Optimizing anaerobic digestion of tannery fleshings with different inoculums using biochemical methane potential test and mathematical modelling

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The present experimental set-up study of tannery fleshings with different inoculum batch sizes, was carried out for an hydraulic retention time of 50 days to check the capability of anaerobic digestion. Biogas production was between 10,102.5 and 14,505 ml/day. The first-order and modified Gompertz models were calibrated using experimental data. For kinetic analysis of biogas production, modified Gompertz models and basic first-order kinetics were employed. In each instance, the kinetic parameters, substrate biogas yield potential, maximal biogas production rate, lag phase time, coefficient of determination and root mean square error were calculated. The model parameters were estimated using the nonlinear regression approach made possible by IBM SPSS software 25.0. Both the models fitted/predicted the experimental data with over 99% accuracy (R^2 = 0.990–0.999).

Keywords: Anaerobic digestion, biogas first-order kinetics, inoculums, tannery fleshings.

Recently, researchers have made predictions of biogas potential using the modified Gompertz model and first-order kinetics model[7]. Assuming that the biogas production rate depends on the growth of methanogenic bacteria in the digester, both models give different results of biogas prediction[5]. The biogas yield prediction using the modified Gompertz model showed a fitting error of 0.7–13.7%. This was more accurate than the first-order kinetics model with a fitting error of 9.2–37.1% (ref. 8). The above information reveals that accurate biogas yield prediction depends on the substrate used as feedstock for the process[9].

Several researchers have been working to improve biomass conversion efficiency and biogas yield by improving contact between the bacteria and substrate co-digestion with other inoculum. Additionally, an effort has been made to optimize biogas yield using the batch-scale reactors in series. Fleshings are the leftover portion of inner skin during the process when the hide is converted into leather. There is a production of 1/4th fleshings for every tonne of processed leather[10,11]. Due to lack of disposal