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Screening of Culture Conditions for Production of Xylanase from Landfill Soil Bacteria

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EXTENDED ABSTRACT

Xylan is a major constituent of hemicellulosic polysaccharides found in plant's cell wall which represent up to 20-30% of the total dry weight in tropical plant biomass [1]. Besides, 9-12% of municipal solid waste are composed of hemicellulose on dry weight basis [2]. Enzymatic method can be used for the degradation of these materials involving the use of microbial enzymes [3] that are less polluting, environmental friendly, energy saving and lower disposal problems [4]. Xylanase is a biocatalyst which specifically degrade xylan into smaller sugars such as xylose and xylobiose [5]. It has been used in many important industrial applications such as pulp, paper, bakery, juice and beer industries [6]. This enzyme has been employed in paper manufacturing to bleach paper pulp and increase the brightness of paper pulp instead of using toxic and expensive chemicals [5]. Xylanase also being used in biofuel production such as ethanol from lignocellulose biomass and used in treatment of barley and wheat to improve the properties of animal diet in animal feed industries [1]. Besides, this enzyme can be applied for conversion of xylan into xylose in agricultural wastewater and to clarify fruit juices in beverage industries [7]. Microbes are prefer by the industries to produce various enzymes, because of high growth rate and large volume of enzymes can be obtained within a short time [8]. Employing microbes such as bacteria, yeast and filamentous fungi, that are known for their ability to secrete extracellular enzymes into the environment, may help to overcome the current challenge in reducing the volume of waste in landfill by biological conversion of municipal solid waste into bioenergy [9].

The purpose of this study was to investigate the effect of culture conditions on the production of xylanase using one-factor-at-a-time (OFAT) method. The bacteria used in the production of extracellular enzyme was isolated from landfill site at Sg. Ikan, Kuala Terengganu, Malaysia (latitude 5°19'07.3"N and longitude 102°59'32.0"E). Five characterization studies of the landfill soil were investigated for their pH, moisture content, ash content, chemical oxygen demand (COD) and biochemical oxygen demand (BOD). The culture conditions were screened for the production of xylanase in 250 mL Erlenmeyer flask such as incubation period (6-30 hr), initial pH of media (pH 5-9), inoculum size (1-20% v/v), carbon sources, nitrogen sources and nitrogen source concentration (1-5% w/v). Xylanase activity was detected using dinitrosalicylic acid (DNS). The activity was determined based on the release of xylose under standard assay conditions.

Based on a few characterization studies of landfill soil, it was observed that the landfill soil pH was between pH 3.4-7.2 with moisture content percentage ranged between 12.4-33.7%. Ash content percentage of the soil ranged between 3.5-4.3% with COD between 84-174 mg/L and BOD between

0.05-0.07 mg/L. As seen in Figure 1a, the trend of xylanase activity was fluctuated from pH 5.0 to pH 9.0. Xylose with concentration of 1% (w/v) (Figure 1b) and peptone with concentration of 1% (w/v) (Figure 1c) was the best carbon and nitrogen sources to promote the xylanase production, respectively. The lowest xylanase activity (0.455±0.0023 IU/mL) was recorded when varying the nitrogen sources concentration as shown in Figure 1d. Results showed that the highest xylanase activity within studied ranges was recorded at 13.8571±0.0384 IU/mL with 10% (v/v) inoculum size, 1% (w/v) xylose as sole carbon source, mixture of 1% (w/v) peptone and 0.25% (w/v) ammonium sulphate as nitrogen sources, carried out at initial pH of 8.0 for 24 hr.

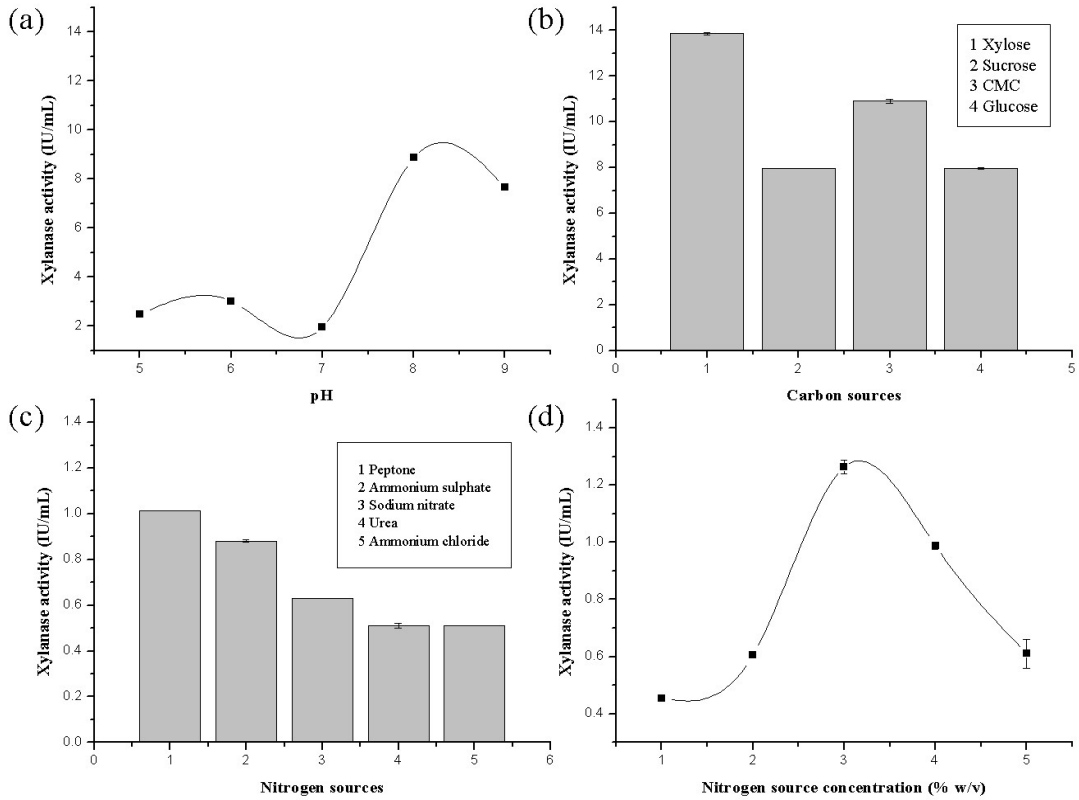

Fig. 1: (a) Effect of initial pH of medium on xylanase activity. (b) Effect of carbon source on xylanase activity. (c) Effect of nitrogen source on xylanase activity. (d) Effect of nitrogen concentration (peptone) on xylanase activity.

Keywords: Xylanase; Bacteria; Landfill soil; Screening parameters; Municipal solid waste

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