



UNIVERSITI PUTRA MALAYSIA

**UTILIZATION OF CORN-DRIED DISTILLER GRAINS WITH SOLUBLES
FROM CHINA IN BROILER DIETS**

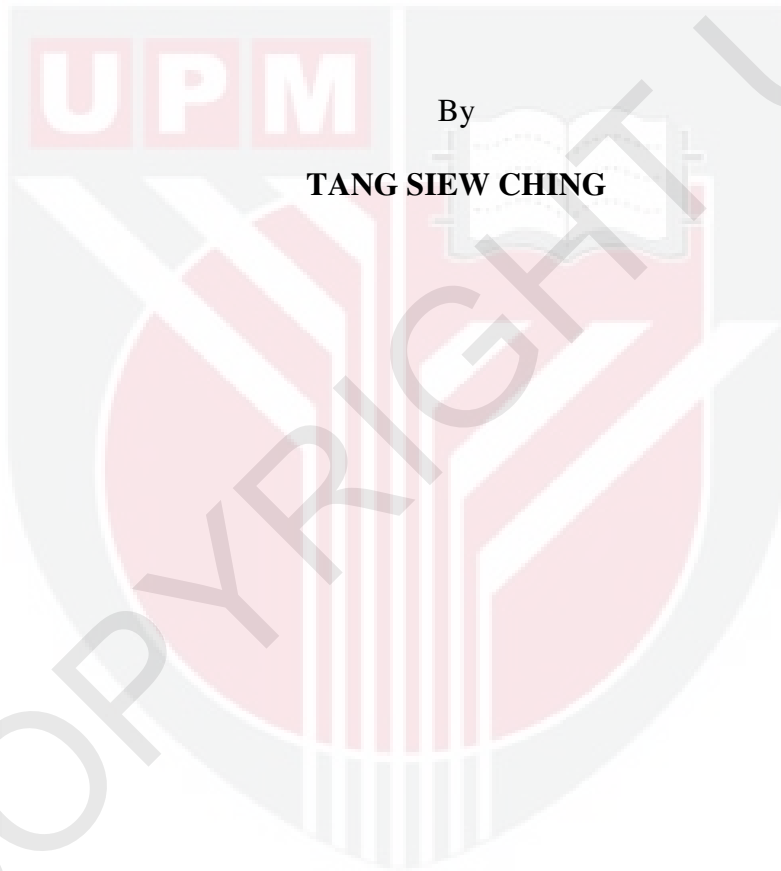
TANG SIEW CHING

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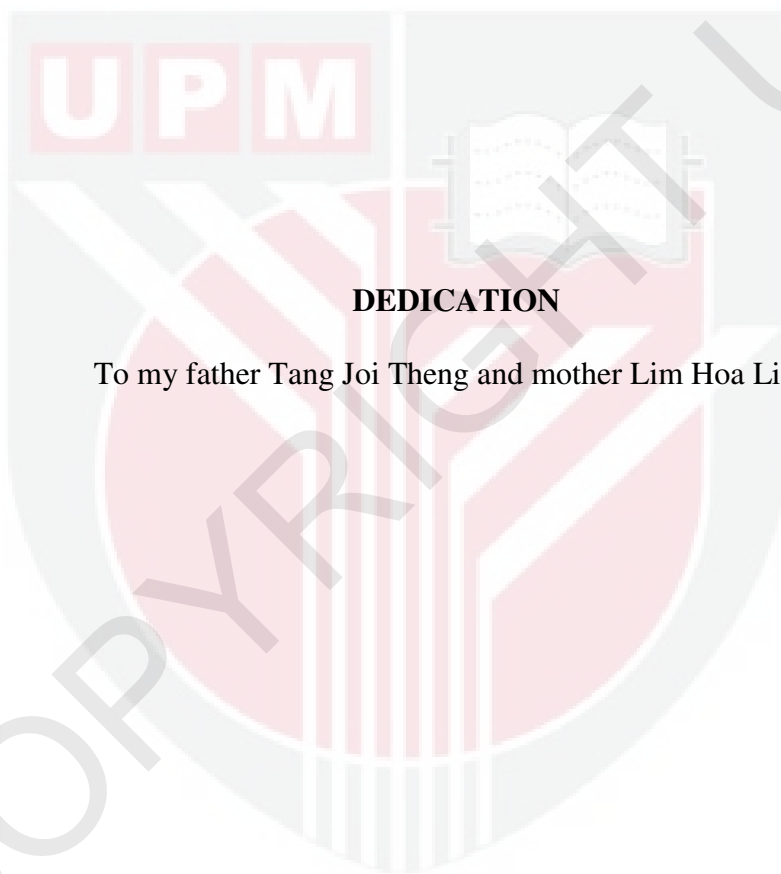
By

TANG SIEW CHING



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

December 2011



DEDICATION

To my father Tang Joi Theng and mother Lim Hoa Liew

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

UTILIZATION OF CORN-DRIED DISTILLER GRAINS WITH SOLUBLES FROM CHINA IN BROILER DIETS

By

TANG SIEW CHING

December 2011

Chairman: Zulkifli Idrus, PhD

Faculty : Agriculture

Corn-dried distiller grains with solubles (CDGS) is a co-product of ethanol production which contains much of the original nutritional value of the corn. There is a considerable information on the use of US source of CDGS in poultry diets but not those from China. Corn grown from different geographic locations can affect the nutrient content of CDGS. A series of experiments were conducted to examine the effect of feeding CDGS and enzyme complex (AllzymeTM SSF) supplementation on broiler performance. The first experiment was conducted to determine the nutrient composition of 12 different sources among the US (5 sources) and Chinese (CN 7 sources) CDGS, followed by two studies for nitrogen corrected true metabolizable energy (TMEn) and true ileal amino acids digestibility (TIAAD) values of CN1 CDGS, based on total excreta and ileal digesta collection, respectively. The findings showed that the nutrient contents of CDGS samples were about two to three times more concentrated than those of corn grain except for gross energy and amino acids concentrations whose values were almost similar to those of corn grain.

However, the chemical properties of CDGS from various sources differed considerably and greater variability in most nutrients was noted among the Chinese source of CDGS when compared to US samples that was more consistent. The TMEn of the determined CN1 CDGS for 5-week-old broiler chicken was 2924 kcal/kg, and showed high TIAAD (83 - 98%) for all amino acids except for threonine and arginine (60% and 66%, respectively). In conclusion, different sources of CDGS contain a greater variability in nutrient content, but CDGS is a good nutrient source and can be used as an alternative feed ingredient in broiler diets.

In experiment II, a completely randomized design with 5 treatments (6 replicates per treatment) was utilized to evaluate the effects of feeding CDGS on growth performance, carcass yield and meat fatty acid composition of chickens. A total of 300 male broilers (Cobb 500) were fed with different levels of CN1 CDGS (0% - control, 5%, 10%, 15%, and 20%) in starter (age 0 to 21 d) and grower (age 21 to 42 d) diets. All diets were formulated isocaloric and isonitrogenous which met or exceeded the NRC requirements. Birds fed 5% CDGS had better ($P < 0.05$) feed conversion ratio than those fed 10%, 15% or 20%, but were not different ($P > 0.05$) from the control over 42 d. There were no differences ($P > 0.05$) in overall weight gain, feed intake, dressing percentages and carcass part yields (% of carcass weight) among treatments over a period of 42 d. There were increasing ($P < 0.05$) percentages of linoleic acid (18:2 *n*-6) and polyunsaturated to saturated fatty acid ratios ($P < 0.05$) in both the breast and thigh meats with increasing levels of dietary CDGS. In conclusion, incorporating 5% of CDGS in the broiler diet did not affect ($P > 0.05$), while levels higher than that were detrimental to growth performance and carcass yield. However, increasing the dietary CDGS level increased ($P < 0.05$) the

percentage of linoleic acid and polyunsaturated to saturated fatty acid ratio in chicken meat.

In experiment III, a 2 x 3 factorial experiment arranged in a randomized complete design with 6 treatments (6 replicates per treatment) was conducted to evaluate the effects of feeding CDGS with enzyme supplementation on growth performance and nutrient availability in broiler chickens. A total of 360 broiler chicks (Cobb 500) in equal number of males and females were fed with corn-soy based diets with or without (control) 15% of CDGS and 3 levels of a commercial enzyme (Allzyme SSF at 0, 200 and 400 mg/kg) in starter (age 0 to 21 d) and grower (age 21 to 42 d) diets. All diets were formulated isocaloric and isonitrogenous which met or exceeded the NRC requirements. Feeding chicks with 15% corn CDGS significantly ($P < 0.05$) depressed body weight, increased feed intake, increased feed conversion ratio and lower energy value of diet when compared to those chicks fed control diet. However, addition of 15% CDGS significantly ($P < 0.05$) increased phosphorus content of tibia bone. In general, there were no significant differences in all the productive parameters measured between birds supplemented with different levels of commercial enzyme (0, 200, and 400 mg/kg) into broiler diets over 42 d. In the present study, there was a lack of interaction between the two factors (diet x enzyme) for the performance parameters, either over the starter (day 0 to 21) or grower (day 21 to 42) period. Irrespective of diet type, higher dose of commercial enzyme (400 mg/kg) caused a reduction in feed consumption at weeks 1 and 4, and depressed body weight in young chicks (day 0-21). In conclusion, incorporating 15% of CDGS in broiler diet significantly reduced their growth performance. In addition, commercial enzyme supplementation had negligible effect on the overall growth

performance and nutrient availability including nitrogen corrected apparent metabolizable energy (AMEn), phosphorus and calcium availability in broilers fed 15% CDGS.



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

**PENGUNAAN PERAMAN JAGUNG TERLARUT KERING DARI CHINA
DALAM DIET AYAM PEDAGING**

Oleh

TANG SIEW CHING

Disember 2011

Pengerusi : Zulkifli Idrus, PhD

Fakulti : Pertanian

Sisa peraman jagung terlarut kering (CDGS) adalah sejenis produk sampingan daripada hasilan etanol yang mengandungi kebanyakan nilai semulajadi nutrisi jagung. Terdapat banyak infomasi mengenai kegunaan sumber US CDGS dalam diet poulti tetapi tiada yang mengenai CDGS dari China. Jagung yang ditumbuh berlainan lokasi geografi boleh mempengaruhi kandungan nutrien dalam CDGS. Satu siri eksperimen telah dijalankan untuk mengkaji kesan pemberian sisa peraman jagung terlarut kering (CDGS) dan penambahan enzim komersial (Allzyme™ SSF) ke atas prestasi ayam pedaging. Eksperimen pertama telah dijalankan untuk menentukan komposisi nutrien dalam 12 sumber CDGS yang berlainan dari US (5 sumber) dan China (7 sumber CN), diikuti dengan penentuan Tenaga Metabolisme Sebenar (TMEn) dan Asid Amino Sebenar (TIAAD) pada CDGS daripada CN1 berdasarkan pada kutipan jumlah najis dan pencernaan di bahagian ileum. Hasil kajian ini menunjukkan kandungan nutrient dalam sampel CDGS adalah 2 – 3 kali ganda lebih tinggi dibandingkan dengan jagung asal, kecuali nilai tenaga kasar dan

asid amino yang hampir sama dalam kedua-duanya. Walau bagaimanapun, hasil analisis kimia pada CDGS adalah berbeza dan terdapat variasi yang luas dalam kebanyakan nutrien pada CDGS dari China dibandingkan dengan CDGS dari US adalah lebih konsisten. Nilai TMEn daripada CDGS dari CN1 untuk ayam pedaging berumur 5 minggu adalah 2924 kcal/kg, dan TIAAD yang tinggi (83 - 98%) untuk semua asid amino kecuali treonina dan arginina (masing-masing, 60% and 66%). Sebagai kesimpulan, sumber CDGS yang berlainan mempunyai variasi yang luas dalam kandungan nutrien, namun CDGS merupakan sumber nutrien yang baik dan boleh dijadikan salah satu ingredien alternatif untuk diet ayam pedaging.

Dalam eksperimen II, satu kajian menggunakan reka bentuk rawak lengkap dengan 5 rawatan (6 replikasi setiap rawatan), telah digunakan untuk menilai kesan pemberian CDGS pada prestasi pertumbuhan, hasil karkas dan komposisi asid lemak dalam daging ayam. Sejumlah 300 ayam pedaging jantan (Cobb 500) telah dipelihara dan diberi diet mengandungi tahap CDGS daripada CN1 yang berlainan (0% - kawalan, 5%, 10%, 15%, dan 20%) pada peringkat permulaan (0 - 21 hari) dan pembesaran (21 - 42 hari). Semua diet mengandungi aras tenaga dan nitrogen yang sama dan memenuhi atau melebihi keperluan NRC. Ayam yang diberi diet 5% CDGS didapati mempunyai kadar penukaran makanan yang lebih baik ($P < 0.05$) daripada ayam yang diberi 10%, 15% atau 20%, tetapi tidak berbeza ($P > 0.05$) dibandingkan dengan kawalan pada hari ke-42. Semua nilai berat badan, jumlah makanan, peratus sembelihan dan hasil bahagian karkas (% daripada berat karkas) tidak berbeza ($P > 0.05$) antara rawatan pada hari ke-42. Peratus asid linoleic (18:2 *n*-6) adalah lebih tinggi ($P < 0.05$) dan dengan penambahan tahap CDGS dalam diet terdapat peningkatan ($P < 0.05$) nisbah asid lemak rantai panjang tidak tepu kepada asid

lemak tepu dalam kedua-dua daging dada dan kaki panggang. Sebagai kesimpulan, aras 5% CDGS dalam diet ayam pedaging tidak memberi kesan ($P > 0.05$), tetapi aras yang lebih tinggi memudaratkan prestasi penumbuhan dan hasil karkas. Walau bagaimanapun, penambahan CDGS dalam diet meningkatkan nisbah peratus asid linoleic dan kadar asid lemak rantai panjang tidak tepu kepada asid lemak tepu dalam daging ayam.

Eksperimen III, satu eksperimen disusun secara 2 x 3 faktorial menggunakan reka bentuk rawak lengkap dengan 6 rawatan (6 replikasi setiap rawatan), bagi menentukan kesan pemberian CDGS dengan penambahan enzim komersial pada prestasi tumbuhan dan kesediaan nutrien untuk ayam pedaging. Sejumlah 360 anak ayam pedaging (Cobb 500) dengan nisbah jantina jantan dan betina yang sama diberi makan diet berasaskan jagung-soya (kawalan) dengan mengandungi/tidak mengandungi 15% CDGS, juga 3 aras enzim komersial (AllzymeTM SSF pada 0, 200 dan 400 mg/kg) pada peringkat permulaan (berumur 0 ke 21 hari) dan peringkat pertumbuhan (berumur 21 ke 42 hari). Semua diet diformulasikan dengannya kandungan tenaga dan nitrogen yang sama dengan memenuhi atau melebihi keperluan NRC. Pemberian diet 15% CDGS (sumber CN1) menurunkan berat badan dengan signifikan ($P < 0.05$), meningkatkan pengambilan makanan, dan kadar penukaran makanan tetapi menurunkan nilai tenaga dalam diet dibandingkan dengan anak ayam yang diberi diet kawalan. Walau bagaimanapun, diet 15% CDGS meningkatkan kandungan fosforus dalam tulang tibia ($P < 0.05$) dengan signifikan. Secara umumnya, semua parameter prestasi memberikan hasil yang tidak berbeza apabila diberi enzim komersial pada aras yang berlainan (0, 200, and 400 mg/kg) dalam diet ayam pedaging pada hari ke-42. Tidak terdapat interaksi antara diet dan

enzim sama ada pada peringkat permulaan (0 ke 21 hari) atau pembesaran (21 ke 42 hari). Dos enzim komersial yang lebih tinggi (400 mg/kg) didapati menurunkan pengambilan makanan pada minggu 1 dan 4, dan menurunkan berat badan ayam pada peringkat permulaan (0-21 hari). Sebagai kesimpulan, pemberian diet 15% CDGS pada ayam pedaging menurunkan prestasi pertumbuhan ayam dengan signifikan. Penambahan enzim komersial pada ayam pedaging yang diberi 15% CDGS juga tidak memberi kesan pada keseluruhan prestasi pertumbuhan dan penggunaan nutrien termasuk nilai Tenaga Metabolisme Kasar (AMEn), fosforus dan kalsium.

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I certify that a Thesis Examination Committee has met on 30 December 2011 to conduct the final examination of Tang Siew Ching on her Master of Science thesis entitled “Utilization of corn-dried distiller grains with solubles from China in broiler diets” in accordance with the Universities and University Colleges Act 1971 and the Constitution of 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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DECLARATION

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

TANG SIEW CHING

Date: 30 December 2011



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