Anaerobic Fermentation of Sewage Sludge for Volatile Fatty Acids Production and the Resource Technology Development

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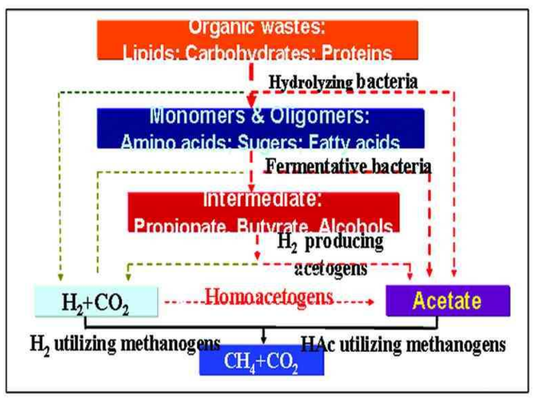
RESEARCH BACKGROUND

In China, the safe treatment and disposal of sewage sludge has become a very urgent environmental problem. In 2010, the amount of sewage sludge reached 30 million tons (80% water content), and it increased by 20% annually. The normal treatment and disposal methods include landfill, compost, land use and incineration. However, development of sustainable technology to realize reuse and resource of the sewage sludge is in a very urgent demand.

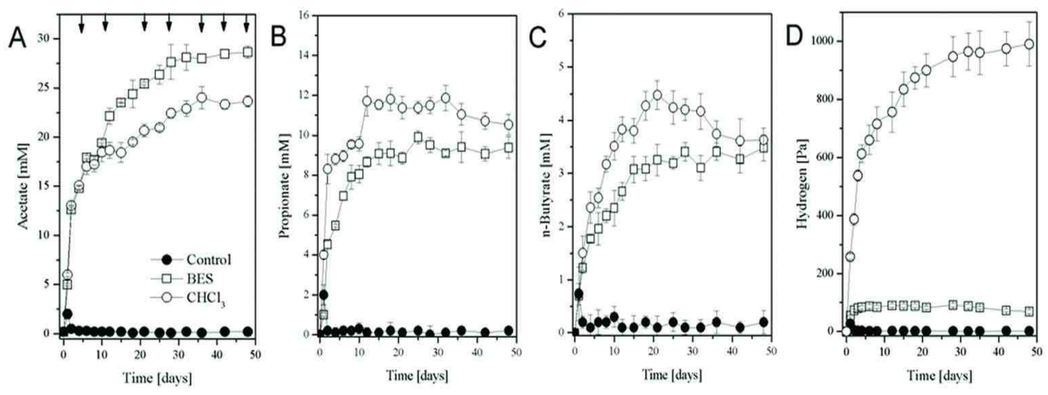
The organic matters in sludge can be converted into volatile fatty acids (VFA) by anaerobic fermentation, such as acetate, propionate and butyrate. These VFAs can be used as basic biochemical materials in fermentation industries to produce higher valuated products or used as external carbon source for the nitrogen or phosphorous removal in the WWTPs. Therefore, production and optimization of the VFA generation from the sewage sludge by anaerobic process is a promising way to realize the recycle of sewage sludge and might be a novel technology to tackle the pollution problem of sewage sludge.



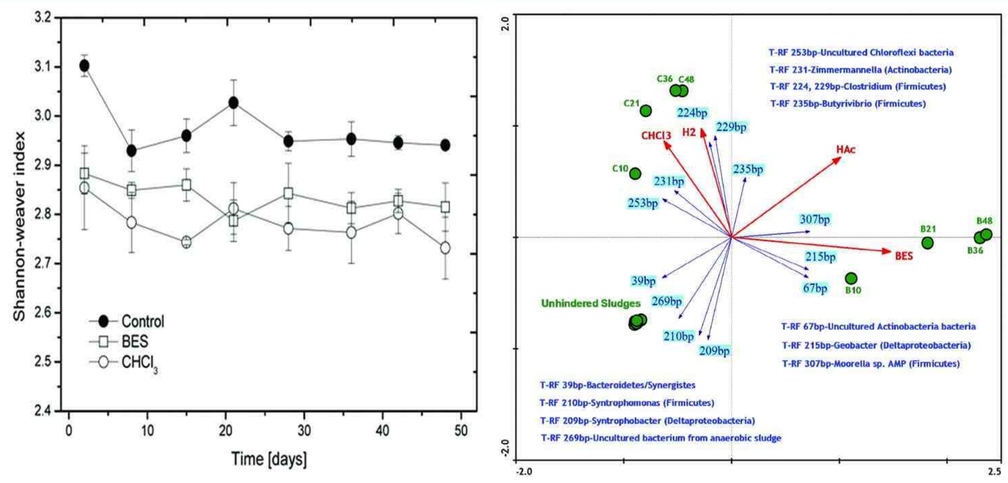
RESEARCH CONTENT

➢Volatile fatty acids and biogas production

Accumulation of fatty acids and H_2 in anaerobic sludge incubated in the presence and absence of different inhibitors.



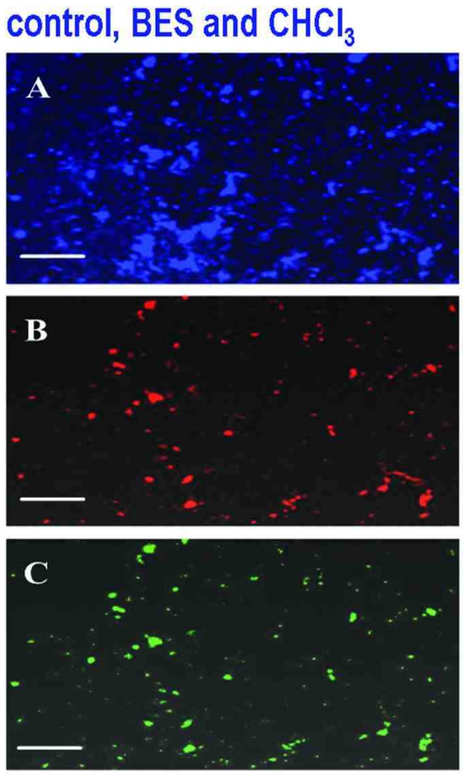
➢Dynamics of bacterial populations

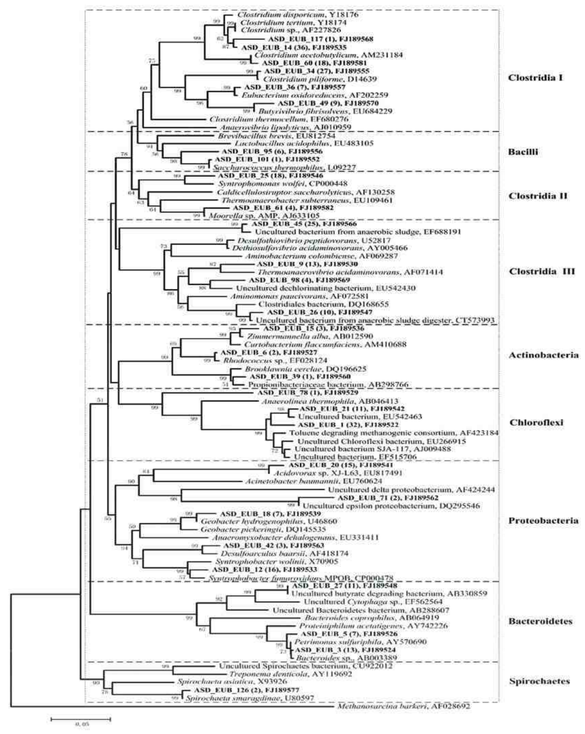


Comparison of Shannon-weaver indexof samples incubated in the presence and absence of different inhibitors; Ordination diagram from redundancy analysis (RDA) of the effect of methanogenic inhibitors and fermentative intermediates on the presence of different T-RFs.

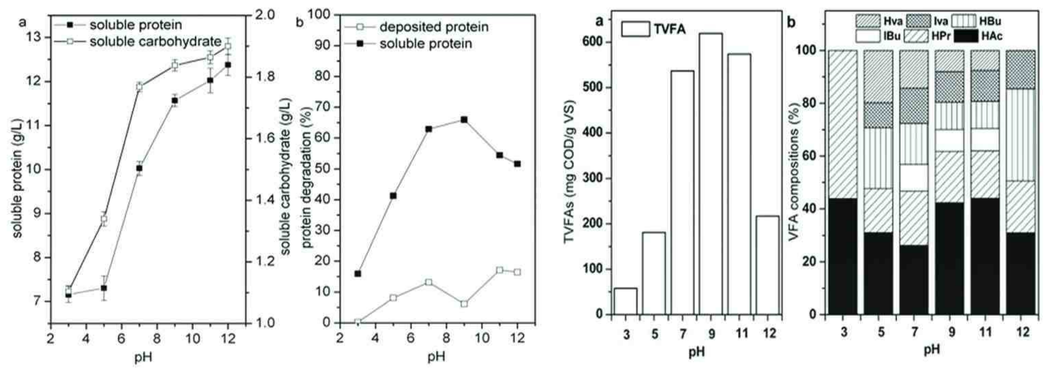
➢Molecular diversity of sludge bacterial community

Three clone libraries were constructed using samples form the control, BES and $CHCl_3$



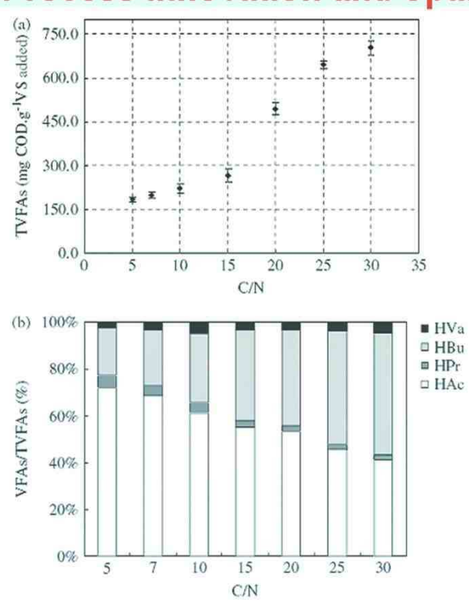


➢Process innovation and optimization



It was found that the alkaline conditions improved degradation and subsequently the conversion to VFA of the soluble protein in the sewage sludge. The total VFA yeild can be as high as 600 mg COD/g VS at the optimum pH value for anaerobic fermentation.

➢Process innovation and optimization



The effect of C/N ratios on the VFA production from sewage sludge has been investigated. It was observed that a higher C/N ratio is favorable to the VFA production and acetic acid as well as butyric acid were the predominant VFAs.

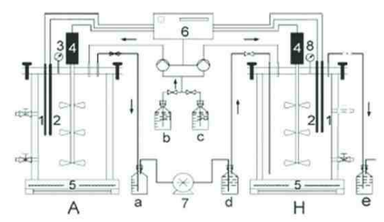


Figure 1. Schematics of the coupling glucose fermentation and homoacetogenesis system: 1, pH sensor; 2, temperature sensor; 3, vacuum meter; 4, mixtor; 5, heating/cooling system; 6, autocontrol system; 7, vacuum pump; 8, pressure meter; A, reactor for glucose fermentation; H, reactor for homoacetogenesis; a, gas buffer; b, HCl; c, NaOH; d,e: $NaHCO_3$ buffer solution.

A novel coupled process was developed and tested by lab scale (20L) and pilot scale (50L) fermentation for the VFA production from sewage sludge.