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Integrated biogas systems: Enhancing methane production through microbial community engineering

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Anaerobic digestion is a cornerstone technology for biogas production, yet its efficiency is often limited by microbial imbalance, process instability, and substrate variability. This research introduces a community-engineering strategy using microbial consortia optimization and targeted metagenomic selection to enhance methane yields from agricultural waste. By enriching hydrogenotrophic methanogens and syntrophic bacteria, methane output increased by 52%. Co-digestion trials with manure, rice straw, and food waste achieved improved process stability and reduced volatile fatty acid accumulation. Bioaugmentation with selected microbial strains reduced retention time by 30%, significantly decreasing processing costs. The upgraded biogas exhibited improved calorific value suitable for electricity generation and grid injection. These results support microbial engineering as a high-impact strategy for next-generation biogas systems.

Biography

Ahmed El-Sherif is a senior researcher in environmental biotechnology at Cairo University, specializing in microbial ecology, anaerobic digestion, and renewable biogas systems. He has contributed to national and regional energy projects focused on sustainable agriculture and waste valorization. His research integrates molecular microbiology with large-scale bioprocess development.

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