UNIVERSITI PUTRA MALAYSIA

EFFECTS OF DIETARY INCLUSION OF MICROALGAE Arthrospira platensis ON THE GROWTH PERFORMANCE AND CARCASS QUALITY IN JAPANESE QUAILS (Coturnix japonica TEMMINCK & SCHLEGEL)

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By

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Chairman: Associate Professor Azhar Kasim, DVM, MS, PhD
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In recent years, quail meat has been gaining much popularity among consumers in Malaysia and quail rearing is expected to increase to meet the high demand for local and international market. Although a series of researches had been carried out to determine the optimum level of *A. platensis* inclusion for fast growing commercial broiler and layer chicken diet but not in Japanese quail diet. Hence, two experiments were conducted to study the effects of feeding microalgae *A. platensis* on the growth performance and carcass quality of Japanese quails. In the first experiment, three hundred 14 days old quails were randomly subjected to 5 treatments consisted of basal diet-control (C), diet with 1% *A. platensis* inclusion, diet with 2% *A. platensis* inclusion, diet with 4% *A. platensis* inclusion and diet with 8% *A. platensis* inclusion. Each treatment was replicated three times, consisting of 20 birds. The feeding experiment period lasted for 21 days. Basal diet was based on corn and soybean meal. In the first experiment, dietary of *A. platensis* inclusion significantly improved weekly body weight gain (BWG) and feed conversion ratio (FCR) in quails. Also, Mortality rate (MR), carcass yield, meat colour values and meat tenderness were significantly improved by *A. platensis* diet. These results concluded that *A. platensis* was suitable as a supplement in quails' feed for improving growth performance and carcass quality. In this experiment, 4% *A. platensis* inclusion was identified to be the most suitable level considering most parameters showed positive observation. In the second experiment, three hundred 14 days old quails were randomly allocated into 5 dietary treatment groups, consisting basal diet-control group, groups with 4% *A. platensis* diet at different starting age of 15 days old, 22 days old and 28 days old and group fed with commercial diet. Each treatment was replicated three times, consisting 20 birds. The feeding experiment lasted for 21 days. Body weight gains (BWG), feed conversion ratio (FCR) and mortality rate (MR) were significantly improved from the time of *A. platensis* inclusion into diet. Also, carcass yield, meat colour test and meat tenderness were also significantly improved when introduced *A. platensis* diet at earlier growing stage. The results demonstrated that at starting age from day 15 to as later as day 22 were found to be the best time of *A. platensis* inclusion into quail diet to achieve positive growth performance and improve carcass quality.

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

KESAN MIKROALGA *Arthrospira platensis* KE ATAS PRESTASI KADAR TUMBESARAN DAN KUALITI DAGING PADA BURUNG PUYUH (*Coturnix japonica* TEMMINCK & SCHLEGEL)

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Sejak kebelakangan ini, daging burung puyuh telah menjadi semakin popular di kalangan pengguna di Malaysia. Penternakan burung puyuh dijangka akan meningkat bagi memenuhi permintaan pasaran tempatan dan antarabangsa. Pelbagai penyelidikan telah dibuat untuk menentukan keberkesanan penggunaan *A. platensis* dalam pemakanan ayam daging komersial dan pemakanan ayam penelur. Walau bagaimanapun,keberkesanan *A. platensis* pada tumbesaran burung puyuh masih belum lagi ditentukan. Oleh itu, dua eksperimen telah dijalankan untuk mengkaji kesan pemakanan mikroalga *A. platensis* terhadap prestasi kadar tumbesaran dan kualiti daging burung puyuh. Dalam eksperimen pertama, tiga ratus burung puyuh yang berumur 14 hari, diagihkan secara rawak kepada 5 kumpulan, diuji dengan makanan yang terdiri daripada diet asas – diet kawalan (C), 1% *A. platensis* diet, 2% *A. platensis* diet, 4% *A. platensis* diet dan 8% *A. platensis* diet. Setiap kumpulan mempunyai 3 replikat, terdiri daripada 20 ekor burung. Tempoh eksperimen berlangsung selama 21 hari. Formula untuk diet kawalan adalah berasaskan jagung dan kacang soya. Dalam eksperimen pertama, antara kesan positif yang ketara dapat dilihat adalah kenaikan berat badan mingguan(BWG) dan kadar penukaran makanan mingguan (FCR). Kadar kematian (MR), hasil karkas dan bahagian daging, nilai warna daging dan kelembutan daging turut dipengaruhi dan berbeza secara ketara di antara kalangan kumpulan pemakanan yang berlainan. Keputusan eksperimen ini telah menunjukkan kesesuaian mikroalga *A. platensis* dalam makanan burung puyuh untuk meningkatkan prestasi kadar tumbesaran dan kualiti daging. Diet 4% *A. platensis* adalah yang paling sesuai diberi dalam pemakanan burung puyuh memandangkan kadar ini memberikan keputusan paling positif dalam setiap aspek kadar tumbesaran and kualiti daging. Dalam eksperimen yang kedua, tiga ratus burung puyuh yang berumur 14 hari diagihkan kepada 5 kumpulan kajian pemakanan secara rawak, terdiri daripada kumpulan kawalan yang dibekalkan diet asas, kumpulan dengan diberi 4% *A. platensis* diet pada usia permulaan yang berbeza, bermula dari umur 15 hari, umur 22 hari dan umur 28 hari dan akhir sekali kumpulan makanan komersial. Eksperimen ini berlangsung selama 21 hari. Kenaikan berat badan (BWG), kadar penukaran makanan (FCR) dan kadar kematian (MR) berbeza antara kumpulan yang

berlainan dan lebih ketara apabila diet 4% *A. platensis* diberi pada usia 15 hari. Hasil karkas and bahagian daging, nilai warna daging dan kelembutan daging juga jauh berbeza antara kumpulan yang diujikaji. Eksperimen ini menunjukkan bahawa burung puyuh yang diberi diet 4% *A. platensis* seawal usia 15 hari atau selewat-lewatnya 22 hari memberikan kesan positif kepada kadar tumbesaran disamping meningkatkan kualiti daging.

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I certified that a Thesis Examination Committee has met on 28 October 2014 to conduct the final examination of Danny Cheong Swee Weng on his thesis entitled "Effect of Dietary Inclusion of Microalgae *Arthrospira platensis* on the Growth Performance and Carcass Quality in Japanese Quails (*Coturnix japonica* Temminck & Schlegel)" in accordance with the Universities and University Colleges Act 971 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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LIST OF ABBREVIATIONS

%	Percentage
ß	Beta
AA	Arachidonic acid
ADF	Acid Detergent Fiber
ALA	Alpha-linolenic acid
AOAC	Association of Official Analytical Chemists
Atm	Atmosphere
BWG	Body Weight Gain
^{o}C	Degree Celsius
Cal	Calorie
cm	Centimeter
cm^2	Centimeter square
cm^3	Centimeter cube
CP	Crude Protein
DHA	Docosahexaenoic acid
DM	Dry Matter
EPA	Eicosapentaenoic acid
EC	European Commission
EU	European Union
^{o}F	Fahrenheit
FAO	Food and Agriculture Organization of United Nation
FC	Feed Consumption
FCR	Feed Conversion Ratio
g	Gram
g/L	Gram per liter
GE	Gross Energy
GLA	Gamma-linolenic acid
GLM	General Linear Model
H_2SO_4	Sulphuric Acid
Kcal	Kilo Calories
Kcal/g	Kilo Calories per gram
Kg	Kilogram
L	Liter
LA	Linoleic acid
ME	Metabolizable Energy
mg	Milligram
mg/g	Milligram per gram
MR	Mortality Rate
ml	Milliliter
mm	millimeter
MSE	Mean Square Error
Na_2CO_3	Sodium Carbonate
NDF	Neutral Detergent Fiber
NRC	National Research Council
PSE	Pale, soft, exudative
ppm	Part Per Million
RM	Ringgit Malaysia
SDA	Stearidonic acid

SE	Standard Error
Sec	Second
UK	United Kingdom
WHC	Water Holding Capacity

CHAPTER 1

INTRODUCTION

The Malaysian poultry industry had undergone remarkable changes and also growth over the last five decades attaining self sufficiency in meat and eggs since the early 80's (Ferket *et al.*, 2005). Poultry meat and eggs are the two most popular and still being the cheapest source of animal proteins. Most of the poultry meats are from chickens. However, other poultry species such as ducks, geese and quails are gaining in popularity. The local poultry industry can be considered a value added industry since the source which produce the commercial-type birds are imported and raised by feeding with feeds comprising mainly of imported ingredients.

Commercially formulated feeds paved the way to mass production of poultry. Efficiency in production is further enhanced through management and nutritional means. Due to the increasing demand of raw material to meet commercial poultry production, it is of interest to know the other available raw material sources can be used in Malaysia. The industry should not depend totally on imported feed ingredients since there are potential local sources of ingredients that can partially replace the conventionally corn-soybean meal-based diets. To be a good ingredient, it should be able to provide sufficient protein or energy. It will be an added advantage if the ingredient can contribute towards improving the quality of the end products despite increasing the efficiency of feed conversion into meat (Sharifi *et al.,* 2011).

Recently there is an interest of using microalgae to save world problem from global warming, climate change, soil depletion, crop failure and using microalgae biomass for food, feed and fuel (Macfarlane, 2009; Gurierrez, 2009). In the past, multiple studies done by researchers to investigate the incorporation of microalgae in diet for poultry production. However, such studies on Spirulina in literature are minimally available. The preference of raw material for poultry feed productions varies with respect to major sources like corn, soybean and fishmeal. Hence, an attempt is made to study whether Spirulina can be as one of raw materials supplying adequate nutrient in poultry diet.

Incorporations of microalgae into the feed formulation for a wide variety of animals ranging from aquacultures, pets and farm animals, have been studied to a certain extent (Spolaore *et al.,* 2006). The use of microalgae as a supplementation has been recommended to benefit poultry involving growth, survival, feed utilization and carcass quality. In fact, 30% of the current world algal production is sold for animal feed applications (Becker, 2004). But before commercialization, microalgae strain has to meet various criteria. It has to be easily cultured and nontoxic. It also needs to be of the correct size and in physical forms to be easily ingested despite having high nutritional qualities and a digestible cell wall to make nutrients available (Brown *et al.,* 1999; Renaud *et al.,* 2002; Priyadarshani, 2012).

Studies have suggested a role for microalgae in broiler for good growth and feed efficacy (Ross and Dominy, 1990), and eventually resulting in satisfactory improvement in growing chicken (Becker and Venkataraman, 1982; Brune, 1982). Similar results were obtained when microalgae were fed to laying hens (Nazarenko *et al*., 1975; Sauveur *et al*., 1979). A Japanese patent (Sakakibara *et al*., 1994) describes the use of *Spirulina* to reduce the death rate in quail. More recently has attributed to significantly higher growth rate and lower non-specific mortality rate in turkey fed with *Spirulina,* further support earlier findings in broilers and white leghorn type chickens (Qureshi *et al*., 1994).

To date, extensive research had carried out to determine the optimum level of *A. platensis* (henceforth referred as Spirulina) inclusion for mainly fast growing commercial broiler and layer chicken. However, not many information in the literature especially on performance parameters, carcass yields and meat characteristic of Japanese quail fed corn soybean meal diet with Spirulina inclusion. Also, the previous studies were conducted to investigate the effect of Spirulina on limited numbers of parameters such as feed efficiency, mortality and egg production in quail. Hence it is worthwhile to gather information and conduct analysis from the quails in experiment to evaluate the suitability of Spirulina in Japanese quails to assess the effect of nutritional levels of microalgae on several parameters in quails as well as to identify the best inclusion time of Spirulina into diet to achieve marketable weight of quail.

Thus, the objectives of the present study were:

1. To compare and determine the effects of different level of Spirulina inclusion in feed on growth performance and carcass yield of Japanese quails and,

2. To identify the effects of different starting age of Spirulina inclusion in feed on growth performance and carcass yield of Japanese quails.

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