Different COD concentration effects on biochemical potential for methane production from vinasse

Silverio, M. S.; Souza[1], T. C. F.[1,2]; Calegari, R.P.[1]; Marabesi, A.O.[1]; Tonoli, F.C.[1]; Carvalho, R de S*[1]; Sica, P. [1]; Seleghim, A. R.[1]; Beltrame, H.[1]; Trevizan, A.T.A.[1]; Das, K. C.[2]; Aguiar, C. L.[1]; Baptista, A. S.[1]

[1] *Escola Superior de Agricultura "Luiz de Queiroz"- ESALQ/USP* (Piracicaba/SP, Av. Pádua Dias - Vila Independência, 13418-260, Brazil)
[2]*University of Georgia* - UGA (Athens, GA 30602, United States).

Brazil is the second largest ethanol producer, with about 29 billion liters per year. In the process, residue production is very high: 10 liters of vinasse per liter of ethanol. Biogas production from this residue has great potential, since 1 m^3 of vinasse might produce 14,6 m^3 of biogas. This study aimed to analyze biogas production according to residue chemical oxygen demand (COD) concentration. Vinasse was obtained from a molasse and sugarcane juice fermentation process, in Piracicaba/SP, Brazil. Chemical characterization consisted on macro and micronutrients. Experiments were conducted in 500 mL reactors, using inoculum obtained from food waste treatment. Five treatments were tested for biogas production: (T1) vinasse COD 25 $g.L^{-1}$; (T2) 20 $g.L^{-1}$; (T3) 15 $g.L^{-1}$; (T4) 10 $g.L^{-1}$; (T5) 5 $g.L^{-1}$. Reaction volume was composed of 10% inoculum and 90% vinasse. Each treatment had four replications, in batch systems. Reactors were kept under anaerobic conditions and agitation, at 28 ºC, for 102 days. Analyses carried were: pH variation, COD removal, biogas production and composition. COD value obtained was 70 g L^{-1} and pH was 4.8. Most abundant elements in vinasse were: K (596 mg L^{-1}), Ca (205 mg L^{-1}), S (146 mg L^{-1}), N (125 mg L^{-1}) and Mn (68.8 mg L^{-1}). It was observed that a higher COD concentration might have an influence on a larger pH variation, thus T1 had the largest pH variation, followed by T2, T3, T4 and T5. At 44th day, pH increased to 6,9 for T1, whereas pH recovery took about 10 days for other treatments. This phenomenon is probably related to a higher organic matter to be hydrolyzed in first methanogenesis process steps, identified by high volatile fatty acids and organic acids concentrations. This result suggests a relation to biogas production and its composition along the experiments. Since reactors reached pH closer to 7, biogas composition went from 90% CO_2 and 10% CH_4 to 20% CO_2 and 80% CH_4. T2 showed the highest biogas production and composition in methane, followed by T3, T4, T1 and T5. The low biogas production for T1 might be due to the long lag phase, which took 44 days, what must have affected COD as well (44%). For other treatments, satisfactory values could be reached, close to 66%. The parameter that seemed to influence the most was pH, but the main difference on results depended on COD concentration, given it seems to influence lag phase time. Best biogas production efficiencies were obtained for T2, followed by T3, T4, T5 and T1.

Keywords: *Vinasse, Anaerobic Digestion, Methane*

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