UNIVERSITI PUTRA MALAYSIA

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AQUEOUS ENZYMATIC EXTRACTION AND BASIC QUALITY ASSESSMENT OF RICE (*Oryza sativa L.*) BRAN OIL

MOHAMED REZA HUSSAIN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia in Fulfillment of the Requirement for the Degree of Master of Science.

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This dissertation is dedicated to

Norihan Zakaria

for endurance, inspiration, encouragement, understanding, sacrifices and doa's during the completion of this project.

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

AQUEOUS ENZYMATIC EXTRACTION AND BASIC QUALITY ASSESSMENT OF RICE (*Oryza sativa* L.) BRAN OIL

By

MOHAMED REZA HUSSAIN

June 2011

Chairperson : Associate Professor Azizah Hj Abd Hamid, PhD

Faculty : Faculty of Food Science and Technology

Rice bran, an industrial by-product of rice milling is rich in proteins, lipids, dietary fibers and antioxidant compounds, such as tocopherol, tocotrienol and oryzanol. This study evaluated the chemical composition of rice bran obtained from 4 Malaysian rice varieties. Results indicated that there is no significant (*P>0.05*) difference in chemical composition of all varieties analyzed. The effect of individual and mixtures of enzymes, namely cellulase (Celluclast 1.5L), protease (Alcalase), amylase (Termamyl), polygalacturonase (Viscozyme), and pectinase (Pectinex ULTRA SP-L) combined with other process parameters - dilution ratio, aqueous media, homogenization, mixing equipment, and centrifugation speed at different level on rice bran oil yield was evaluated. Results of the study showed that these enzymes had successfully extracted the rice bran oil from rice bran (75.66%) compared to that without enzymes (18.97%). Results also showed that using Alcalase resulted in higher oil yield compared to other enzymes. The maximum oil recovery of 70.3% was achieved at pH 9 and 70^{o}C with <750 μm particle size bran, 2.0%

enzyme concentration and 3-hour extraction times. Iodine value (104.7± 0.3 *g* iodine/100 g oil*)*, peroxide value (0.5± 0.2 meq/kg) and anisidine value (24.8± 0.2) of enzyme extracted oil obtained was comparable to that of commercially available rice bran oil. The oil however, was found to contain appreciable free fatty acid (2.6± 0.3 as % oleic acid), although still within the acceptable level for edible oils. It is encouraging to note that the enzyme extracted oil consisted of significantly higher concentration of both total and individual isomers (α-, β+γ, δ-) of tocopherol and tocotrienol compared SE oil. High level of oryzanol (2344 ppm) and carotenoids (β-carotene and lycopene) (58.72 and 12.74 ug/100g) were also found in the oil. The result showed that enzymatic extracted rice bran oil exhibited appreciable antioxidative activity that was significantly ($P<0.05$) highest compared to that of solvent extracted as measured by DPPH radical scavenging method, ferric thiocyanate (FTC) and thiobarbituric acid (TBA) tests. The study revealed that RB from Malaysian rice consisted of excellent level of nutrient especially many health promoting constituents and which could be considered as the most valuable rice milling process. The study also demonstrated that extracts of the RBO are a viable source of natural antioxidants or as value–added products in the preparation of specialty oil and for enrichment of certain products such as salad oil or functional ingredient in the development of functional food.

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

PENGEKSTRAKAN AKUAS BERENZIM DAN PENILAIAN KUALITI ASAS MINYAK DEDAK BERAS (O*ryza sativa* L.)

Oleh

MOHAMED REZA HUSSAIN

Jun 2011

Pengerusi : Professor Madya Azizah Hj Abd Hamid, PhD

Fakulti : Fakulti Sains dan Teknologi Makanan

Dedak beras merupakan satu hasil sampingan pengilangan beras yang kaya dengan sumber protein, lemak, serat diet dan bahan antioksidan seperti tokoferol, tokotrienol dan orizanol. Kajian ini dijalankan untuk menentukan komposisi kimia dedak 4 varieti beras di Malaysia. Keputusan menunjukkan bahawa tiada perbezaan yang signifikan ($P>0.05$) di dalam komposisi kimia untuk semua varieti beras yang dianalisis. Kesan enzim secara individu dan campuran enzim iaitu enzim selulase (Celluclast 1.5L), protease (Alcalase), amilase (Termamyl), poligalakturonase (Viscozyme), dan pektinase (Pectinex SP-L ultra) untuk mengekstrak minyak dedak beras telah digabungkan dengan lain-lain parameter iaitu nisbah pencairan, jenis media berair, kaedah penghomogenan, peralatan pencampuran dan kelajuan pengemparan pada tahap yang berbeza telah dinilai. Keputusan kajian menunjukkan bahawa enzim tersebut telah berjaya mengekstrak minyak dedak beras (75.66%) berbanding tanpa penggunaan sebarang enzim semasa pengekstrakan (18.97%). Dari keputusan analisis, didapati penggunaan Alcalase telah menghasilkan kandungan minyak yang lebih tinggi berbanding penggunaan enzim yang

lain. Perolehan minyak yang maksimum sebanyak 70.3% telah dicapai pada pH 9 dan 70^{o}C dengan < 750μm saiz zarah dedak, kepekatan 2.0% enzim dan 3-jam masa untuk pengekstrakan. Nilai iodin (104.7± 0.3 g iodine/100 g minyak), nilai peroksida (0.5± 0.2 meq/kg) dan nilai anisidin (24.8± 0.2) minyak pengekstrakan enzim adalah setanding dengan minyak dedak beras yang didapati di pasaran. Walaubagaimanapun, minyak dedak beras didapati mengandungi asid lemak bebas yang memadai (2.6± 0.3 sebagai % asid sebagai % oleik), walaupun ianya masih berada pada tahap yang boleh diterima sebagai minyak makan. Hal ini mendorong untuk diberi perhatian bahawa pengekstrakan enzim menghasilkan minyak yang mengandungi kepekatan tokoferol dan tocotrienol beserta individu isomernya (α-, β + γ, δ-) jauh lebih tinggi. Kandungan orizanol (2344 ppm) dan karotenoid (β-karotena and likopena) (58.72 and 12.74 ug/100g) yang dikesan juga adalah tinggi berbanding pengekstrakan mengunakan pelarut. Keputusan kajian menunjukkan bahawa ekstrak berenzim minyak dedak mempunyai aktiviti antioksidan yang lebih tinggi secara signifikan ($P < 0.05$) berbanding dengan ekstrak berpelarut yang diukur dengan kaedah pemerangkapan radikel DPPH, ferik tiosianat (FTC) dan ujian asid tiobarbiturik (TBA). Keputusan kajian menunjukkan bahawa varieti beras Malaysia mengandungi kandungan nutrien yang sangat baik terutamanya mengandungi juzuk yang boleh meningkatkan kesihatan dan boleh dianggap sebagai proses pengilangan padi yang paling berharga. Kajian juga menunjukkan bahawa ekstrak dari minyak dedak beras adalah sumber antioksidan semulajadi yang tinggi dan sebagai nilai tambah produk dalam penyediaan minyak khusus dan untuk memperkayakan produk tertentu seperti minyak salad atau sebagai ramuan fungsian dalam pembangunan makanan berfungsi.

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This thesis was submitted to the Senate of Universiti Putra Malaysia has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Azizah Abdul Hamid, Ph.D.
Associate Professor,
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Chairman)

Yaacob Che Man, Ph.D.
Professor
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Member)

Nazamid Saari, Ph.D.
Professor,
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Member)

Azizah Osman, Ph.D.
Professor,
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Member)

_____

HASANAH MOHD GHAZALI, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia
Date :

DECLARATION

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

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MOHAMED REZA HUSSAIN

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