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POTENTIAL OF Azolla pinnata R. BR. AS PARTIAL PROTEIN SUPPLIMENT IN BROILER DIET

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By

FADZLIN AFIQAH BT A. SAMAD

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

July 2020

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DEDICATION

I am dedicating this thesis to my beloved parents, A. Samad Mohammed and Mi'ah Zainon who are always supporting me to finish this thesis. Next, I dedicated this thesis to my siblings, lecturers and friends for continuously supports, prayers, and encouragements during my postgraduate life.

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

POTENTIAL OF *Azolla pinnata* R. BR. AS PARTIAL PROTEIN SUPPLEMENT IN BROILER DIET

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FADZLIN AFIQAH BT A. SAMAD

July 2020

Chairman : Lokman Hakim Bin Idris, PhD
Faculty : Veterinary Medicine

Azolla pinnata is well known as an aquatic plant that contains high protein level. Due to this beneficial value, farmers widely used *Azolla pinnata* as alternative protein sources to livestock, especially chickens. However, in this country, there is no relevant scientific evidence on the growth performance of broiler chickens fed with *Azolla pinnata*. Therefore, this study was conducted to investigate the potential of *Azolla pinnata* as a protein supplement in broiler diet on the growth performance of broiler chicken. In the first experiment, the nutritional composition of *Azolla pinnata* was analyzed by using a proximate analysis method. In the second experiment, it involved 200 male day-old broiler chicks that divided into four dietary treatment groups (control: 0% of *Azolla pinnata*, T1: 5% of *Azolla pinnata*, T2: 10% of *Azolla pinnata* and T3: 15% of *Azolla pinnata*). Each group consists of 50 birds with five replicates and ten birds per pen. Bodyweight and feed intake were recorded weekly. At the end of the experiment, the FCR, body weight gain, feed intake, and feeding cost were calculated. At day 21, and day 42, ten birds from each treatment were slaughtered to collect ileal digesta sample. The ileal digesta samples were collected to determine the effect of *Azolla pinnata* on nutrient digestibility of broiler chickens. At the same time, during day 42, the birds were slaughtered to determine the carcass and meat quality of the birds fed with *Azolla pinnata*. The finding in the first experiment showed, *Azolla pinnata* contain 5.14% of dry matter (DM), 24.82% crude protein (CP), 2.00% ether extract (EE), 16.64% crude fiber (CF), 11.59% ash, 34.95% nitrogen-free extract (NFE), 42.53% neutral detergent fiber, 31.15% acid detergent fiber (ADF) and 16.87% acid detergent lignin (ADL). The result from this study showed T3 (15% of *Azolla pinnata*) has significantly highest ($P< 0.05$) bodyweight gain. However, in terms of feed intake and feed conversion ratio, there were no significant differences among treatments. The feeding cost result showed that feed containing *Azolla pinnata* was economical compared to control feed. For the nutrient digestibility experiment, the findings showed compared with a control group, feeding of 10% or 15% of *Azolla pinnata* led to significant

improvement (P< 0.05) in nutrient digestibility. The results showed there were no significant differences between the control and treatment group in term of carcass characteristics. In the meat quality, the inclusion of *Azolla pinnata* in the feed had no adverse effect toward meat color. However, in term of pH, T3 (15% of *Azolla pinnata*) was significantly (P< 0.05) highest compare to control. The study conclude, the inclusion of *Azolla pinnata* up to 15% in broiler chicken feed ration showed no adverse effect on the growth performance, nutrient digestibility, meat production and meat quality of the birds.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Sarjana Sains

POTENSI *Azolla pinnata* R. BR. SEBAGAI SUPLEMEN PROTIN DI DALAM MAKANAN AYAM DAGING

Oleh

FADZLIN AFIQAH BT A. SAMAD

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Azolla pinnata merupakan tumbuhan akuatik yang mempunyai kadar protein yang tinggi. Kelebihan yang dimiliki *Azolla pinnata* ini menyebabkan penternak-penternak memilih *Azolla pinnata* sebagai sumber protein alternatif bagi haiwan-haiwan ternakan, terutamanya ayam. Walau bagaimanapun, tiada bukti saintifik berkaitan prestasi tumbesaran ayam pedaging yang diberi makan *Azolla pinnata* di negara ini. Oleh sebab itu, kajian ini dilakukan untuk mengkaji kesan-kesan *Azolla pinnata* sebagai bahan makanan ayam pedaging. Di dalam eksperimen yang pertama, analisis proksimat telah dilakukan untuk menilai komposisi nutrisi *Azolla pinnata* Ketika eksperimen kedua, sebanyak 200 ekor anak ayam jantan yang berumur satu hari telah digunakan, dan anak-anak ayam tersebut telah dibahagikan kepada empat kumpulan diet (kontrol: 0% *Azolla pinnata*, T1: 5% *Azolla pinnata*, T2: 10% *Azolla pinnata* dan T3: 15% *Azolla pinnata*). Setiap kumpulan mempunyai 50 ekor ayam dengan lima kumpulan kecil dan setiap kumpulan kecil mempunyai 10 ekor ayam. Berat badan dan kadar makanan telah dicatat setiap minggu. Pada akhir eksperimen, nisbah penukaran makanan (FCR), kadar kenaikan berat, kadar makanan dan kos makanan telah dikira. Ketika hari ke 21 dan hari ke 42, 10 ekor ayam daripada setiap kumpulan telah disembelih untuk pengumpulan digesta ilea. Tujuan digesta ilea diambil ialah untuk menentukan kesan *Azolla pinnata* terhadap penghadaman nutrien ayam pedaging. Di samping itu, ketika hari ke 42, ayam-ayam ini juga telah disembelih untuk menentukan kualiti karkas dan daging ayam yang telah diberi makan *Azolla pinnata*. Hasil keputusan daripada eksperimen pertama menunjukkan, *Azolla pinnata* mengandungi 5.14% bahan kering (DM), 24.82% protein kasar (CP), 2.00% ekstrak eter (EE), 16.64% serat kasar (CF), 11.59% abu, 34.95% ekstrak bebas nitrogen (NFE), 42.53% serat detergen neutral (NDF), 31.15% serat detergen asid (ADF) dan 16.87 % serat detergen lignin (ADL). Selain itu, keputusan daripada kajian ini menunjukkan T3 (15% *Azolla pinnata*) mempunyai kadar tumbesaran yang tertinggi ($P< 0.05$). Walau bagaimanapun, tiada sebarang perbezaan yang

berlaku di dalam setiap kumpulan diet dalam kadar makanan dan nisbah penukaran makanan . Keputusan kos makanan menunjukkan makanan yang mempunyai *Azolla pinnata* mempunyai harga lebih murah daripada kontrol. Hasil keputusan penghadaman nutrisi mendapati memberi 10% atau 15% *Azolla pinnata* boleh memberi kesan yang baik kepada penghadaman nutrisi ayam ($P< 0.05$). Selain itu, tiada sebarang perbezaan yang berlaku pada ciri-ciri karkas semua kumpulan diet. Penambahan *Azolla pinnata* di dalam makanan tidak memberi kesan buruk terhadap warna daging. Namun begitu, T3 (15% *Azolla pinnata*) mempunyai nilai pH yang tinggi berbanding kontrol. Kesimpulannya, penambahan *Azolla pinnata* pada kadar 15% di dalam makanan, tidak memberi kesan buruk terhadap prestasi tumbesaran, penghadaman nutrisi dan penghasilan dan kualiti daging ayam pedaging.

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

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LIST OF ABBREVIATIONS

ADF	Acid detergent fiber
ADL	Acid detergent lignin
AFTA	ASEAN free trade area
AID	Apparent ileal digestibility
ANOVA	Analysis of variance
AOAC	Association of official analytical chemists
BW	Body weight
BWG	Body weight gain
C	Celsius
CF	Crude fiber
CIE	International Commission on Illumination
cm	Centimeter
CP	Crude protein
Cu	Copper
DM	Dry matter
DVS	Department of veterinary services
EE	Ether extract
FAO	Food and agriculture organization
FCR	Feed conversion ratio
g	Gram
GIT	Gastrointestinal tract
GLM	General linear model
H_2O_2	Hydrogen peroxide
H_2SO_4	Sulfuric Acid

HCl	Hydrochloric acid
kcal	Kilocalorie
kg	Kilogram
L	Liter
ME	Metabolize energy
mg	Milligram
ml	Milliliter
mm	Millimeter
N	Nitrogen
NaOH	Sodium hydroxide
NDF	Neutral detergent fiber
NFE	Nitrogen free extract
nm	Nanometer
NRC	National Research Council
RBF	Round bottom flask
SBM	Soy-bean mill
SE	Standard error
sec	Second
spp	Subspecies
SPSS	Statistical package for the social sciences
TiO_2	Titanium dioxide

CHAPTER 1

INTRODUCTION

1.1 Background of Study

The poultry industry is known as the most profitable agriculture business in Malaysia, which provides nutritious meat and egg for human consumption in a short period. In this country, the demand for chicken's meat and eggs was highest compared to ducks and quails. The growth of this industry has been proven as the inclining of farm's establishment in this country. The demanding of chicken's meat around the world allows poultry industry in Malaysia to export the meat to several countries such as Singapore. In spite of the fact that, this continuously growth industry still have the problems that they need to facing. The cost production of poultry industry is incredibly high specifically the cost of feed. Our poultry industry is too depending on imported sources especially for crucial protein sources like soybean. Limited of sources for animals feed ingredient especially poultry urge this country to import the feed ingredient from other country such as Thailand, Indonesia, and Vietnam (Ministry of Agriculture and Agro-Based Industry, 2017). It has been recorded that during 2016, the importing costs for the feed ingredients reach RM 6.67 billion. The fluctuating of cost in importation and ingredient itself can lead to inclining of feed cost. Hence, several attempts have been made by researcher and nutritionists to seek the alternative of feed resources to reduce the cost of poultry production. The Food and Agriculture Organization (FAO) come out with one idea and program to increase the usage of feed-based from the local feed available in the country. Usage of potential local feed ingredient may influence the sustainability of the livestock production system and at the same time improved the animal's feed industry in certain country.

Azolla pinnata is one of species of *Azolla* that growth well in Malaysia. It is floating fern which resembles algae. It grows typically in paddy field and shallow water, and it can multiply rapidly (Kathirvelan et al., 2015). According to Kathirvelan et al. (2015), farmers usually mix *Azolla pinnata* with commercial feed with ratio 1: 1 or directly give the *Azolla pinnata* to the livestock. *Azolla pinnata* has been used in a particular country as green manure and fertilizer for rice fields. Kathirvelan et al. (2015) stated that in Indochina, *Azolla pinnata* was collected from ponds and fed to pigs and ducks because they claimed *Azolla* pinnata could improve the body fat of the animals. In Vietnam, *Azolla pinnata* had used for a feed of cattle, poultry, and fish (Alalade et al., 2006). Besides, the previous study shows that *Azolla pinnata* had used as feed ingredients in ruminant, poultry, pigs, and fish (Basak et al., 2002; Alalade et al., 2006).

Chicken diets is a mixture of several types of feedstuffs such as corn, soybean meal, animal byproducts meal, plant byproduct meal, fat, salts, minerals, and vitamins. Some farmers will add a supplement such as molasses in the feed to

increase the efficiency of the feed. However, the nutritional requirements of chickens were differ based on their breed, strain, age, gender, and functional status. As mentioned by NRC (1994), broiler chickens need 18 – 22 % of protein and layer chickens required only 12.5 – 18.8 % of protein. Basak et al. (2002) mentioned that *Azolla pinnata*. had potential to substitute the commercial protein sources such as corn and soybean due to it protein content (25 – 30%).

1.2 Problem Statement

Poultry industry is known as most sustained business in agriculture sector in Malaysia that provides meat and eggs to consumer. However, the growth of this industry is disrupted with the cost of production especially feed cost. Our industry is too depending on imported sources especially for protein sources. Due to that, researchers and nutritionist have to find out any ingredient that can use as potential protein sources to partially replace the crucial ingredient of protein, and then lead to reduction of the feed cost. One of the ingredients is an aquatic plant known as *Azolla pinnata*. Plenty of small farmers in Malaysia used *Azolla pinnata* as a feed for their broiler chickens without any scientific evidence about the performance of their chickens after feed with *Azolla pinnata*. Therefore, it is important to study the potential of *Azolla pinnata* as a partial protein supplement in protein diet. The data from this study can be used as reference and further contribute in the feed industry of Malaysia.

1.3 Objectives

1. To determine the nutritional composition of *Azolla pinnata* that growth in Malaysia
2. To investigate the different level of inclusion *Azolla pinnata* used as potential supplement protein ingredient in broiler diet.
3. To evaluate the carcass composition and meat quality of broiler fed with different composition of *Azolla pinnata* included in their diet.
4. To calculate the feeding cost of broiler chickens that feed with diet containing *Azolla pinnata*.

1.4 Hypothesis

Azolla pinnata has potential as broiler protein sources. The feed containing 15% of *Azolla pinnata* can lead to improvement of the growth performance of the broiler chickens and meat quality of the birds without any adverse effect. Feed containing 15% of *Azolla pinnata* have lowest feeding cost.

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