

## Effects of Laser Irradiation and Ni Nanoparticles on Biogas Production from Anaerobic Digestion of Slurry

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### Abstract

This study investigated the simultaneous effects of nanoparticles (NPs) addition to rumen fluid (archaea source) and laser irradiation of the mixture on biogas production from anaerobic digestion of dairy manure. Where, the previous study reported that the addition of 2 mg L<sup>-1</sup> nickel nanoparticles (Ni NPs) significantly ( $p < 0.05$ ) increased the biogas and methane volumes by 1.74 and 2.01 times compared to the control, respectively. The results indicated that the most efficient irradiation time was 2 h laser with the addition of 2 mg L<sup>-1</sup> Ni NPs ( $p < 0.05$ ), which minimized the lag phase from 4 days to 1 day and the Hydraulic Retention Time (HRT) to attain the peak of biogas production in comparison to the control from 28 days to 16 days. The combination of laser irradiation and nanoparticles addition yielded the highest significant value of the specific biogas and methane production, compared to all treatments (incandescent light, control), which were 679.5 mL biogas g<sup>-1</sup> VS and 453.3 mL CH<sub>4</sub> g<sup>-1</sup> VS. Furthermore, Laser photocatalysis of Ni NPs enhances the photo-reduction/photo-oxidation of CH<sub>4</sub> formation pathways. Consequently, this treatment increased the biogas and methane volumes by 1.9 and 2.32 times the biogas and methane volumes resulted from the control, respectively.

### Keywords

Biogas  
Laser radiation  
Anaerobic digestion  
Nanoparticles  
Methane production  
Manure