Optimisation of pre-harvest sago frond sap for the production of L-lactic acid using \textit{Lactococcus lactis} IO-1

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**ABSTRACT**

The major restriction of sago palm plantation is the long maturation period for the starch extraction. As such, alternative commodity has to be identified to increase commercial value of sago palm especially from the by-product. Sago frond has been harvested to have numerous advantages as an alternative substrate for the production of biomaterial and biofuel such as lactic acid and bioethanol. This study focuses on effective approach to maximise the concentration of sugar in the substrate and to identify the ideal concentration of sago frond sap (SFSp) as sole media to produce L-lactic acid and grow \textit{L. lactis} IO-1. Result shows that SFSp extracted from sago rachis using a roller press machine contained glucose (43.8 g/L), xylose (17.3 g/L) as free sugars and starch (5.55 g/L). Combination of enzymatic hydrolysis and sterilisation pre-treatment was found to maximise the concentration of total carbon source (68 g/L) and sterilised sago frond sap suitable to be used for fermentation process. The ideal concentration of SFSp that was determined at 50% dilution produces the highest amount of L-lactic acid (24.02 g/L) synergist by most efficient sugar consumption (89.93%). The use of SFSp as fermentation medium for L-lactic acid production generated maximum biomass concentration of 14.53 g/L. The utilisation of SFSp extracted from pre-harvest sago frond as substrate promote efficiency of L-lactic acid production associated to exceptional growth performance of \textit{L. lactis} IO-1. In conclusion, the concept of utilizing by-product from sago palm as novel raw material promise reliable resources and superiority of \textit{L. lactis} IO-1 to metabolise sugar in SFSp promote lucrative and ethical production of L-lactic acid.

1. Introduction

The sago palm industry is one of the major industrial crop that contribute to the Gross Domestic Product (GDP) to Sarawak, mainly for the production of sago starch. Sarawak is one of the biggest sago starch exporter in the world, generating about 200,000 tons and exporting 47,000 tons annually to support global starch supply. As reported by Ministry of Plantation Industries and Commodities Malaysia (MPIC, 2012), increasing global starch demand, the export value of sago starch increased from RM 135/ton in 1970 to RM 2000/ton in 2010. Sago starch is utilised mainly for food production, such as for the manufacturing of vermicelli, bread, cracker, biscuits and many traditional delicacies. In addition, sago starch is used as raw material to produce high fructose syrup and glucose as an ideal alternative to reduce dependency on imported corn starch. Along with tapioca, sago starch is also used for the manufacturing of monosodium glutamate (MSG). Industrial grade sago starch is used as an extender for urea formaldehyde adhesive in the wood industry, an alternative to hydroxyethyl cellulose to control fluid loss in the petroleum industry, stable and long-lasting biodegradable ma-

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