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sciforum-114299: Meat Processing Wastewater Valorised through Microalgae Production

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The treatment of meat processing wastewater (MPWW) is crucial to mitigating its environmental impact but remains challenging due to its high organic content and contents of nitrogen and solids.

The novelty of this work lies in evaluating the treatment and valorization of real MPWW with variable composition, as well as the process scalability, in a fed-batch raceway reactor while exploring the synergistic microbial interactions within the system. A microalgae-based consortium with proven bioremediation capacity was used as biomass. In batch assays, the microalgae-based biomass thrived in raw MPWW, demonstrating synergistic interactions with the native wastewater microbiome that facilitated organic carbon and total nitrogen removal. In sieved and sedimented MPWW, the COD removal rates were higher (1097.5±22.2 mg L^{-1} day^{-1}) than in raw MPWW (828.5±60.5 mg L^{-1} day^{-1}), and the microalgae growth rate also improved. In a laboratory-scale raceway reactor, in fed-batch mode, COD removal rates ranging from 181.3 to 806.3 mg L^{-1} day^{-1} were achieved, despite variable wastewater composition. The nitrogen mass balance indicated that ammonium, nitrate, and nitrite were consumed. The increase in photosynthetic pigments' concentration throughout operation, from 0.4 to 17.9 µg mL^{-1}, demonstrated robust microalgae growth under variable wastewater compositions. The biomass microbiome, initially dominated by microalgae from the *Chlorophyta* and *Ciliophora* phyla, evolved to include other eukaryotic taxa (including yeast and fungi) and likely bacteria. The microbiome's adaptability and its microbial diversity appeared to be key drivers in enhancing biological removal processes.

This work advances microalgae-based processes for treating and valorising MPWW by highlighting microbial ecology's role in system resilience and efficiency and giving insights in process scalability, showcasing its robustness for real-world applications.

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