ABSTRACT

Extensive use of fossil fuels over the years has resulted in increased petrol and electricity prices as well as negative impacts on the environment resulting from increased Green House Gas (GHG) emissions. There is therefore a need for a renewable and more environmental friendly source of energy. The aim of this study was to produce an alternative fuel source in a form of biofuels from sweet potato tuber using a laboratory-scale Fluidized Bed Bio-Reactor (FBBR). Sweet potato was a substrate of choice because of its high carbohydrate content. Although sweet potato is a food source, there is a huge surplus annually which is regarded as waste. Bacteria isolated from sweet potato tuber were identified based on their 16S rRNA sequence using colony PCR followed by sequencing. Strains identified belonged to species: *Klebsiella, Enterobacter, Rhodobacter, Bacillus, Citrobacter, Alcaligenes* and *Bordetella*. Industrial applications of each bacterial isolate were predicted from known bacterial species. Batch fermentation was operated using M9 minimal growth medium and GP medium and a consortium of the identified species. In these experiments, pH was measured but not controlled. Using M9 minimal growth medium, acetic acid (48.6 g/l), ethanol (29 g/l), propionic acid (29 g/l), butyric acid (22.9 g/l), methane (21.1 g/l), hydrogen (3.2 g/l) and carbon dioxide (6.2 g/l) were produced; however, lower concentrations were produced in GP medium (acetic acid, 13.1 g/l; ethanol, 7.3 g/l; propionic acid, 16.7 g/l, methane, 0.2 g/l; hydrogen, 1.7 g/l and carbon dioxide, 0.6 g/l) except for butyric acid, 23.6 g/l. Under fluctuating pH conditions, higher concentrations were obtained at a pH value of 6.0. Based on results, it appeared that M9 medium and pH 6.0 were preferred. However, liquid and gas products obtained at controlled pH 6.0 were lower than those obtained under uncontrolled pH conditions. This resulted in using M9 medium under uncontrolled pH conditions in a continuous FBBR. Three Hydraulic Retention Times (HRTs) of 6 hours, 3 days and 12 days were investigated. FBBR was operated at each HRT over 42 days with a 14 day interval. HRT of 6 hours resulted in the highest

productivity. Maximum concentrations of acetic acid (18.5 g/l), ethanol (5.2 g/l), propionic acid (16.9 g/l), butyric acid (16.9 g/l), hydrogen (16.3 g/l) and carbon dioxide (5.3 g/l) were obtained by day 42. Bacterial growth dynamics were monitored by plate counts while cell attachment on granular activated charcoal (GAC) was studied using scanning electron microscope (SEM). SEM micrographs showed attachment of bacterial cells as well as extracellular polymeric substance (EPS) indicating that mixed cultures used in this study were able to form biofilms.