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Optimising Production of Kojic Acid from Sago Fibre by Solid-State Fermentation Using Response Surface Methodology

ALVIN MIAI SPENCER, NURASHIKIN SUHAILI*, AHMAD HUSAINI, DAYANG SALWANI AWANG ADENI & KOPLI BUJANG

Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia.
*Corresponding author: snurashikin@unimas.my
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ABSTRACT

Kojic acid is an organic acid that has manifold industrial applications mainly in cosmetics, food and medicine. This research aims to optimise the production of kojic acid from sago fibre using a locally isolated *Aspergillus flavus* strain under solid-state fermentation (SSF). Central Composite Design (CCD) of Response Surface Methodology (RSM) consisting of 5 factors and 5 levels were employed to determine the influence of culture conditions such as initial moisture content (50-90% (v/w)), inoculum density (5-35% (v/w)), urea concentration (0.5-3.5% (w/w)), mineral salts solution (5-35% (v/w)) and incubation time (9-21 days) on kojic acid production. The results showed that the data were best represented by a quadratic model where the significant factors for kojic acid production were identified as inoculum density and incubation time with their optimal values of 30% (v/w) and 18 days, respectively. The maximum production of kojic acid achieved in this study represented a 2-fold increase from that achieved in the non-optimised conditions. In summary, this work describes the optimisation of kojic acid production from sago fibre employing RSM. In addition, this research represents a further step towards developing a sustainable production of kojic acid employing an eco-friendly and low-cost indigenous feedstock.

Keywords: *Aspergillus flavus*, kojic acid, optimisation, Response Surface Methodology (RSM), sago fibre, sago 'hampas', solid-state fermentation

INTRODUCTION

Kojic acid is a metabolite typically produced by *Aspergillus, Penicillium* and *Acetobacter*. The most prominent role of kojic acid is found to be in cosmetic, food and health care industries as it serves as an essential depigmenting agent for production of cosmetic products (Saeedi *et al*., 2019), antioxidant agents (Burnett *et al*., 2010) and food additives. Over the decades, kojic acid has replaced the role of hydroquinone, which has been banned in many healthcare products due to its carcinogenic effects (Saeedi *et al*., 2019). This has resulted in an escalating demand for kojic acid as the alternative depigmenting agent across the globe.

Conventionally, kojic acid is produced via chemical synthesis. Nonetheless, the method is claimed as cumbersome and expensive. Hence, adoption of fermentation as a production route has become a common practice particularly at the industrial level as it is more economical and environmentally friendly. A number of works have reported the production of kojic acid via fermentations addressing various aspects (Suhaili *et al*., 2015; Liu *et al*., 2016; Shakibaie *et al*., 2018). One of the remaining bottlenecks of the industrial production of kojic acid is the expensive cost of raw materials. Although there is a number of works that reported the production of kojic acid by fermentations, nevertheless, most of the works focused on the use of synthetic media as feedstocks, which are often deemed as costly.

Utilisation of agricultural residues as alternative substrates offers an economical and eco-friendly solution as they are relatively cheaper than synthetic media apart from their wide ubiquity. It is revealed that kojic acid can be produced using starchy sources such as corn starch (Futamura *et al*., 2001), sago starch and potato starch (Rosfarizan *et al*., 1998). Among the challenges related to the utilisation of agricultural waste as feedstocks for kojic acid production in the aforementioned works, which employed