UNIVERSITI PUTRA MALAYSIA

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By

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

ENZYMATIC TREATMENT IN IMPROVING NUTRITIVE VALUE OF LOCAL BROWN RICE FOR POULTRY FEED

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NURUL ASYIFAH MUSTAPHA

November 2012

Chairman : Professor Suraini Abd Aziz, PhD

Faculty : Biotechnology and Biomolecular Sciences

Malaysian poultry industry depends heavily on expensive imported feed materials like soybean and maize. Local brown rice is a potential feed ingredient to replace these imported feeds. It is produced locally, easily available and low in production cost. Brown rice composed of nutrients required by poultry such as protein, carbohydrates and fats. However, it may also contain anti-nutrients that cause adverse effects to poultry performance. In this study, brown rice varieties MR239 and MR257 were investigated for their nutrients, anti-nutritional factors mainly non-starch polysaccharides (NSP) and its true metabolisable energy (TME) value. The enzymatic hydrolysis was carried out with the aim of eliminating the NSP and further optimize for production of hydrolyzed brown rice. The effects of enzyme supplementation were evaluated through true metabolisable energy (TME) value of poultry. The composition of both varieties

showed that they contained nutrient as required by the poultry such as protein content of 9.0% and 8.8%, carbohydrates contents of 87.6% and 87.7% for MR239 and MR257, respectively and balanced amino acids. The energy value of both varieties were also high represent by gross energy of 16.0 MJ/kg and 15.9 MJ/kg and also TME value of 12.2 MJ/kg and 15.5 MJ/kg for MR239 and MR257, respectively. The NSP was present in small amount as compared to other types of feedstuffs such as wheat and barley which represent by cellulose 1.6% and 0.1%, hemicelluloses 4.3% and 2.0%, arabinoxylan 0.042% and 0.03% and also β-glucan 0.2% and 0.3% for MR239 and MR257, respectively. The application of enzymes by enzymatic hydrolysis showed that xylanase, cellulase and β-glucanase were able to degrade the fibrous fraction of NSP in brown rice. The optimization of enzymatic hydrolysis condition was carried out using these three enzymes with activity range from 1 – 3 U/mL, temperature from 30 - 50°C, pH of 4 - 6 and substrate concentration of 5 – 15% w/v. The range of each factor was set based on preliminary experiment. The significant factors screened using two-level factorial design was temperature, pH, substrate and cellulase activity. These parameters were optimized by central composite design and produced optimal value of pH 4.5, temperature of 40°C, 12.5% w/v of substrate concentration and 2 U/mL of cellulase activity. Hydrolyzed brown rice was produced based on these optimized conditions. The effectiveness of enzymes supplementation was evaluated by determination of chemical composition and conducted the force feeding experiment for TME value. The composition of hydrolyzed brown rice has shown the improvement in the nutrients content by

increase in protein content as 11.2%, fat as 2.7% and also the reduction in NSP components to 3.0% cellulose, 1.3% hemicelluloses, 0.4% β-glucan and 0.05% arabinoxylan after enzymatic hydrolysis process. The energy value has been increased for hydrolyzed brown rice. The TME value of hydrolyzed substrate was 16.1 MJ/kg as compared to TME of untreated brown rice which was 13.9 MJ/kg. Local brown rice MR239 and MR257 that were not suitable for human consumption was selected for poultry feed as it has potential to replace the imported feed. The results showed the nutritive values of brown rice were improved with the treatment of enzymes.

Abstrak tesis yang dikemukan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains

RAWATAN BERENZIM UNTUK PENINGKATAN NILAI NUTRIEN BERAS PERANG TEMPATAN SEBAGAI MAKANAN AYAM

Oleh

NURUL ASYIFAH MUSTAPHA

November 2012

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Industri ayam di Malaysia sangat bergantung kepada sumber makanan import yang mahal seperti soya dan jagung. Beras perang tempatan adalah sumber makanan yang berpotensi untuk menggantikan makanan ayam yang diimport ini. Ia dihasilkan dalam negara, mudah didapati dan kos pengeluaran yang rendah. Beras perang mengandungi nutrien yang diperlukan oleh ayam seperti protin, karbohidrat dan lemak. Walau bagaimanapun, ia juga mungkin mengandungi anti-nutrien yang menyebabkan kesan buruk terhadap prestasi ayam. Dalam kajian ini, beras perang MR239 dan MR257 dikaji dari segi nutrien dan anti-nutrien terutamanya polisakarida bukan kanji (PBK) dan nilai tenaga metabolisma sebenar (TME) sebagai makanan ayam. Hidrolisis berenzim telah

dijalankan dengan tujuan menghapuskan PBK dan diteruskan dengan proses pengoptimuman untuk pengeluaran beras perang terhidrolisis. Kesan daripada penambahan enzim dinilai melalui nilai tenaga metabolisma sebenar (TME) ayam. Komposisi kedua-dua varieti menunjukkan bahawa ia mengandungi nutrien yang diperlukan oleh ayam seperti kandungan protein 8.96% dan 8.79%, kandungan karbohidrat 87.58% dan 87.71% masing-masing untuk MR239 dan MR257 dan asid amino yang seimbang. Nilai tenaga bagi kedua-dua variati juga tinggi yang diwakili oleh tenaga kasar 16.03 MJ/kg dan 15.89 MJ/kg serta nilai TME 12.15 MJ/kg and 15.45 MJ/kg masing-masing untuk MR239 dan MR257. PBK hadir dalam jumlah yang kecil berbanding dengan jenis makanan lain yang digunakan untuk ayam seperti gandum dan barli yang ditunjukkan oleh selulose 1.63% dan 0.08%, hemiselulose 4.25% dan 1.97%, arabinoxylan 0.042% dan 0.03% serta β-glucan 0.17% and 0.29% masing-masing untuk MR239 and MR257. Penambahan enzim kepada beras perang melalui hidrolisis berenzim menunjukkan bahawa xilanase, selulase dan β-glukanase dapat merendahkan pecahan berserabut PBK dalam beras perang. Pengoptimuman keadaan hidrolisis berenzim telah dijalankan menggunakan tiga enzim ini dengan aktiviti berbeza daripada 1 - 3 U/mL bersama-sama dengan julat suhu 30-50°C, pH 4 - 6 dan kepekatan substrat daripada 5 - 15% w/v. Julat setiap faktor ditentukan melalui eksperimen awal. Faktor penting yang disaring menggunakan reka bentuk faktorial dua peringkat adalah suhu, pH, kepekatan substrat dan aktiviti selulase. Parameter ini dioptimumkan oleh reka bentuk komposit pusat dan menghasilkan nilai optimum pH 4.5, suhu 40°C, kepekatan substrat 12.5% w/v

dan 2 U/mL aktiviti selulase. Beras perang terhidrolisis dihasilkan berdasarkan syarat optimum melalui hidrolisis berenzim. Keberkesanan penambahan enzim telah dinilai oleh penentuan komposisi kimia dan melalui kajian suapan paksa untuk nilai TME. Komposis beras perang terhidrolisis menunjukkan peningkatan dalam kandungan nutrien dengan peningkatan portein menjadi 11.2%, lemak 2.65% dan juga penurunan dalam komponen PBK menjadi 2.99% selulose, 1.3% hemiselulose, 0.4% β-glucan dan 0.05% arabinoxylan selepas proses hidrolisis berenzim. Nilai tenaga telah meningkat dalam beras perang terhidrolisis. Nilai TME substrat terhidrolisis adalah 16.1 MJ/kg berbanding dengan TME beras perang yang tidak dirawat adalah 13.9 MJ/kg. Beras perang tempatan variati MR239 dan MR257 yang tidak sesuai untuk kegunaan manusia telah dipilih sebagai makanan ayam kerana ia mempunyai potensi untuk menggantikan makanan import. Keputusan menunjukkan nilai nutrient beras perang telah dipertingkatkan dengan rawatan berenzim.

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I certify that a Thesis Examination Committee has met on 9 November 2012 to conduct the final examination of Nurul Asyifah Mustapha on her thesis entitled "Enzymatic Treatment in Improving Nutritive Value of Local Brown Rice for Poultry Feed" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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

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DECLARATION

I declare that the thesis is 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 Universiti Putra Malaysia or other institution.

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NURUL ASYIFAH MUSTAPHA

Date: 9 November 2012

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