Direct interspecies electron transfer performance through nanoparticles (NPs) for biogas production in the anaerobic digestion process

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ABSTRACT

Biogas production can be appreciated as an energy source for humankind, and its role in world biomaterial turnover with billions of tons of methane produced annually by microorganisms. Several nanoparticles (NPs) are used for microbes-to-microbes communication in enzymatic reactions for waste conversion into bioenergy. In the anaerobic digestion (AD) process, direct interspecies electron transfer (DIET) is a newly discovered step that helps to increase biogas production. The DIET process promotes rapid electron donation/acceptance of microbes that produce higher biogas during the AD process. In DIET, microbial syntrophic growth involves independent electron transfer from one microbe to another without shuttling by forming hydrogen or formate. In the methanogenesis stage, *Geobacter metallireducens* and *Methanoseta* showed a positive response for DIET in the presence of different NPs in the AD system. This review focuses on the role of NPs (metallic, carbon, and non-carbon) in DIET and the advantages and disadvantages of NPs in the biogas production process. A membrane surrounded by protein and metallic or nonmetallic NPs in the DIET mechanism has explicitly elaborated on the appearance of metallic conductive pili. In the methane digester, carbon, and non-carbon-based NPs help to interact with microbes to improve the DIET process and biogas production. Finally, the state of the art of implementing various prospective NPs in biogas production to upgrade AD technology for future development.

KEYWORDS

DIET; Metallic NPs; Elactron transfer mechanism; Anaerobic digestion; Geobacter metallireducens; Inhibition impact

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