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A sustainable and affordable production design of cleaner biogas from human excreta using eggshell

- Moses E. Emetere,
- L. Chikwendu,
- T. J. Abodunrin,
- T. C. Jen &
- S. A. Afolalu

Abstract

Low-quality, infectious pathogens, toxic chemicals, heavy metals, genotoxic, or radioactive particles are associated problems of biogas derived from human excreta. Most researchers had focussed solely on production optimization but with realities of pathogenic bioaerosols that may be dangerous to the users, there is a need to focus on the clean source-enhanced biogas production from human excreta. This research is designed to seek clear optimizable parameters in the clean production of biogas and its commercialization. A laboratory set-up was constructed to determine the biogas yield, bacteria mass, time of highest yield, and temperature. The surface response method was used to examine the influence of the microbial growth modifications from syntropic acetate oxidation (SAO) to a novel syntropic calcium acetate oxidation (SCAO) bacteria-using eggshell. It was observed that the human biogas production can be as high as 1020 g/ml on laboratory-scale within 30 days. More so, the biogas quality was improved by crashing the nitrogen gas content by 66%. The SCAO bacteria was observed to decompose the ammonia gas to form methane and NOx gases at a ratio of 3:1 within the first 20 days. The novel SCAO bacteria are suggested as good candidates to control ammonia and greenhouse gas emissions from human waste. It is recommended that there are still more to be done in culturing SCAO bacteria with slow growth and longer life span to make this process appreciate to industrial scale.