UNIVERSITI PUTRA MALAYSIA

A COMPARATIVE STUDY ON THE EFFICACY OF A COMMERCIAL PREBIOTIC, PROBIOTIC AND ORGANIC ACIDS IN IMPROVING THE PERFORMANCE OF BROILER CHICKEN

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By

MOHAMMAD HOUSHMAND

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

October 2010

DEDICATION

To my late mother

To my father, my brother, my sisters, my wife and children

To my late brother, Haj Habibollah, who was an honourable man and deceased to Allah very soon

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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Chairman: Associate Professor Azhar Kasim, PhD

Faculty: Agriculture

Non antibiotics in the form of organic acids, prebiotics, probiotics and synbiotics have the potential to eliminate the usage of antibiotics in poultry feeding. Four experiments were conducted to establish the potencies and usage levels of commercial non antibiotics feed additives in poultry.

Experiment 1 was a 4 × 2 factorial arrangement of four feed additive programs (a basal diet without any feed additive as control, basal diet added with organic acids, basal diet added with prebiotic and basal diet added with probiotic) with National Research Council (NRC) recommended or low (90 % of recommended) levels of energy. A total of 640 day-old male and female broiler chicks were randomly assigned to one of eight treatments, with four littered floor pens of 20 birds. Starter and finisher diets were fed from 1 to 21 and 22 to 42 d of age, respectively. Dietary level of other nutrients, housing and general management practices were same for all treatments. Dietary inclusion of additives had no significant effect on broilers performance, intestinal villus height, crypt depth, gut pH and dietary AME. Birds fed

low energy diets were heavier (2447 g compared to 2390 g) but had inferior FCR (1.830 compared to 1.698) than those fed NRC recommended energy diets. However, protein digestibility was significantly higher for prebiotic (74.9 %) and organic acid (71.4 %) treatments compared to control (67.5 %). NRC recommended energy diets significantly increased AME and protein digestibility compared to low energy diets. No interaction was observed for measured parameters.

In Experiment 2, a total of 288 day old male Cobb chicks were randomly assigned to a 2 × 4 factorial arrangement, with two levels of crude protein (NRC recommended or low) and four feed additive programs which were similar to experiment 1. Lowering dietary protein level, significantly decreased bird performance. Birds fed prebiotic supplemented diets had better FCR than control during 22-42 (1.882 vs 1.984) and 1-42 (1.769 vs 1.839) d of age. Also, supplementation with prebiotic resulted in longer duodenum villi compared to control treatment. All feed additives significantly increased antibody titers against Newcastle disease at 21 d of age.

Experiment 3 was conducted using a 2 × 2 × 2 factorial arrangement with two levels of prebiotc (with or without), two levels of crude protein (NRC recommended or low level) and two levels of stocking density (normal or high). Protein level had significant effects on broiler performance. Supplementation with prebiotic had no significant effect on performance and other parameters. Birds reared at high density, had inferior finisher (22-42 d) and overall FCR (1-42 d) compared with birds housed at normal density. Significant interactions between protein levels and stocking density were observed for body weight gain and final body weight. Prebiotic, protein level and stocking density had no significant effect on spleen and bursa ratio weight. Protein level had no significant effect on antibody titer against Newcastle disease. However, normal density resulted in higher antibody titer (2.67) against Newcastle

disease compared to high density (2.50). Stocking density had no significant effect on blood levels of glucose, cholesterol, corticosterone and heterophil to lymphocyte ratio.

In Experiment 4, effects of different feed additives on performance, tibial dyschondroplasia (TD) incidence and tibia characteristics of male broilers fed low calcium diets were studied. A completely randomized design, with 6 treatments and 5 replicates of 5 chicks was used. Experimental treatments were: 1. Basal diet containing recommended level of calcium (1 %) as control treatment, 2. Low calcium (0.67 %) diet without any additive, 3. Low calcium diet added with probiotic, 4. Low calcium diet added with prebiotic, 5. Low calcium diet added with mixture of probiotic and prebiotic, 6. Low calcium diet added with organic acids. Different treatments had no effect on TD incidence. Feeding with low calcium diet negatively influenced not only broiler performance but also tibia characteristics. However, dietary inclusion of all feed additives had beneficial effects on above mentioned parameters. In conclusion, the results of current project indicated that prebiotic and organic acids improved protein digestibility. Supplementation with probiotic, prebiotic and organic acids resulted in better immunity as measured by higher antibody titers against Newcastle disease. When low calcium diets were fed, dietary inclusion of all feed additives had beneficial effects on broilers performance as well tibia characteristic. Under condition of this project, among different feed additives, prebiotic had the most beneficial effects on broilers.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan Doktor Falsafah

PERBANDINGAN KEBERKESANAN PREBIOTIK, PROBIOTIK DAN ASID ORGANIC KOMERSIL DALAM MENINGKATKAN PRESTASI AYAM PEDAGING

Oleh

MOHAMMAD HOUSHMAND

Oktober 2010

Pengerusi: Profesor Madya Azhar Kasim, PhD

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Bahan bukan antibiotik dalam bentuk asid organik, prebiotik, probiotik dan sinbiotik mempunyai potensi mengenepikan penggunaan antibiotik dalam pemakanan poltri. Empat eksperimen telah dijalankan bagi menentukan potensi dan tahap penggunaan bahan aditif makanan komersil tanpa antibiotik untuk poltri.

Experiment 1 adalah dalam bentuk 4 × 2 susunan faktorial, iaitu empat program aditif (makanan asas tanpa aditif makanan sebagai kawalan, makanan asas ditambahkan asid organik, makanan asas ditambah prebiotik dan makanan asas ditambah probiotik), dan paras tenaga yang di syorkan oleh 'National Research Council' (NRC) atau pada paras tenaga rendah (90 % dari paras yang disyorkan). Sejumlah 640 ekor anak ayam daging umur sehari bercampur jantina dibahagikan secara rambang kepada setiap lapan rawatan, menggunakan petak bersarap mengandungi 20 ekor ayam setiap satu. Makanan permulaan dan penghabisan diberikan dari umur 1 ke 21 dan 22 ke 42 hari secara respektif. Paras nutrient lain dalam makanan, perumahan dan praktis pengurusan am adalah sama bagi semua rawatan. Aditif dalam makanan tidak menunjukkan kesan bererti keatas prestasi

ayam daging, ketinggian villus usus, kedalam krip, pH usus dan AME makanan. Ayam yang diberi makanan bertenaga rendah mempunyai badan lebih berat (2447 g berbanding dengan 2390 g) tetapi nisbah pertukaran makanannya adalah lebih rendah(1.830 berbanding dengan 1.698) dari ayam yang diberi makanan mengandungi tahap tenaga berdasarkan syor NRC. Disebaliknya, prebiotik (74.9 %) dan asid organic (71.4 %) secara bererti meningkatkan penghadaman protein berbanding dengan kawalan (67.5 %). Makanan berasaskan tenaga yang disyor NRC menambahkan AME dan penghadaman protein secara bererti jika dibandingkan dengan makanan yang rendah kandungan tenaga. Tidak ada kesan interaksi pada parameter yang diukur.

Pada Experimen 2, sejumlah 288 ekor anak ayam jantan Cobb umur sehari dibahagikan secara rambang kepada rawatan berasaskan susunan 2 × 4 faktorial, dengan dua paras protein kasar, disyor NRC atau rendah dan empat program aditif makanan sama seperti pada Experimen 1. Paras protein yang rendah dalam makanan menyebabkan penurunan prestasi ayam secara bererti. Penambahan prebiotik menyebabkan penambahbaikkan pada kadar pertukaran makanan berbanding dengan kawalan pada umur 22-42 (1.882 vs 1.984) dan 1-42 hari (1.769 vs 1.839). Ayam yang diberi makanan mengandungi prebiotik mempunyai villi duodenum yang lebih tinggi dibandingkan dengan kawalan. Semua aditif makanan secara bererti meningkatkan titer antibodi terhadap penyakit Newcastle pada umur 21 hari.

Experimen 3 dijalankan berpandukan susunan rawatan 2 × 2 × 2 faktorial dengan dua paras prebiotik (ada dan tiada), dua paras protein kasar, syor NRC atau paras rendah dan dua paras kepadatan kawasan (biasa atau tinggi). Paras protein secara bererti membawa kesan kepada prestasi ayam daging. Penambahan prebiotik tidak membawa kesan bererti pada prestasi dan lain-lain parameter. Ayam pada kepadatan

kawasan tinggi mempamirkan kadar pertukaran makanan inferior pada tahap penghabisan (22-42 hari) dan keseluruhan (1-42 hari) jika dibandingkan dengan ayam pada kepadatan kawasan yang normal. Interaksi bererti antara paras protein dan kepadatan kawasan dilihat pada kenaikan berat badan dan berat badan akhir. Prebiotik, paras protein dan kepadatan kawasan tidak memberikean bererti pada nisbah berat limpa dan bursa. Paras protein tidak membawa kesan bererti pada titer antibody terhadap penyakit Newcastle. Di sebaliknya, kepadatan kawasan yang normal menyebabkan titer antibody yang tinggi (2.67) terhadap penyakit Newcastle berbanding dengan kepadatan tinggi (2.50). Kepadatan tinggi tidak membawa kesan bererti pada paras glucose, cholesterol, corticosterone dan nisbah H/L dalam darah.

Pada Experimen 4, kesan jenis aditif makanan ke atas prestasi, insiden tibial dyschondroplasia (TD) dan ciri tibia pada ayam daging jantan yang diberi makanan mengandungi paras kalsium rendah dikaji. Rawatan secara rawak sepenuhnya, berasaskan 6 rawatan dan 5 replikasi mengandungi 5 ekor anak ayam digunakan. Rawatan ialah : 1. Makanan asas mengandungi paras kalsium yang disyorkan (1 %) sebagai kawalan, 2. Kalsium rendah (0.67 %) dalam makanan tanpa aditif, 3. Kalsium rendah dalam makanan mengandungi probiotik, 4. Kalsium rendah dalam makanan mengandungi prebiotic, 5. Kalsium rendah dalam makanan mengandungi campuran probiotik dan prebiotik, 6. Kalsium rendah dalam makanan mengandungi asid organik. Semua rawatan tidak memberi kesan kepada insiden TD. Pemberian makanan berkalsium rendah mempengaruhi prestasi ayam daging dan juga ciri tibia secara negative. Disebaliknya, penambahan semua jenis aditif dalam makanan memberi kesan baik pada parameter tersebut. Sebagai rumusan, keputusan-keputusan ini menunjukkan prebiotik dan asid-asid organic meningkatkan penghadaman protein. Penambahan probiotik, prebiotik dan asid-asid organic

memberikan immunity lebih baik dengan pengukuran titer antibodi yang tinggi kepada penyakit Newcastle. Pemberian makanan yang mengandungi kalsium rendah dengan penambahan semua aditif makanan memberi kesan bermenafaat pada pencapaian ayam daging dan juga ciri-ciri tibia. Pada situasi projek ini, prebiotik memberi kesan yang paling bermenafaat kepada ayam daging berbanding dengan aditif makanan yang lain.

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I certify that a Thesis Examination Committee met on 22 October 2010 to conduct the final examination of Mohammad Houshmand on his thesis entitled "A Comparative Study on The Efficacy of A Commercial Prebiotc, Probiotic and Organic Acids in Improving the Performance of Broiler Chicken" 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 candidate be awarded the Doctor of Philosophy.

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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 other degree at Universiti Putra Malaysia or at any other institution.

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MOHAMMAD HOUSHMAND

Date: 22 October 2010

TABLE OF CONTENTS