**SYNGAS FERMENTATION BY USING ANAEROBIC GRANULAR SLUDGE AND CLOSTRIDIUM SPP FOR BIOETHANOL PRODUCTION**

Naorem Bela Devi, Rama Karn, Kannan Pakshirajan

Department of Biosciences and Bioengineering, Indian Institute of Technology, Guwahati, Assam, India 781039

Corresponding author*:* [*n.bela@iitg.ac.in*](mailto:n.bela@iitg.ac.in), +919643775938

**Abstract**

With the increasing urgency of environmental issues such as global warming, novel renewable energy sources that could substitute fossil fuels are being aggressively researched. Syngas (CO, CO2, and H2) has received particular focus due to the dual benefit of syngas fermentation in carbon sequestration (pollution reduction) and energy generation. Syngas can be generated by gasifying biomass or as a byproduct of various industrial processes. Multiple microorganisms can produce these waste gases into value-added products like alcohols, short-chain fatty acids, fuels, and other valuable products. In this research, ethanol and acetic acid production were first studied by syngas fermentation using anaerobic granular sludge from an industrial wastewater treatment system as inoculum. The highest ethanol and acetic acid concentrations of 3.5 and 3.2 g/L were obtained by utilizing CO/CO2/H2 and CO as gaseous substrates. In the next part of the study, three different *Clostridium spp* namely, *Clostridium ljungdahlii, Clostridium carboxidivorans*, *Clostridium rangsdalei* capable of producing alcohols and volatile short-chain fatty acids were evaluated for their product formation kinetics. The maximum ethanol productivity values of 19.8 mgL-1h-1 using CO2/H2, 29.48 mgL-1h-1 using CO and 5.2.08 mgL-1h-1 using CO for Clostridium ljungdahlii, Clostridium carboxidivorans and Clostridium ragsdalei, respectively, were obtained. Liquid Chromatography-Mass Spectroscopy/ Mass Spectroscopy (LC-MS/MS) of the broth revealed the presence of other compounds such as valeric acid, hexanoic acid, hexanol and isopropanol, etc., that were produced by *C. carboxidivorans* and *C. ragsdalei*. This research demonstrates renewable production of value-added chemicals and fuels from waste gases by anaerobic bioconversion.

Keywords: *syngas fermentation, bioethanol, Clostridium ljungdahlii, Clostridium carboxidivorans, Clostridium ragsdalei,* *granular sludge*