



UNIVERSITI PUTRA MALAYSIA

**THE EFFECTS OF RICE BRAN AND BLENDED RICE BRAN OILS ON
INDICES OF CORONARY HEART DISEASE**

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**THE EFFECTS OF RICE BRAN AND BLENDED RICE BRAN OILS ON
INDICES OF CORONARY HEART DISEASE**

By

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THE EFFECTS OF RICE BRAN AND BLENDED RICE BRAN OILS ON INDICES OF CORONARY HEART DISEASE

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June 2005

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Reducing dietary saturated fatty acid, increasing dietary polyunsaturated fatty acid together with the presence of naturally occurring plant minor components in fats and oil have been shown to be able to reduce plasma cholesterol level. In this study, the hypocholesterolemic effects of rice bran and blended rice bran oils were investigated. In an animal study to determine the effect of defatted and fullfat rice brans, hypercholesterolemia-induced male *Sprague Dawley* rats (n=77) were divided into five groups receiving diets containing; normal chow (Control), defatted rice bran diet (10% TDF; DFBC), full-fat rice bran diet (10% TDF; FRBC), cellulose diet (10% TDF; CC) and normal chow containing cholesterol (NC). All experimental diets contained 0.3% cholesterol and 0.1% cholic acid except for the Control group. Blood samples were collected at week 3 for lipid profile determination. Results of this study showed that animals on FRBC diet had lower plasma total and LDL cholesterol levels compared to animals on



DFBC and CC diets. Animals fed both DFBC and CC diets, however had higher plasma total and LDL cholesterol levels compared to the NC group. These results demonstrated that only full-fat rice bran diet caused significant reduction ($p < 0.05$) in plasma total and LDL cholesterol. The higher content of unsaturated fatty acids (75%) and the presence of high unsaponifiable matter in the rice bran lipid fraction are suggested to contribute to the cholesterol reduction. In summary, local full-fat rice bran could be used as a good agent to reduce plasma cholesterol level.

A human feeding study was carried out to determine the effects of experimental oils [palm oil (100% PO), rice bran oil (100% RBO) and blended rice bran-palm oils; 45% RBO and 60% RBO] on CHD indices of normocholesterolemic to mild hypercholesterolemic subjects ($n=18$). The subjects received normal diets prepared using each experimental oil for 5 weeks in a single blind crossover design. In this study, diets prepared using experimental oils, did not significantly ($p > 0.05$) alter the plasma lipid profile of subjects. However, blended oil diets (45% and 60% RBO) improved the LDL/HDL ratio of subjects with 45% RBO favourable for normo- and 60% RBO favourable for mild hypercholesterolemic subjects. Other indicators such as apo A1, apo B, Lp(a) and plasma antioxidant enzymes (glutathione reductase and glutathione peroxidase) of subjects were not affected by the dietary changes induced in the experimental oils used. The 45% RBO and 60% RBO diets also caused significant reduction ($p < 0.05$) in plasma conjugated diene and malondialdehyde levels of subjects. Plasma total antioxidant status of subjects increased following intake of blended oil diets with

the highest total antioxidant status level during intake of 60% RBO diet. The increased total antioxidant status was related to significantly ($p < 0.05$) higher level of plasma tocotrienol (5.19 ppm) compared to other diets (< 2 ppm). These results demonstrated that both blended oils (45% RBO and 60% RBO) have shown some functional properties (relative to 100% RBO and 100% PO) in improving indicators of CHD. Blending of RBO and PO at specific ratios improved the fatty acid composition and antioxidant contents of the resulting oils. There could be some interactions between palm tocotrienol and rice bran oryzanol in the blended oil diets that resulted to these beneficial effects. In future, further studies are needed to determine the exact mechanisms involved.



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**KESAN DEDAK BERAS DAN MINYAK CAMPURAN DEDAK BERAS KE
ATAS PENUNJUK PENYAKIT JANTUNG KORONARI**

Oleh

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Perubahan diet yang mengurangkan pengambilan asid lemak tepu, meningkatkan pengambilan asid lemak politaktepu serta kehadiran bahan komponen minor dalam lemak dan minyak didapati dapat menurunkan aras kolesterol darah. Dalam kajian ini, kesan hipokolesterolemik dedak beras dan minyak campuran dedak beras telah pun dijalankan. Dalam kajian haiwan untuk menentukan kesan dedak beras nyah lemak dan penuh lemak, tikus jantan dari jenis *Sprague Dawley* teraruh tinggi kolesterol (n=77) telah dibahagikan kepada lima kumpulan yang menerima diet mengandungi; makanan tikus biasa (Kawalan), dedak beras nyah lemak (10% jumlah fiber diet; DFBC), dedak beras penuh lemak (10% jumlah fiber diet; FRBC), selulosa (10% jumlah fiber diet; CC) dan campuran makanan tikus biasa dan kolesterol (NC). Kesemua diet kajian mengandungi 0.3% kolesterol dan 0.1% asid kolik kecuali bagi diet kumpulan kawalan. Sampel-sampel darah haiwan telah diambil pada akhir minggu ke-3 bagi penentuan profil lipid. Keputusan kajian ini mendapati, haiwan yang diberi

makan diet FRBC mempunyai aras total dan LDL kolesterol dalam plasma yang lebih rendah berbanding haiwan yang diberi makan diet DFBC dan CC. Haiwan yang diberi diet DFBC dan CC didapati mempunyai aras total dan LDL kolesterol dalam plasma yang lebih tinggi berbanding haiwan yang menerima diet NC. Hasil kajian ini mendapati hanya diet mengandungi dedak beras penuh lemak menyebabkan penurunan yang signifikan ($p < 0.05$) aras total kolesterol dalam plasma. Kehadiran asid lemak politatkepu (75%) dan bahan tidak disaponifikasi dalam fraksi lipid dedak beras telah dicadangkan menyebabkan kesan penurunan kolesterol. Sebagai kesimpulan, didapati dedak beras penuh lemak tempatan adalah sesuai digunakan sebagai agen yang mampu menurunkan aras kolesterol dalam darah.

Satu kajian pemakanan menggunakan subjek manusia bagi mengkaji kesan penggunaan minyak masak kajian [minyak sawit (100% PO), minyak dedak beras (100% RBO) dan minyak campuran dedak beras-sawit; iaitu 45% RBO dan 60% RBO] ke atas petunjuk penyakit jantung koronari (CHD) subjek normokolesterolemik sehingga hiper kolesterolemik sederhana ($n=18$) telah dijalankan. Subjek menerima diet biasa yang telah disediakan dengan menggunakan minyak masak kajian selama lima minggu bagi setiap jenis diet. Kajian ini telah menggunakan rekabentuk silang. Diet yang telah disediakan menggunakan minyak masak kajian, didapati tidak mempengaruhi profil lipid darah subjek secara signifikan ($p > 0.05$). Walau bagaimanapun, diet yang telah disediakan menggunakan kedua-dua minyak masak campuran (45% RBO dan 60% RBO) didapati dapat memperbaiki nisbah LDL/HDL subjek dengan minyak

campuran 45% RBO didapati baik untuk subjek normokolesterolemik manakala minyak campuran 60% RBO adalah baik untuk subjek hiper kolesterolemik sederhana. Sebaliknya, petunjuk lain seperti apo A1, apo B, Lp(a) dan enzim-enzim antioksidan dalam plasma seperti glutathion reduktase dan glutathion peroksidase tidak dipengaruhi oleh perubahan diet melalui perubahan minyak yang digunakan. Minyak campuran 45% RBO dan 60% RBO juga didapati telah menyebabkan penurunan yang signifikan ($p < 0.05$) dalam aras diena konjugat dan malondialdehid dalam plasma. Aras status antioksidan total dalam plasma juga meningkat dengan pengambilan diet menggunakan minyak campuran; terutamanya minyak campuran 60% RBO yang telah memberikan aras status antioksidan total tertinggi. Aras yang tinggi ini adalah disebabkan peningkatan kandungan tokotrienol yang signifikannya ($p < 0.05$) dalam plasma (5.19ppm) berbanding dalam diet lain (< 2 ppm). Keputusan kajian ini telah mendapati bahawa minyak campuran dedak beras-sawit telah menunjukkan sifat berfungsi yang baik (berbanding minyak 100% RBO dan 100% PO) terhadap petunjuk penyakit jantung koronari. Percampuran minyak dedak beras-sawit pada nisbah tertentu didapati telah memperbaiki komposisi asid lemak dan kandungan antioksidan dalam minyak yang terhasil. Kemungkinan terdapat interaksi di antara tokotrienol dari minyak sawit dan orizanol dari minyak dedak dalam diet yang telah disediakan dengan menggunakan minyak campuran yang telah memberikan kesan baik yang telah dapat dilihat. Pada masa hadapan, kajian lanjutan perlu dijalankan untuk menentukan mekanisme sebenar yang terlibat.

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I certify that an Examination Committee met on 27th June 2005 to conduct the final examination of Azrina bt Azlan on her Doctor of Philosophy thesis entitled "The Effects of Rice Bran and Blended Rice Bran Oils on Indices of Coronary Heart Disease" 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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DECLARATION

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


AZRINA AZLAN
Date: 28/01/05

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LIST OF ABBREVIATIONS

ACAT	Acyl-CoA: cholesterol O-acyltransferase
AHA	American Heart Association
AOAC	Association of Official Analytical Chemists
Apo(a)	Apoprotein (a)
Apo(b)	Apoprotein (b)
BMI	Body mass index
CAD	Coronary artery disease
CD	Conjugated diene
CHD	Coronary heart disease
EDTA	Ethylene diamine tetra acetic acid
FAME	Fatty acid methyl ester
FAO	Food and Agricultural Organization
GPX	Glutathione peroxidase
GR	Glutathione reductase
HDL-C	High density lipoprotein cholesterol
IDL	Intermediate density lipoprotein cholesterol
LCAT	Lecithin cholesterol acyl transferase
LDL-C	Low-density lipoprotein cholesterol
Lp(a)	Lipoprotein (a)
LPL	Lipoprotein lipase
MDA	Malondialdehyde
MUFA	Monounsaturated fatty acids

NCEP	National Cholesterol Education Programme
P/S	Polyunsaturated to saturated ratio
PL	Phospholipid
PO	Palm oil
PUFA	Polyunsaturated fatty acids
RBO	Rice bran oil
SD	Standard deviation
SEM	Standard error mean
SFA	Saturated fatty acids
SOD	Superoxide dismutase
T3	Tocotrienol
TAS	Total antioxidant status
TBARS	Thiobarbituric acid reactive substance
TC	Total cholesterol
TFA	<i>Trans</i> fatty acids
T	Tocopherol
VLDL-C	Very low-density lipoprotein