UNIVERSITI TEKNOLOGI MARA

PRODUCTION OF LACCASE AND DECOLOURISATION OF TEXTILE DYES BY LOCAL WHITE-ROT FUNGI

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Candidate's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

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ABSTRACT

A total of 106 local white-rot fungi were screened for their ability to produce the enzyme laccase and to decolourise four textile dyes namely Remazol Brilliant Blue (RBB), Remazol Red (RR), Remazol Yellow (RY) and Procion Yellow (PY). Of these, 22 white-rot fungal isolates were able to produce laccase with activities exceeding 10 U/L. Among these 22 strains, seven decolourised RBB efficiently when cultured on solid media. Isolate UiTM80 was the most efficient decolourising strain and was able to decolourise RBB completely within 6 days. The corresponding laccase production in submerged fermentation reached a maximum of 67 U/L in 5 days. A Plackett-Burman Design and Response Surface Methodology (RSM) were employed to optimise the media for laccase production by UiTM80. Eight parameters were screened for their effects on laccase production; out of which pH and yeast extract were identified as the most significant media components. The RSM study suggested that the optimum media composition for laccase production is as follow: glucose, 10.0 g/L; KH_2PO_4, 0.50 g/L; trace elements, 5.00 mL/L; yeast extract, 9.83 g/L; ammonium tartarate, 5.24 g/L and pH 7.42. The experimental yield of laccase in this medium was 1,672 ± 950 U/L against a predicted yield of 1,850 U/L. Scale-up studies in a 5 litres-bioreactor showed that 10% inoculum (v/v) of UiTM80 was able to remove 91% of COD and 97% of colour from a 75 ppm RBB dye solution. In industrial textile wastewater, the fungus was able to remove 93% of COD and 33% of colour.

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CHAPTER 1

INTRODUCTION

Malaysia's textile industry has been the fourth largest foreign exchange earner in the last two decades. There are approximately 1500 textile factories in Malaysia, manufacturing different types of fabric and garments. In 2004, the Malaysian Textile Manufacturers Association (MTMA) reported that the total textile and apparel exports amounted to RM9.7 billion while from January to April 2005, the exports were worth RM3.1 billion (Malaysian Textile Manufacturers Association, 2005).

In order to cope with the increasing market demand from local or overseas market, many factories operate almost 24 hours a day. Hence, large amount of wastewater is produced. The textile manufacturing sector, either modern factories or conventional small-scale industries are still facing serious problems in complying with government specified effluent discharge standards (Sidhu & Abdul Hamid, 1993). The Department of Environmental (DOE) has in place stringent legislations which state that, under section 25 (1) of the Environmental Quality Act 1974, a fine not exceeding RM100,000.00 or a jail term of up to 5 years or both is imposable on offenders.

Textile wastewater generally contains approximately 10% of dyes escaping from the dyeing process. According to Jarosz-Wilkolazka *et al.* (2002), most of the dyes in the wastewater are highly resistant to microbial degradation. Therefore, conventional biological treatment plants often fail to remove dyes from the wastewater.

In Malaysia, textile wastewater is treated by using physico-chemical methods, anaerobic-aerobic methods and adsorption by activated carbon. Physical adsorption by activated carbon is the preferred method, since the colour in the effluent is efficiently