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Editorial

Effect of Illumination on the Metabolic Pathways in Anaerobic Digestion

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Anaerobic digestion has been widely used for treating biomass wastes, for not only protecting environment, but also obtaining renewable energy. At present, we know that anaerobic methane yield can be carried out in darkness, but the knowledge of whether and how anaerobic methane yield was influenced by the illumination is still few.

As shown in Figure 1, during the process of anaerobic digestion, complex organic molecules are degraded into soluble organic molecules sugar, amino acids, and fatty acids by hydrolytic bacteria, which are then converted by acidogenic microorganisms into organic acids. Acetogenic bacteria then digest which into carbon dioxide, hydrogen and acetic acid; H_2-producing bacteria also utilize some of which for H_2 yield. Finally, methane produced from hydrogen, carbon dioxide and acetate.

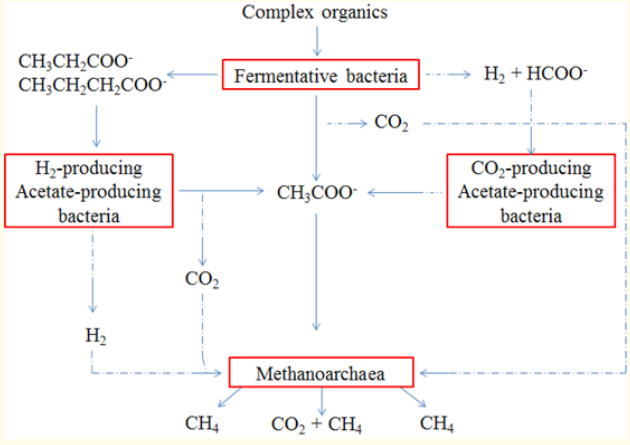

Figure 1: *Methanogenesis in anaerobic environments (Robert 2001).*

For hydrogen-producing bacteria group of the hydrogen-acetic acid producing phase, there is a type of photosynthetic bacteria that can use light energy to break down small organic acids to generate hydrogen, such as purple non-sulfur (PNS) bacteria [1].

Hydrogen production is primarily influenced by nutritional and environmental factors, such as choice of carbon and nitrogen sources, the carbon to nitrogen ratio, pH levels, temperature, light intensity, wavelength of light, light-dark cycles and so on [2-4]. Yi., *et al*. [5] investigated the effect of illumination on cow manureand pig manure's anaerobic digestion. The results shown that when theillumination conditions were at 0 hours (P1), 6 hours (P2), 12 hours (P3) and 24 hours (P4), the cumulative gas production of pig manure is 8136 mL, 857 mL, 15618.5 mL and 0 mL respectively. P3 > P1 > P2 > P4. The cumulative gas production of cow dung at 0 hours (C1),6 hours (C2), 12 hours (C3) and 24 hours (C4)of illumination is 3182.5 mL, 1244.5 mL, 7680 mL and 567.5 mL, respectively, C3 > C4 > C1 > C2. Chen., *et al*. [6] studied the effect of light on anaerobic digestion process of *spartina alterniflora* under 35°C. The results shown that biogas production was improved by 10.87% under illumination. The low improvement may be due to continuous illumination.

However, there is no reported study on the mechanism of how illumination affects the microbial community and then the biogas yield. Based on previous related studies and knowledge, the mechanism can be speculated (Figure 2): illumination can improve the activity and the breeding of photosynthetic bacteria, which lead to the decrease of intermediates from the stage of fermentation, then the improvement of activity and breeding of methanogens due to the reduced inhibition of intermediates; the increase of H_2 from photosynthetic bacteria can alsoimprove the activity and breeding of methanogens as substrate. In another word, the illumination facilitates the coordination between H_2-production/acetate-production stage and methanogenesis stage and then the improvement of biogas yield.

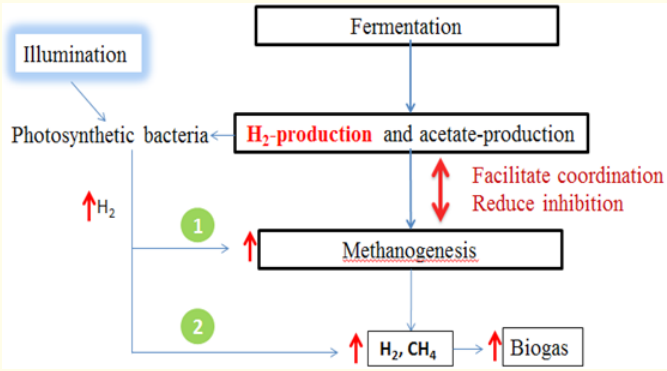

Figure 2: *Pathway of the effect of illumination on biogas yield.*

Based on the above, the following results can be anticipated:

1. The H_2-producing bacteria will increase due to the illumination.
2. The methanogens will increase due to the increase of H_2.
3. The increase of methanogens will lead to good coordination between H_2-production/acetate-production stage and methanogenesis stage.
4. Time used for reaching the stable status of AD will be short due to 1 and 2.
5. 1, 2 and 3 will result in the increase of biogas.

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