



UNIVERSITI PUTRA MALAYSIA

**CHEMICAL COMPOSITION OF STABILIZED RICE BRAN MILLING
FRACTIONS AND CHARACTERIZATION OF THEIR FERULIC ACID
RICH EXTRACTS**

RAJA ROHAYA BT. RAJA SULAIMAN

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By

RAJA ROHAYA BT. RAJA SULAIMAN

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in
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September 2009



DEDICATION



To my dearest.....

*.....loving **hubby** (for the unbreakable patience and understanding...), who would have loved to see this thesis completed.*

For my beloved....

*..... **Che** and **Ayah** (for the strength and courage...), who have devoted themselves for their children well-beings.*

*To **Kak Inie**, **Kak Nora**, **Adique**, **Imie**, **Irie**, **Idie** and **Iden**...and also my other family members and in-laws....*

....Thank you

.... Thank you

.....Thank you

*Lastly, but not the least....to my precious **Nik Muhammad Nafiz Najwan**....*

You are the best gift yet the toughest test...

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

CHEMICAL COMPOSITION OF STABILIZED RICE BRAN MILLING FRACTIONS AND CHARACTERIZATION OF THEIR FERULIC ACID RICH EXTRACTS

By

RAJA ROHAYA BINTI RAJA SULAIMAN

September 2009

Chairman : Dr Azizah Hj. Abd. Hamid, PhD

Faculty : Food Science and Technology

The research was carried out to study the characteristics of local stabilized rice bran. Four rice bran-milling fractions, after stabilized by microwave heating, were analyzed for their chemical composition. Its potential as a source of phenolic antioxidants was investigated by assessing the Total Phenolic Compounds (TPC) by spectrophotometry and the effect of stabilization. The fraction with the highest yield of TPC was subjected to High Performance Liquid Chromatography (HPLC) analysis for phenolic compounds profiling. The yield and selectivity of different extraction solvents for phenolic compounds analysis were investigated. Phenolic acid content of the crude extract of the 1st Rice Bran Milling Fraction which fractionated by Sephadex LH-20 column chromatography was determined by HPLC. The antioxidant capacity of isolated rice bran extracts were assayed by Ferric Thiocyanate (FTC) and Thiobarbituric Acid Reactive Substances (TBARS). Results showed that all milling fractions especially the 1st fraction were rich in fat, protein, carbohydrates and total dietary fibre (TDF). The TPC found in rice bran in



decreasing order was: Fraction 1 > Fraction 3 > Fraction 2 > Fraction 4. The TPC of all fractions were detected at 257-488 mg ferulic acid equivalent/kg. The stabilization gave no losses of phenolic compounds in all bran fractions studied except for Fraction 3. The efficiency of various solvent to extract phenolic acids from rice bran in decreasing order was: 1 % acidified water > ethanol > acetone \approx methanol > ethyl acetate. The 1st rice bran milling fraction contained highest of ferulic acid, followed by *p*-coumaric, caffeic acid and sinapic acid. Rice bran was found to be potentially a source of phenolic compounds particularly the 1st milling fraction. The amount of TPC in fractionated extracts (Fraction A – D) was about 6-folds higher than that in stabilized rice bran. Fraction C and D contained higher ferulic acid at 831.51 and 841.54 ppm; respectively, may ideally serve as the ferulic acid-rich extracts. FTC and TBARS methods showed Fraction A - D possessed significantly higher inhibition activities than that of α -tocopherol. Thus, the fractionation employed was efficient in obtaining the ferulic acid rich-extracts with comparable antioxidative activities. Apart from increasing the utilizations of local raw materials, the first rice bran fraction was found to be an excellent source of energy, fat, mineral and could be a very good source of dietary fiber and other nutrients especially many health-promoting components such as ferulic acid. Therefore, the rice bran fraction can be a potential natural source of antioxidants or as a value-added product to variety of functional foods.

Keywords: rice bran, stabilization, proximate composition, total phenolic compounds (TPC), fractionation, ferulic acid-rich extract, FTC, TBARS, antioxidant activity.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

**KOMPOSISI KIMIA BAHAGIAN KISARAN DEDAK BERAS YANG
DISTABILKAN DAN PENCIRIAN EKSTRAK YANG KAYA ASID
FERULIK**

Oleh

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Penyelidikan ini dijalankan bagi mengkaji ciri-ciri dedak beras tempatan yang distabilkan. Empat fraksi kisaran dedak beras, setelah distabilkan melalui pemanasan mikrogelombang, dianalisis bagi komposisi kimia mereka. Potensi sebagai sumber antioksidan fenolik dikaji melalui penentuan Jumlah Sebatian Fenolik (JSF) dengan kaedah spektrofotometer serta kesan ke atas penstabilan. Fraksi dengan hasil JSF yang tertinggi dianalisis dengan Kromatografi Cecair Prestasi Tinggi (KCPT) bagi sebatian fenolik. Hasil dan kecenderungan pelbagai pelarut pengekstrakan ke atas analisis sebatian fenolik telah diselidik. Kandungan asid fenolik bagi ekstrak kasar fraksi kisaran-pertama dedak beras yang telah diperingkatkan melalui kromatografi turus Sephadex LH-20 telah ditentukan KCPT. Kaedah FTC dan TBARS telah digunakan untuk mengkaji keupayaan antioksidan ekstrak dedak beras. Keputusan menunjukkan semua fraksi kisaran terutama fraksi pertama adalah kaya lemak, protein, karbohidrat dan Jumlah Serabut Diet (JSD). JSF dedak beras yang ditemui mengikut turutan menurun: Fraksi 1 > Fraksi 3 > Fraksi 2 > Fraksi 4. JSF kesemua fraksi dikesan sebanyak 257 - 488 mg bersamaan asid ferulik /kg.

Penstabilan itu tidak menyebabkan kehilangan sebatian fenolik dalam semua fraksi dedak kecuali Fraksi 3. Kecekapan pelbagai pelarut untuk mengekstrak asid fenolik daripada dedak beras dalam turutan menurun adalah: air berasid 1 % > etanol > aseton \approx metanol > etil asetat. Fraksi kisanan-pertama dedak beras mengandungi asid ferulik yang tertinggi, diikuti oleh asid *p*-kumarik, asid kafeik, dan asid sinapik. Dedak beras didapati berpotensi sebagai sumber sebatian-sebatian fenolik terutama Fraksi kisanan-pertama. Amaun JSF ekstrak terperingkat (Fraksi A - D) adalah 6 kali lebih tinggi daripada dedak yang distabilkan. Fraksi C dan D mengandungi lebih tinggi asid ferulik iaitu 831.51 dan 841.54 ppm, adalah sesuai sebagai ekstrak kaya-asid ferulik. Kaedah FTC dan TBARS menunjukkan Fraksi A - D mempunyai aktiviti perencatan lebih tinggi dan signifikan daripada α -tocopherol. Oleh itu, pemeringkatan yang digunakan adalah berkesan dalam mendapatkan ekstrak kaya-asid ferulik dengan aktiviti antipengoksida yang setanding. Selain meningkatkan penggunaan bahan-bahan mentah tempatan, fraksi pertama dedak beras didapati sebagai sumber terbaik tenaga, lemak, mineral dan mungkin satu sumber serat pemakanan yang amat bagus dan nutrien lain terutama banyak komponen-komponen yang meningkatkan kesihatan seperti asid ferulik. Oleh itu, fraksi dedak beras ini mungkin berpotensi sebagai satu sumber antipengoksida semulajadi atau sebagai satu nilai tambah produk untuk pelbagai jenis makanan berfungsi.

Katakunci: dedak beras, penstabilan, komposisi proksimat, Jumlah Sebatian Fenolik (JSF), pemeringkatan, ekstrak kaya-asid ferulik, FTC, TBARS, aktiviti antipengoksida.

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I certify that an Examination Committee met on **8.9.2009** to conduct the final examination of **Raja Rohaya Binti Raja Sulaiman** on her **Master of Science** thesis entitled "**Chemical Composition Stabilized Rice Bran Milling Fractions And Characterization Of Their Ferulic Acid Rich Extracts**" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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Date : 12 August 2010



DECLARATION

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

RAJA ROHAYA RAJA SULAIMAN

Date : 8 September 2009

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