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Methanogenic activity optimization using the response surface methodology, during the anaerobic co-digestion of agriculture and industrial wastes. Microbial community diversity

J. Jiménez [a,*], Y. Guardia-Puebla [b], O. Romero-Romero [a], M.E. Cisneros-Ortiz [c], G. Guerra [d], J.M. Morgan-Sagastume [c], A. Noyola [c]

[a] Universidad de Sancti Spíritus, Ave. de los Mártires, No 360, CP 60100 Sancti Spíritus, Cuba
[b] Universidad de Granma, Carretera de Manzanillo, Km 17 ½, CP 85100 Bayamo, Granma, Cuba
[c] Instituto de Ingeniería, Universidad Nacional Autónoma de México, Circuito Escolar S/N Ciudad Universitaria, Delegación Coyoacán, CP 04510 D.F. México, Mexico
[d] Facultad de Biología, Universidad de La Habana, Calle 25 e/ I y J, Vedado, CP 10400 La Habana, Cuba

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ABSTRACT

The anaerobic co-digestion of manure, agriculture and industrial wastes for methane production depends on the nutritional condition to develop the microbial community. The effect of each substrate concentrations, as well as their interactive effects on specific methanogenic activity and microbial community diversity were investigated in this work. A central composite design and the response surface methodology were applied for designing the anaerobic co-digestion batch test at 35 and 55 °C. It was analyzed the anaerobic sludge by specific methanogenic activity (SMA) and using molecular techniques (terminal restriction fragment length polymorphism, TRFLP). The results showed a significant interaction among the substrates and an enhancement of the methane production and SMA response caused by the three components. Rice straw had lower influence on SMA than clay residues, due to the mineral content and the beneficial ammonia nitrogen adsorbent properties of the latter. The optimum condition for mesophilic and thermophilic anaerobic co-digestion of pig manure, rice straw and clay mixture allowed SMA values of 1.31 and 1.38 gCH_4-COD/$gVSSd^{-1}$, respectively. The TRFLP analysis showed the effect of rice straw and clay addition on microbial community diversity at both temperatures. The acetotrophic methanogens belonging to the order *Methanosarcinales* (*genera Methanosarcina* and *Methanosaeta*) dominated in mesophilic condition, whereas at thermophilic conditions dominated *Methanomicrobiales* and *Methanobacteriales* order. The optimization allowed identifying the substrate interaction effects in a concentration range with a reduced number of experiments. Besides, the model validation proved to be useful for defining optimal combination of wastes in anaerobic system.

* *Corresponding author*. Tel.: +53 41664137.
E-mail addresses: janet@uniss.edu.cu (J. Jiménez), yguardiap@udg.co.cu (Y. Guardia-Puebla), mec@pumas.iingen.unam.mx (M.E. Cisneros-Ortiz), ggr@fbio.uh.cu (G. Guerra), jmm@pumas.iingen.unam.mx (J.M. Morgan-Sagastume), noyola@pumas.iingen.unam.mx (A. Noyola).
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