UNIVERSITI TEKNOLOGI MARA

BIO-HYDROGEN PRODUCTION THROUGH DARK FERMENTATION OF CORN WASTES

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ABSTRACT

The objective of this study was to investigate biohydrogen production under parameters such as pH, temperature, and catalyst using corn wastes as substrate and cow dung as inoculum. The sample of inoculum and substrate was collected at corn farm near Tanjung Karang, Kuala Selangor. The collected sample was clean with tap water, air dry for 1-2 days. After drying process, the corn wastes were chopped down into smaller parts and stored at room temperature prior to experimental works. The substrate and inoculum were characterized using CHNS analysis, then optimized under parameter such as pH, temperature and substrate, and up-scale hydrogen production operating under optimized parameters. The characterization of inoculum and substrate was recorded in percentage of total solids, volatile solids, with carbon, hydrogen, and nitrogen content. During characterization, the total solid (TS) and volatile solids (VS) in cow dung were 16.93% and 74.9%, respectively. In comparison, corn waste consisted of more TS and VS, which were 98.95% and 93.09, respectively. Information such as cumulative biohydrogen production, lag-phase, hydraulic retention duration, and hydrogen production rate was achieved by optimizing and scaling up biohydrogen production. It was discovered that pH 5.5 yielded 13.8 ml/g H_2 with the rate of 8.6 ml/h, while temperature 35°C yielded 11.7 ml/g H_2 corn wastes with the rate production of 6.9 ml/h and addition of $CoCl_2$ yielded 8.2 ml/g H_2 corn wastes with the rate of production of 1.0 ml/H_2. 5L up-scale biohydrogen digester at pH 5.5 produced 70.5 ml/g H_2 with 7.6 ml/h production rate; temperature 35 °C produced 53.4 ml/g hydrogen with the production rate of 14.2 ml/h; and addition of $CoCl_2$ 17.6 ml/g H_2 with 2.6 ml/h of production rate. Thus, corn wastes have great potential to be used as one of the energy sources to produce hydrogen and potential for agricultural wastes management.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

Today's global energy supply depends heavily on fossil fuels. Approximately 80 % of the energy used worldwide comes from fossil fuels and the remaining 20 % comes from nuclear and renewable energy sources (Singh & Wahid, 2015). Significant efforts have been made to use non-carbonaceous fuels produced from renewable feedstock, as it produces less greenhouse gas emissions during both fuel production and combustion. Combination of anthropogenic climate change and dwindling fossil fuel reserves are driving intense research for alternative energy sources. One attractive avenue is to use a biological process to produce a biofuel. Among the various biofuels available, biohydrogen gas is an attractive future energy option due to its potentially higher efficiency of conversion to usable power, low to non-existent generation of pollutants and high energy density. With the advancement of technology nowadays with integration of Internet-of-things, and digitalisation in industry, it is possible to enhance the knowledge of hydrogen development research. Thus, most stakeholder nowadays keen to see research study for the clean energy such as hydrogen productions. Hence, hydrogen can be considered to be one of the promising fuels for the future and widely recognized as potential substitute of fossil fuels (Hallenbeck, Abo-Hashesh, & Ghosh, 2012).

Nowadays, alternative energy sources such as hydrogen and methane undergo vigorous development in mitigating the issues of fossil fuels depletion and prices fluctuation. There were various reasons for development of hydrogen as an alternatives. Most advanced nations already foreseen potential of hydrogen as an alternative renewable energies and energetic carrier. Countries that are seriously evaluating the possibility of using hydrogen as an alternative fuel in their power systems are the United Kingdom, Denmark, the United States, Italy, Taiwan, China, India, Korea, Switzerland, Austria, Canada, Japan and Germany (Dutta, 2014). Biological hydrogen production has attracted considerable attention since it could deal with the conversion of low cost residues or organic waste/wastewater to hydrogen (Han, Ye, Jun, Ting, & Feng, 2015).