

OPTIMIZATION AND KINETIC STUDY OF  
PIGMENTS PRODUCTION ON SOLID STATE  
FERMENTATION USING OIL PALM FROND  
BY *MONASCUS PURPUREUS* FTC 5357

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## ABSTRAK

*Monascus* sp. dapat menghasilkan pigmen *Monascus* yang bermanfaat sehingga banyak digunakan dalam industri makanan. Terdapat kajian ekstensif terhadap *Monascus* sp. dalam penapaian keadaan pepejal (PKP) menggunakan kelalang, namun begitu, kajian *Monascus* sp. menggunakan bioreaktor dram teraduk tidak banyak dikaji. Oleh itu, kajian ini bertujuan untuk mengoptimalkan pengeluaran pigmen (iaitu kuning, oren dan merah) dari *Monascus purpureus* FTC 5357 menggunakan pelepah kelapa sawit (PKS) dalam bioreaktor 5 L dram teraduk. Sebelum proses PKP, rawatan hidrotermal (121 ° C, 15 min) dilakukan. Reka bentuk Box – Behnken (BB) tiga aras digunakan untuk pengoptimuman dengan tiga parameter seperti kandungan kelembapan awal, kadar pengudaraan dan kepekatan pepton. PKS yang telah difermentasi diekstrak dan dianalisis untuk pengeluaran pigmen (iaitu kuning, oren dan merah), kepekatan biojisim dan glukosa. Seterusnya, profil kinetik pada keadaan optimum dan parameter kinetik juga dinilai. Berdasarkan hasil analisis ANOVA, kandungan kelembapan awal, kadar pengudaraan dan kepekatan pepton memberikan impak yang besar terhadap pengeluaran pigmen. Keadaan penapaian yang optimum adalah kandungan kelembapan awal pada 70% w/w, kadar pengudaraan pada 1.30 vvm dan kepekatan pepton pada 4.40% w/w. Dalam keadaan ini, pengeluaran pigmen masing-masing diperoleh pada 22.03, 20.11 dan 18.59 Au/g.d untuk kuning, oren dan merah. Eksperimen pengesahan dilakukan untuk mengesahkan kecukupan model dengan menghasilkan pigmen dalam keadaan optimum. Hasil kajian menunjukkan pentingnya kandungan kelembapan awal, kadar pengudaraan dan kepekatan pepton untuk pengeluaran pigmen dan biomas. Kadar pertumbuhan spesifik maksimum, hasil pertumbuhan, hasil pigmen, produktiviti sel dan produktiviti pigmen untuk kuning, oren dan merah adalah masing-masing 0.707 d<sup>-1</sup>, 0.15 mg/mg, 0.193 Au/mg sel, 12.514 mg/(g.d), 2.447 Au/(g.d.d), 2.234 Au/(g.d.d) dan 2.065 Au/(g.d.d). Pigmen yang dihasilkan melalui proses PKP menggunakan PKS sebagai substratum oleh *Monascus purpureus* FTC 5357 berpotensi besar untuk digunakan sebagai sumber pigmen untuk makanan di masa depan.

## ABSTRACT

*Monascus* sp. produce useful *Monascus* pigments that widely used in food industry. Extensive study available on *Monascus* sp. in solid-state fermentation (SSF) using shake flask, however, cultivation of *Monascus* sp. in stirred drum bioreactor is insufficiently reported. Thus, this study aims to optimize pigments production (i.e. yellow, orange and red) from *Monascus purpureus* FTC 5357 using oil palm frond (OPF) in 5 L stirred-drum bioreactor. Prior to the SSF process, hydrothermal treatment (121 °C, 15 min) was done. A three-level Box–Behnken design (BBD) was used for the optimization, with three-parameters such as initial moisture content (IMC), aeration rate (AR) and peptone concentration (PC). The dried fermented OPF were extracted and analysed for pigments production (i.e. yellow, orange and red), biomass and glucose concentration. Next, the kinetic profile of the optimize condition and kinetic parameters were also been evaluated. Based on the ANOVA analysis results, IMC, AR and PC contributed significantly to the pigments production. The optimal fermentation conditions resulted IMC at 70 % w/w, AR at 1.30 vvm and PC at 4.40 % w/w. Under these conditions, the pigments production were obtained at 22.03, 20.11 and 18.59 Au/g.d for yellow, orange and red, respectively. Validation experiment was done to confirm the adequacy of the models. The fermentation profile at optimized condition indicated that *Monascus purpureus* FTC 5357 reached maximum pigments and biomass at day 9. Results obtained from this study showed the importance of IMC, AR and PC for pigments production and biomass. Meanwhile, the production kinetic parameters such as maximum specific growth rate, the growth yield, pigment yield, cell productivity, pigments productivity for yellow, orange and red were 0.707 day<sup>-1</sup>, 0.15 mg/mg, 0.193 Au/mg cell and 12.514 mg/(g.day), 2.447 Au/(g.d.day), 2.234 Au/(g.d.day) and 2.065 Au/(g.d.day), respectively. The pigments produced through SSF process using OPF as a substrate by *Monascus purpureus* FTC 5357 has a great potential to be utilized as a source of pigment for food in future.

## TABLE OF CONTENT

<b>DECLARATION</b>	
<b>TITLE PAGE</b>	
<b>ACKNOWLEDGEMENTS</b>	<b>ii</b>
<b>ABSTRAK</b>	<b>iii</b>
<b>ABSTRACT</b>	<b>iv</b>
<b>TABLE OF CONTENT</b>	<b>v</b>
<b>LIST OF TABLES</b>	<b>ix</b>
<b>LIST OF FIGURES</b>	<b>x</b>
<b>LIST OF SYMBOLS</b>	<b>xii</b>
<b>LIST OF ABBREVIATIONS</b>	<b>xiv</b>
<b>CHAPTER 1 INTRODUCTION</b>	<b>1</b>
1.1 Research Background	1
1.2 Problem Statement	3
1.3 Research Objective	4
1.4 Scope of Study	4
1.5 Thesis Overview	5
<b>CHAPTER 2 LITERATURE REVIEW</b>	<b>7</b>
2.1 Food Colorant	7
2.1.1 Synthetic Food Colorants	7
2.1.2 Natural Food Colorants	8
2.2 Fermentation	10
2.2.1 Type of Fermentation	10
2.2.2 <i>Monascus purpureus</i>	15



2.2.3	Substrate	18
2.3	Parameters Affect the Pigment Production	21
2.3.1	Nitrogen Source	22
2.3.2	Carbon Source	23
2.3.3	Aeration	23
2.3.4	Initial Moisture Content (IMC)	24
2.3.5	pH	25
2.3.6	Temperature	26
2.4	Optimization of Pigment Production	27
2.4.1	Response Surface Methodology (RSM)	27
2.5	Kinetic Study	34
2.6	Chapter Summary	35
 <b>CHAPTER 3 METHODOLOGY</b>		 <b>36</b>
3.1	Introduction	36
3.2	Materials	38
3.2.1	Chemicals	38
3.2.2	Microorganism and Conservation	38
3.3	Substrate Preparation (Hydrothermal Treatment)	39
3.4	Inoculum Preparation	40
3.5	Solid State Fermentation	41
3.5.1	Stirred Drum Bioreactor	41
3.5.2	Fermentation Profile	42
3.5.3	Experimental Design	43
3.5.4	Fermentation Profile at Optimized Condition	45
3.5.5	Growth Kinetic Parameter Values	45

3.6	Analysis of Responses	47
3.6.1	Pigments concentration	47
3.6.2	Biomass estimation	47
3.6.3	Determination of glucose concentration	48
<b>CHAPTER 4 RESULTS AND DISCUSSION</b>		<b>50</b>
4.1	Characterization of Oil Palm Frond (OPF)	50
4.1.1	Composition Changes of OPF before and after Treatment	50
4.1.2	Fourier Transform IR Spectroscopy (FTIR) Analysis of Functional Groups	51
4.1.3	Morphology Changes of OPF before and after Treatment	54
4.2	Fermentation Profile	55
4.3	Optimization of Pigments Production by Box-Behken Design (BBD)	57
4.3.1	Analysis of Variance (ANOVA)	59
4.3.2	Analysis of Response Surface	70
4.3.3	Validation Test	89
4.3.4	Effect of Optimized Condition on Microstructure Changes	90
4.4	Kinetic of Pigments Production at Optimized Condition	91
4.4.1	Fermentation Profile	91
4.4.2	Production Kinetic Parameters of <i>Monascus purpureus</i> FTC 5357	94
4.5	Summary of Key Experimental Finding	96
<b>CHAPTER 5 CONCLUSION</b>		<b>98</b>
5.1	Conclusion	98
5.2	Recommendations	99



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