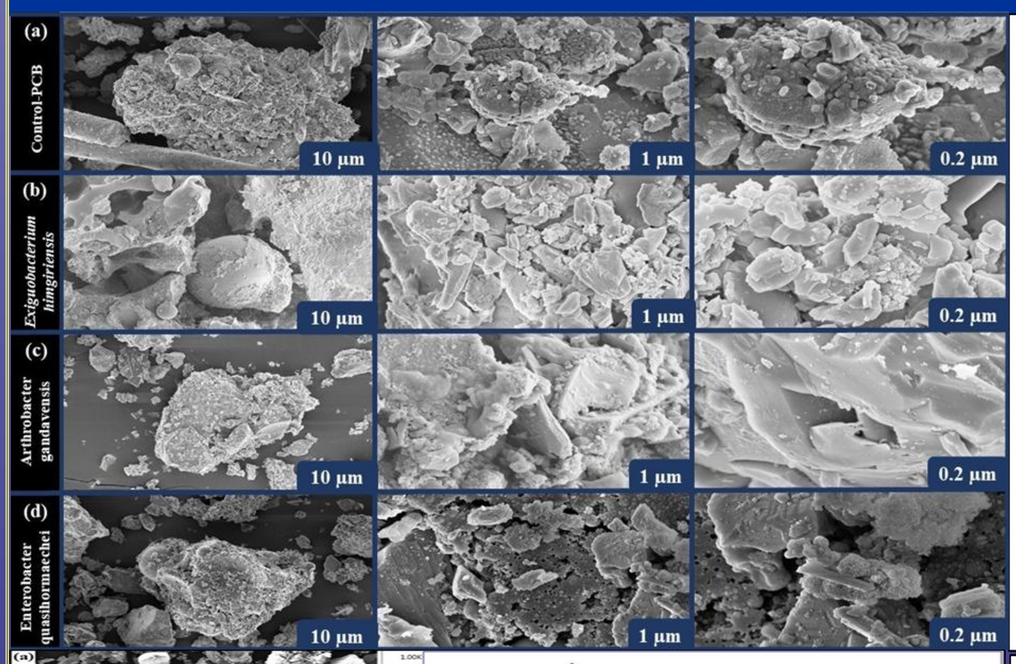
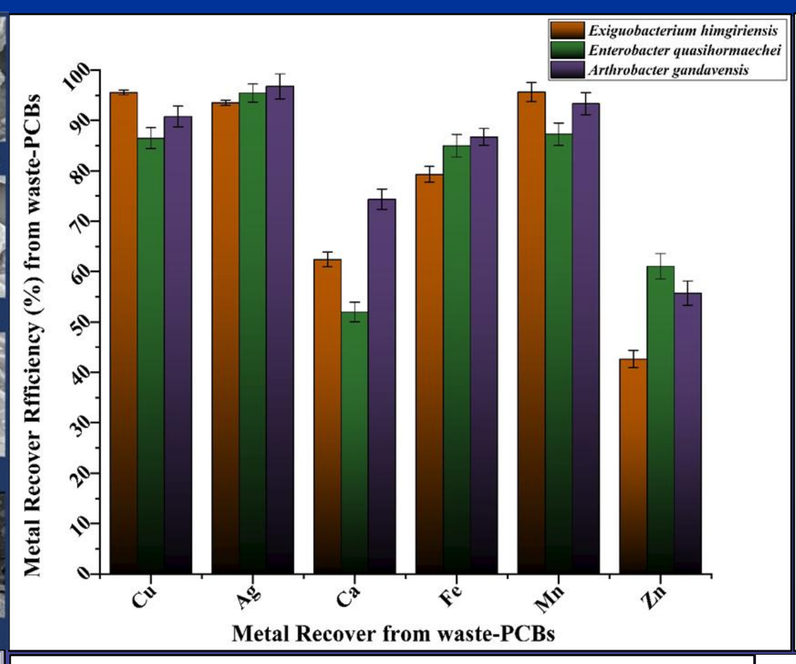
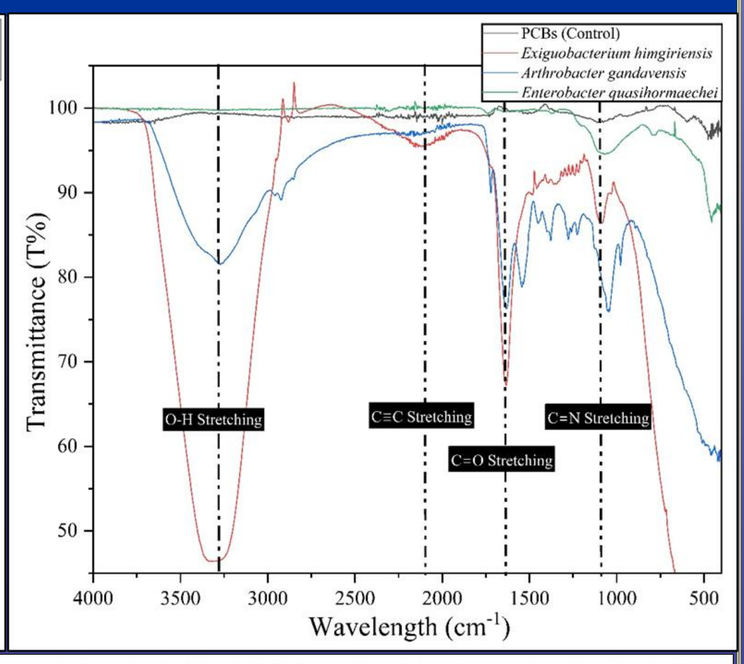


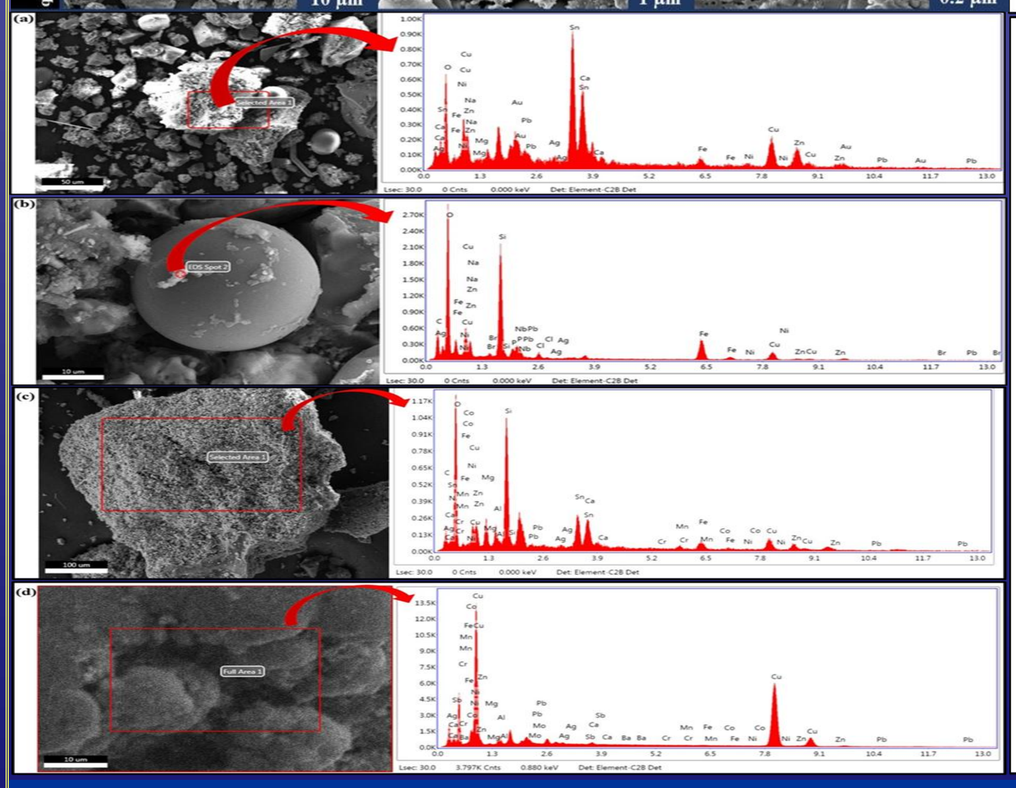
Fig.2: Isolation of bacterial strains and bioleaching process

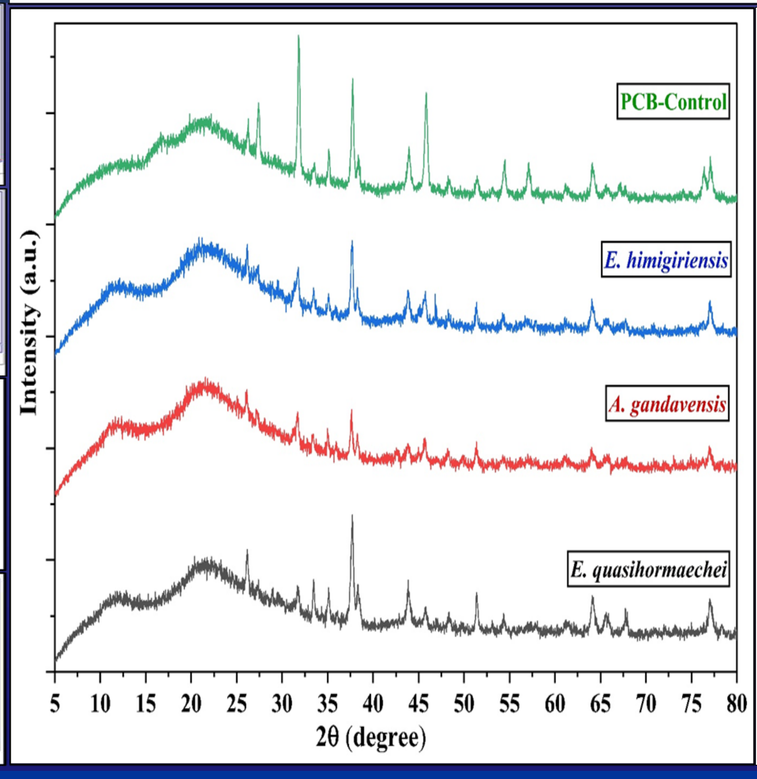
Results & Discussion











Conclusions

- Novel bacterial strains were isolated from PCBs waste.
- *Arthrobacter gandavensis* showed highest multi-metal recovery.
- *Exiguobacterium himgiriensis* achieved maximum Cu recovery.
- High Cu and Ag recovery occurred without toxic chemicals.
- FT-IR confirmed acidolysis and complexolysis mechanisms.
- FE-SEM/EDS and XRD showed surface and phase changes after bioleaching.
- Bioleaching is environmentally sustainable compared to conventional methods.
- Major impacts included human toxicity, marine ecotoxicity, and global warming.

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