

PRODUCTION OF RED PIGMENT FROM
OIL PALM FROND USING *MONASCUS*
PURPUREUS FTC 5356 IN SOLID STATE
FERMENTATION

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Science in bioprocess technology.

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citation which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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LIST OF SYMBOLS

°C Degree Celcius

% Percentage

LIST OF ABBREVIATIONS

Abs	Absorbance
ANOVA	Analysis of variance
CCD	Central composite design
cm	Centimetre
df	Dilution factor
DM	Dry matter
DNS	Dinitrosalicylic acid
EFB	Empty fruit bunch
g	Gram
h	Hour
L	Litre
Mm	Milimetre
MPOB	Malaysian Palm Oil Board
nm	Nanometre
OD	Optical density
OFAT	One factor at One Time
OPB	Oil palm biomass
OPF	Oil palm frond
OPK	Oil palm kernel
OPS	Oil palm shell
OPT	Oil palm trunk
RSM	Response surface methodology
SmF	Submerge fermentation
SSF	Solid state fermentation

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ABSTRAK

Penghasilan pigmen merah oleh spesies *Monascus* telah dikenali sebagai pigmen yang boleh dimakan dimana kaya dengan pelbagai jenis aktiviti biologi. Secara tradisinya, pigmen dari *Monascus* telah dihasilkan dengan menggunakan tepung beras sebagai substrat, namun kelemahannya ialah tidak praktikal untuk skala komersial berikutan harganya yang mahal. Untuk mengurangkan kos, penggunaan pelepah kelapa sawit (OPF) sebagai substrat alternatif telah dikaji. Kajian ini memberi tumpuan kepada pemajuan dan pengoptimuman pengeluaran pigmen merah dari *Monascus purpureus* FTC 5356 menggunakan OPF sebagai substrat dalam fermentasi pepejal. Dapatan kajian yang dibentangkan dalam tesis ini adalah berdasarkan kepada siri eksperimen yang dijalankan berbeza-beza mengikut kerumitan seperti dari eksperimen mudah seperti satu faktor dalam satu masa (OFAT) kepada proses penyaringan, pengoptimuman dan proses pengesanan. Untuk menetapkan julat bagi setiap faktor, lima faktor seperti kandungan kelembapan awal OPF (%), pH awal (pH), peratusan pepton (%), peratusan batang OPF dan saiz inokulum (spora / ml) adalah dinilai melalui kaedah OFAT. Untuk penyaringan, teknik reka bentuk faktorial digunakan dan didapati bahawa peratusan pepton, kandungan kelembapan awal, dan nilai pH merupakan faktor yang menyumbang kepada peningkatan pengeluaran pigmen merah. Untuk pengoptimuman, kaedah *Central Composite Design* (CCD) dari *Response Surface Methodology* (RSM) telah digunakan dan dalam keadaan optimum, didapati bahawa nilai pH awal adalah faktor yang paling penting yang mempengaruhi dalam pengeluaran pigmen merah. Penghasilan pigmen merah menunjukkan peningkatan dari 2.90 AU/g (sebelum optimum) kepada 46 AU/g (selepas optimum). Konklusinya, penggunaan OPF untuk penghasilan pigmen merah dari *Monascus purpureus* FTC 5356 telah berjaya dan mempunyai potensi tinggi untuk digunakan sebagai substrat kos rendah.

ABSTRACT

Production of red pigment by *Monascus* species has known as an edible pigment which rich in wide range of biological activities. Traditionally, *Monascus* pigment has been produced using rice powder as a culture substrate, which was industrially impractical due to pricey. To reduce the cost, the feasibility of oil palm fronds (OPF) used as an alternative substrate was investigated. This work focused on development and optimization of red pigment production from *Monascus purpureus* FTC 5356 using OPF as a substrate in solid state fermentation. The research findings presented in this thesis are based on a series of experiments carried out varying in complexity such as from simple preliminary and One Factor at One Time (OFAT) process to screen, optimize and validate process. In order to set the range for each factor, five factors which are initial moisture content of OPF (%), initial pH (pH), percentage of peptone (%), percentage of petiole and size of inoculums (spores/ml) were evaluated through OFAT method. For screening, factorial design technique was used and it was found that percentage of peptone, initial moisture content, and initial pH were the significant factors that contribute to the increasing of red pigment production. For optimization, Central Composite Design (CCD) of Response Surface Methodology (RSM) was used. Under the optimal condition, it was found that initial pH was the most significant factor that influences the red pigment production. The red pigment yield shows the increment from 2.90 AU/g (before optimized) to 46 AU/g (after optimized). As a conclusion, the usage of OPF is succeeded and has high potential as an alternative low-cost substrate for red pigment production by using *Monascus purpureus* FTC 5356.

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