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Factorial Analysis of Xylanase and Cellulase Production from Pineapple Peel Waste

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Abstract. Pineapple wastes (skin, core and crown) are mainly composed of carbohydrates (cellulose, hemicellulose, and lignin). Non-starch polysaccharides (NSP) in feed are indigestible by the endogenous enzymes in poultry. Thus, exogenous enzymes (xylanase and cellulase) are required to overcome this problem. Due to high fiber content, pineapple wastes are unsuitable for animal feed. However, the fermented waste juice could be used to produce enzymes. The objective of this study is to produce xylanase and cellulase from the fermentation of pineapple waste using *Lactobacillus casei* (*L. casei*) bacteria inoculated from probiotic drink. The fermentation was performed using different screening parameters (incubation time, temperature, pH value and substrate concentration) according to Two-Level Full Factorial Design (FFD) by Design Expert. From this study, the incubation temperature and substrate concentration had the highest influence on the xylanase activity (39.82 U/mL) while the fermentation time and substrate concentration mostly affected the cellulase activity (8.05 U/mL). Meanwhile, the pH had the least influence on both enzyme activities. The pineapple waste at its best fermentation parameters not only offers an economical way of high enzyme production but also alleviates the agricultural waste disposal issue. Further optimization of the pineapple waste fermentation parameters is required though to maximize enzyme production.

Introduction

The pineapple peel waste (PPW) contains 19% cellulose, 22% hemicellulose, 5% lignin, and 53% cell soluble matters (bioactive compounds, minerals, and nutrients) [1], the concentration of soluble sugars, which is inclusive of 5.2% sucrose, 3.1% glucose, and 3.4% fructose [2]. The key components of lignocellulosic material are carbohydrate polymers (cellulose and hemicellulose) and lignin layers. Since the pineapple waste contains useful substances such as carbohydrates in it, it can be used as a source of enzymes production [3].

Generally, chickens are able to develop their own enzymes to aid the absorption of nutrients from the feed [4]. These enzymes that are produced by the chickens internally and naturally are known as the endogenous enzymes. Due to the lack of endogenous enzymes which could degrade the dietary fibres (structural carbohydrates or non-digestible components that make up the plant cell wall) in the feed, along with the high molecular weight of the soluble NSP, causes the intestinal viscosity of the chickens to increase, which slows down the nutrient migration and absorption. Thus, this impacts the health of the poultry and elevates the cost of production [5]. In order to improve the digestibility of the chickens, exogenous enzymes (produced externally and fed or injected to the chickens) are required. Usage of exogenous enzymes derived from the waste to break down the NSPs may reduce the waste accumulation and at the same time it can improve the digestibility among the chickens [4].