UNIVERSITI PUTRA MALAYSIA

DIFFERENT ENERGY AND PROTEIN RATIO IN FEED FORMULATION OF VILLAGE CHICKEN BASED ON ALTERNATIVE FEEDSTUFFS UNDER TWO MANAGEMENT SYSTEMS

NADIA EZDIANIE NORAZAMAN

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By

NADIA EZDIANIE NORAZAMAN

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

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

DIFFERENT ENERGY AND PROTEIN RATIO IN FEED FORMULATION OF VILLAGE CHICKEN BASED ON ALTERNATIVE FEEDSTUFFS UNDER TWO MANAGEMENT SYSTEMS

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May 2016

Chairman : Professor Dahlan Ismail, PhD
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Energy and protein are two important components of food that generates a lot of interest and challenges to nutritionists. Energy and protein ration play important role in formulate the diet of the poultry. It is important to find alternative to replace the uses of imported grains (plant proteins) in the feed of chickens with local sources to reduce the production cost in poultry production. This research aim to determine the effect of dietary protein and energy level on growth performance, carcass characteristic and meat quality of Arabian strain village chicken raised in close confinement and free range system and fed on dehydrated food waste (DFW), dehydrated superworms (DSW) and dried eggs (DE). DFW as the main energy source, DSW and DE as the main protein sources. This research divided by two experiment of feeding trial (starter and grower phase). The chicks were reared in cages from day one old till the age of 6 weeks. During week 7 until week 12 the chicks were randomly allocated to two production system (indoor pen and free range system). The growth performance of the chicks was measured weekly. Six experimental diets were formulated to have 3 level of energy to protein ratio (EP134, EP150 and EP164). Every ratio has two different protein sources with the same value of inclusion. T1 EP150 (DFW+Fishmeal) as a control, T2 EP164 (DFW+DSW), T3 EP164 (DFW+DE), T4 EP150 (DFW+DSW+DE), T5 EP134 (DFW+DSW) and T6 EP134 (DFW+DE). Each treatment comprised of two replicates with fifteen birds each. Feed and water were provided *ad libitum*. A complete randomized design was used in experiment. Proximate analysis of the main ingredient in the diet showed DFW 4,500.54kcal/kg for gross energy and 25.18% of crude protein. Meanwhile DSW and DE have high in crude protein 46.54% and 46.33% respectively and DE have significantly higher ($P<0.05$) for protein quality to compared with DSW and this made it a suitable alternative source of protein. At the end of week 6, a single diet energy:protein (E:P) ratio of 134 kcal ME/kg protein supported optimum feed conversation ratio and growth rate of Arabian strain village chicken aged between one to six weeks. In experiment two, for feeding trial T6 showed the best performance among the other treatment but diet E:P ratio of 164 kcal ME/kg protein supported optimum growth performance during the grower stages. The production system with free range resulted in

increased feed intake and poorer FCR compared with the indoor system. The indoor system had superior growth performance. There was no statistical interaction effect between management system and treatment on carcass characteristics of the village chickens. However, abdominal fat tended to decrease as dietary protein increased with the 134 ratio ($P<0.05$), while higher energy levels increased abdominal fat from 13.75g to 18.00g when energy was increased with the 164 and 150 ratio respectively. For the chemical composition of the breast muscle, the protein content of breast muscle ranged from 22.66 to 24.45, being significantly higher ($p<0.05$) in free range production system. Production system also showed high values for moisture and fat in indoor pen system. The present study shows high CP content with the ratio 134, 150 and 164 respectively. Fat content high with the ratio 164 with the highest energy in the treatment and the lowest fat content in the 134 ratio with lowest energy. The pH of free range chickens was lower than that of indoor pen system. Free range system chickens also have significantly different ($P<0.05$) presented with the highest value in drip loss, cooking loss, L*, a*, b* and the shear force. For the conclusion, the use of appropriate ratio in formulated the diet are very important in the growth performance, carcass characteristic and meat quality of Arabian village chicken. These by-products can be considered as an alternative source of protein-energy rich poultry feed. These findings have implications on ration formulation for village chicken in Malaysia. Free range system of village chicken seems to be a possible alternative to the conventional method (indoor pen system). This is due to the more natural rearing conditions that increase motor activity, favors the development of the muscle mass, reduce fatness and high with the protein and also contribute to animal welfare issues. Furthermore, this kind of production system is more practical and cheaper through using appropriate technology.

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

KESAN TAHAP TENAGA DAN PROTEIN DI DALAM RANGSUM MAKANAN AYAM KAMPUNG DENGAN MENGGUNAKAN BAHAN ALTERNATIF DI BAWAH DUA SISTEM PENGURUSAN

Oleh

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Tenaga dan protein adalah dua komponen penting di dalam pemprosesan makanan ayam yang menarik banyak minat dan cabaran untuk pakar pemakanan. Tenaga dan protein memainkan peranan yang penting di dalam merangka diet ayam. Adalah penting untuk mencari alternatif bagi menggantikan penggunaan bijirin yang diimport (protein tumbuhan) dalam formulasi makanan ayam dengan sumber-sumber tempatan untuk mengurangkan kos pengeluaran ayam. Kajian ini bertujuan untuk menentukan kesan protein dan tenaga tahap pemakanan kepada kadar pertumbuhan, ciri karkas dan kualiti daging ayam kampung dari baka Arabian yang di pelihara di dalam sangkar dan lepas bebas dan diberi makan dengan menggunakan sisa makanan kering (DFW), superworms (DSW) dan telur kering (DE). DFW sebagai sumber utama tenaga, manakala DSW dan DE sebagai sumber protein utama. Kajian ini dibahagikan kepada dua eksperimen, ujian perbandingan makanan (fasa permulaan dan fasa pembesaran). Anak ayam telah dipelihara di dalam sangkar dari hari pertama sehingga mencapai umur 6 minggu dan pada minggu ke-7 hingga minggu ke-12 anak ayam ditetapkan secara rawak kepada dua sistem pengeluaran (sistem sangkar dan lepas bebas). Kadar pertumbuhan anak ayam diukur setiap minggu. Ada enam kumpulan rangsum makanan yang telah di formulasikan untuk mempunyai tiga tahap tenaga kepada nisbah protein (EP134, EP150 dan EP164). Setiap nisbah mempunyai dua sumber protein yang berbeza dengan nilai komposisi yang sama. T1 EP150 (DFW+Fishmeal) sebagai kontrol, T2 EP164 (DFW+DSW), T3 EP164 (DFW+DE), T4 EP150 (DFW+DSW+DE), T5 EP134 (DFW+DSW) and T6 EP134 (DFW+DE). Setiap rawatan terdiri daripada dua replikasi dengan 15 ekor anak ayam setiap satu. Makanan dan minuman yang diberikan adalah secara *ad libitum*. Sistem rawak telah digunakan di dalam eksperimen ini. Analisis proksimat bahan utama dalam diet menunjukkan sisa makanan kering mempunyai 4,500.54kcal untuk tenaga kasar dan 25.18% protein. Sementara itu DSW dan DE mempunyai nilai protein yang tinggi masing-masing 46,54% dan 46,33% dan DE mempunyai nilai protein yang lebih tinggi ($P<0.05$) jika di bandingkan dengan DSW dan ini menunjukkan kedua-dua protein ini sesuai untuk dijadikan sumber alternatif untuk protein**.** Di penghujung minggu keenam, keputusan menunjukkan nisbah tenaga kepada protein 134 kcalME/kg protein mendapati nisbah penukaran

makananan (FCR) dan kadar pertumbuhan untuk ayam kampung baka Arabian strain adalah di tahap maksimum. Dalam eksperimen kedua, dalam ujian perbandingan makanan untuk fasa tumbesaran T6 menunjukkan prestasi yang terbaik di antara rawatan yang lain tetapi 164 kcalME/kg protein E:P ratio menunjukkan kadar pertumbuhan untuk ayam kampung baka Arabian strain adalah di tahap maksimum. Sistem pengeluaran lepas bebas menyebabkan peningkatan pengambilan makanan dan FCR tidak bagus berbanding sistem tertutup. Sistem tertutup mempunyai prestasi pertumbuhan yang unggul. Tiada kesan interaksi statistik antara sistem pengurusan dan rawatan kepada ciri-ciri karkas ayam kampung. Walau bagaimanapun, lemak di bahagian abdomen akan berkurangan sekiranya protein di dalam rangsum makanan meningkat dengan nisbah 134 ($P < 0.05$), sementara itu peningkatan tahap tenaga akan meningkatkan kandungan lemak di bahagian abdomen dari 13.75g ke 18.00g apabila tenaga telah meningkat dengan nisbah 164 dan 150 masing-masing. Untuk komposisi kimia otot, kandungan protein otot adalah antara 22.66% - 24.45%, yang jauh lebih tinggi ($P < 0.05$) dalam sistem lepas bebas. Sistem pengeluaran juga menunjukkan nilai yang tinggi untuk kelembapan dan lemak di dalam sistem tertutup. Kajian ini menunjukkan kandungan CP tinggi dengan nisbah yang masing-masing 134, 150 dan 164. Kandungan lemak yang tinggi dengan nisbah 164 dengan jumlah tenaga yang paling tinggi di dalam rangsum makanan dan kandungan lemak yang rendah dalam nisbah 134 dengan jumlah tenaga yang rendah. pH daging ayam adalah lebih rendah di dalam sistem lepas bebas berbanding daripada sistem tertutup. Sistem lepas bebas juga PHPSXQDL3GHQDQQLODLDQSDOLQJWLQLGDODP GULSORVVFRRNLQJ ORVV´/ D E GDQ QLODL WDKDS NHHPEXWDQ GDLQJ Kesimpulannya, penggunaan nisbah yang sesuai dalam merumuskan diet adalah sangat penting dalam pertumbuhan ayam kampung, kualiti karkas dan kualiti daging ayam kampung. Produk sampingan daripada DFW, DSW dan DE boleh digunakan sebagai sumber alternatif protein-tenaga di dalam makanan ayam. Penemuan ini mempunyai implikasi terhadap rangsum makanan untuk ayam kampung di Malaysia. Sistem lepas bebas untuk ayam kampung seolah-olah menjadi alternatif yang baik jika dibandingkan dengan kaedah konvensional (sistem di dalam sangkar). Ini adalah disebabkan oleh keadaan penternakan lebih semula jadi yang meningkatkan aktiviti motor, pembentukkan jisim otot, mengurangkan kegemukan dan tinggi dengan protein dan juga menyumbang kepada isu-isu kebajikan haiwan. Tambahan pula, sistem pengeluaran lepas bebas ini adalah lebih praktikal dan lebih murah melalui menggunakan teknologi yang sesuai.

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I certify that a Thesis Examination Committee has met on 23 May 2016 to conduct the final examination of Nadia Ezdianie binti Norazaman on her thesis entitled "Different Energy and Protein Ratio in Feed Formulation of Village Chicken Based on Alternative Feedstuffs Under Two Management Systems" 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 was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

CF	Crude Fiber
CFCR	Cumulative feed conversation ratio
CFI	Cumulative feed intake
CP	Crude protein
CWG	Cumulative weight gain
DM	Dry matter
DFW	Dehydrated Food waste
DSW	Dehydrated superworm
DE	Dried egg
EE	Ether extract
E:P	Energy to protein ratio
FCR	Feed conversion ratio
g	Gram
GIT	Gastrointestinal tract
HCL	Hydrochloric acid
H_2SO_4	Sulphuric acid
kcal	Kilo calorie
ME	Metabolizable energy
NaOH	Sodium Hydroxide
NFE	Nitrogen free extract
SM	Superworm

CHAPTER 1

INTRODUCTION

1.1 Background of study

Malaysia has big potential in village chicken industry. Special quality of village chicken meat that is healthier due to less fat content (Lokman *et al.,* 2011) can increase income of farmers where presently only a small market but their popularity is rapidly growing because its meat unique taste and texture (Azahan and Norazizah, 1994). Village chicken usually being by poor farmers and usually it provides only supplementary income rather than being primary income source (Henning *et al*., 2007). Village chicken production is considered as low input and low output agriculture activity because birds are kept extensively and require little attention from farmers (Paderson, 2000). The present Malaysian Village Chicken, commonly NQRZQDV'DDPNDPSXQJ\YLOODJHFKLFNHQLVWKHUHVXOWRIFURVVEUHHGLQJ of the Red Jungle Fowl with mixed exotic domestic breeds brought by Europeans, mainly the British (Azahan and Zahari, 1983; Peterson et *al*., 1991). Close inbreeding occurs among the indigenous stock (Aini, 1990). The unplanned multiple mating of the various domesticated breeds introduced into an area, make it difficult to standardize their characteristics and production performances of Village Chicken in different localities (Oh, 1987). In general, the Village Chickens are slow growth rates, dual-purpose types, small body size, and different colors of plumage, variable body conformation and physical characteristics.

In livestock industry, feed is the main issue as it covers a large portion of the cost of production. The aim of modern poultry production is to reduce feed cost for optimal economic returns because feed alone contribute about 60 ± 70% of the total cost of poultry production (Henrichs and Steinfield, 2007). The efficient use of feed is extremely important in poultry production (Attia *et al.,* 2012). There is a need to formulate rations that will fulfill all the nutrient requirements including energy and protein for growth. While IRUPXODWLQJ D SRXOWU\ GLHW PRVW emphasizes are placed on metabolize energy (ME) and crude protein (CP), because ME itself comprises 70% of the total cost of feed and protein is the most expensive nutrient in poultry diets.

Energy and protein are two important components of food that generates a lot of interest and challenges to nutritionists. Energy is required for body functioning and protein is essential constituent of all tissues of animal body. The right relation between nutrients in the feedstuff requests a good knowledge of needed concentrations of energy to protein ratio. In poultry production, it is very important to evaluate the ratio between metabolic

energy and protein level in the poultry diets to ensure maximum utilization of each and every nutrient of the diet, to optimum growth of the birds and to minimize the surplus use of vital dietary component. Feeding of chickens is depending on the age of the chickens which are divided into starter, grower and finisher (NRC 1994). In poultry diet, different rations are often used to formulate the diet and it is depending on the production stage of the chicken. Starter rations are high in protein and expensive feed ingredient. However, grower and finisher rations can be lower in protein since older birds require less protein consumption. It is well known that poultry, like many other animals, are inefficient in converting feed to protein. To achieve PD[LPXPFKLFNV¶$HUIRUPDQFHWKHGLHWDU\FUXGHSURWHLQ&3FRQWHQWPXVW provide sufficient levels of Essential Amino Acids (EAA) and Non-Essential Amino Acids (NEAA) to allow maximum protein synthesis and meet the demands of metabolic processes. Reduction in nitrogen excretion and improvement in the efficiency of nitrogen deposition can be obtained by matching amino acid composition of the diet with the amino acid requirement of the chicks for maintenance and meat production.

The high cost of feed in poultry industry is due to the importation cost of the based ingredients in poultry diet which is grain (corn) as energy source and soybean as protein source (Lepleaideur, 2004; Conolly, 2012). This is a threat in the poultry farming industry. There are various researches that focus on the alternatives feedstuff that able to reduce the feed cost of poultry diet. Accordingly, much effort is being made to study the possibilities of utilizing agricultural, animal and industrial waste in the nutrition of poultry. As a consequence, there can be a reduction in the use of traditional feed ingredients such as maize, wheat and soybeans that can also be consumed by humans. By proper processing technology these waste materials can be utilized efficiently. The use of agricultural by-products, wet food waste, insect meal, unfertilized egg and other organic materials can be considered as an alternative source of protein-energy rich poultry feed.

By using converted biological waste as animal feed, a new industry and market can be established and pollution can be lowered in developing as well as developed countries. This may be reflected in the national income. Beside this, low-cost poultry meat and eggs will be available and will assist in reducing hunger by lowering the competition between humans and poultry for food.

In theoretical Gueye (2000), there are three types of poultry management system which is intensive system, semi-intensive system and extensive system. They are differentiated on the basis of their flock size and input and output relationship. In this study two management systems had been evaluated, extensive system (free range system) and semi-intensive system (confined system).

1.3 Objectives

The general objective of this study is to develop feed formulation for village chicken by using DFW, DSW and DE mixed with the other ingredient in order to fulfill the nutritional requirement of the chicks.

The specific objectives for this experiment are:

1. To investigate the nutritional value of the dehydrated food waste (DFW), superworms larvae (DSW) and dried eggs (DE) to be used as ingredient in feed for village chicken.
2. To compare the performance of village chicken on three level of energy to protein ratio in free range and indoor pen system
3. To investigate the use of DFW as energy source and the use of DSW and DE as protein source for growth performance and meat quality of village chicken in free range and indoor pen system
4. To evaluate carcass and meat quality of village chicken fed on the formulated diets, raised under free range and indoor pen system

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