World Academy of Science, Engineering and Technology
International Journal of Agricultural and Biosystems Engineering
Vol:9, No:01, 2015

Production of Bioethanol from Oil PalmTrunk by Cocktail Carbohydrases Enzyme Produced by Thermophilic Bacteria Isolated from Hot spring in West Sumatera, Indonesia

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Abstract : Recently, alcohol fuels have been produced on industrial scales by fermentation of sugars derived from wheat, corn, sugar beets, sugar cane etc. The enzymatic hydrolysis of cellulosic materials to produce fermentable sugars has an enormous potential in meeting global bioenergy demand through the biorefinery concept, since agri-food processes generate millions of tones of waste each year (Xeros and Christakopoulos 2009) such as sugar cane baggase , wheat straw, rice straw, corn cob, and oil palm trunk. In fact oil palm trunk is one of the most abundant lignocellulosic wastes by-products worldwide especially come from Malaysia, Indonesia and Nigeria and provides an alternative substrate to produce useful chemicals such as bioethanol. Usually, from the ages 3 years to 25 years, is the economical life of oil palm and after that, it is cut for replantation. The size of trunk usually is 15-18 meters in length and 46-60 centimeters in diameter. The trunk after cutting is agricultural waste causing problem in elimination but due to the trunk contains about 42% cellulose, 34.4%hemicellulose, 17.1% lignin and 7.3% other compounds,these agricultural wastes could make value added products (Pumiput, 2006).This research was production of bioethanol from oil palm trunk via saccharafication by cocktail carbohydrases enzymes. Enzymatic saccharification of acid treated oil palm trunk was carried out in reaction mixture containing 40 g treated oil palm trunk in 200 ml 0.1 M citrate buffer pH 4.8 with 500 unit/kg amylase for treatment A: Treatment B: Treatment A + 500 unit/kg cellulose; C: treatment B + 500 unit/kgg xylanase: D: treatment D + 500 unit/kg ligninase and E: OPT without treated + 500 unit/kg amylase + 500 unit/kg cellulose + 500 unit/kg xylanase + 500 unit/kg ligninase. The reaction mixture was incubated on a water bath rotary shaker adjusted to 600C and 75 rpm. The samples were withdraw at intervals 12 and 24, 36, 48,60, and 72 hr. For bioethanol production in biofermentor of 5L the hydrolysis product were inoculated a loop of Saccharomyces cerevisiae and then incubated at 34 0C under static conditions. Samples are withdraw after 12, 24, 36, 48 and 72 hr for bioethanol and residual glucose. The results of the enzymatic hidrolysis (Figure1) showed that the treatment B (OPT hydrolyzed with amylase and cellulase) have optimum condition for glucose production, where was both of enzymes can be degraded OPT perfectly. The same results also reported by Primarini et al., (2012) reported the optimum conditions the hydrolysis of OPT was at concentration of 25% (w /v) with 0.3% (w/v) amylase, 0.6% (w /v) glucoamylase and 4% (w/v) cellulase. In the Figure 2 showed that optimum bioethanol produced at 48 hr after incubation,if time increased the biothanol decreased. According Roukas (1996), a decrease in the concentration of ethanol occur at excess glucose as substrate and product inhibition effects. Substrate concentration is too high reduces the amount of dissolved oxygen, although in very small amounts, oxygen is still needed in the fermentation by Saccaromyces cerevisiae to keep life in high cell concentrations (Nowak 2000, Tao et al. 2005). The results of the research can be conluded that the optimum enzymatic hydrolysis occured when the OPT added with amylase and cellulase and optimum bioethanol produced at 48 hr incubation using Saccharomyses cerevicea whereas 18.08 % bioethanol produced from glucose conversion. This work was funded by Directorate General of Higher Education (DGHE), Ministry of Education and Culture, contract no.245/SP2H/DIT.LimtabMas/II/2013

Keywords : oil palm trunk, enzymatic hydrolysis, saccharification

Conference Title : ICAB 2015 : International Conference on Agriculture and Biotechnology

Conference Location : Jeddah, Saudi Arabia

Conference Dates : January 26-27, 2015