Jurnal Kedokteran Hewan
P-ISSN : 1978-225X; E-ISSN : 2502-5600
September 2022, 16(3):101-105
DOI: https://doi.org/10.21157/j.ked.hewan.v16i3.25282

BODY WEIGHT, MUSCLE WIGHT, PROTEIN, DNA AND RNA CONTENTS IN BREAST MUSCLE *(M. Pectoralis Major)* OF SELECTED LOCAL MEAT CHICKEN FED ON A DIFFERENT LEVEL OF KIAPU (*Pistia stratiotes* L.) IN FERMENTED DIET

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ABSTRACT

The study to evaluate changes in body weight, muscle weight, muscle protein content and total DNA and RNA on breast muscle of selected local chicken due to different levels of fermented feed containing Kiapu (*Pistia stratiotes* L.) was conducted using a factorial randomized design for 7 weeks. This study used 72 selected local chickens, which were separated into 2 groups (male and female) and fed on 3 types of feed treatment, namely P0 (control treatment with 100% commercial feed), P1 (80% commercial feed + 20% fermented Kiapu feed), and P2 (70% commercial feed + 30% fermented Kiapu feed). Parameters were body weight, muscle weight, muscle protein content and total DNA and RNA on breast muscle of chicken. Total protein, DNA and RNA content were analysed by enzymatic reactions of prokaryotic cell and measured with a UV-Spectrophotometer according to the specified OD (optical density). The results showed that feeding Kiapu fermented 20-30% increased body weight and protein content of breast muscle of female chicken by change in DNA content. However, the feeding treatment had no changes in muscle weight and RNA content of both in male and female chicken. On the other hand, substitution of 20-30% Kiapu fermented feed caused negative changes in DNA level of breast muscle. From this study, it was concluded that substitution of fermented feed containing 20-30% Kiapu associated with the growth process of breast muscle protein is suitable for female but not suitable for male chicken.

Key words: breast muscle, chicken, DNA, Kiapu, protein, RNA

ABSTRAK

Penelitian bertujuan mengevaluasi berat badan, berat otot, kandungan protein otot serta total DNA dan RNA otot dada ayam lokal pedaging terseleksi akibat perbedaan level pemberian pakan fermentasi yang mengandung Kiapu (Pistia stratiotes L.) telah dilakukan dengan menggunakan rancangan acak faktorial. Dalam penelitian ini digunakan 72 ekor ayam lokal yang telah diseleksi, dipisahkan ke dalam dua kelompok (jantan dan betina) serta diberi tiga jenis perlakuan pakan yaitu P0 (perlakuan kontrol dengan 100% pakan komersial), P1 (80% pakan komersial + 20% pakan fermentasi Kiapu) and P2 (70% pakan komersial+ 30% pakan fermentasi Kiapu). Parameter yang diukur adalah berat badan, berat otot, kandungan protein otot, serta total DNA dan RNA pada otot dada ayam. Kandungan total protein, DNA dan RNA dianalisis dengan reaksi enzimatik dan diukur dengan UV-Spektrofotometer sesuai OD yang telah ditentukan. Hasil penelitian menunjukkan bahwa pemberian pakan fermentasi Kiapu 20-30% menaikkan berat badan, kandungan protein dada, dan merubah kandungan DNA otot dada pada ayam betina, namun tidak berpengaruh terhadap perubahan berat otot dan kandungan RNA otot dada ayam betina. Subtitusi pakan fermentasi Kiapu 20-30% menyebabkan perubahan negatif pada kadar DNA otot paha. Disimpulkan bahwa pemberian pakan fermentasi yang mengandung Kiapu 20-30% terkait dengan proses pertumbuhan protein otot dada sangat sesuai untuk ayam betina tetapi kurang sesuai untuk ayam jantan.

Kata kunci: otot dada, ayam, DNA, Kiapu, protein, RNA

INTRODUCTION

Study about improving the genetic quality of local chickens has been carried out intensively at Field Laboratory of Animal Science, University of Syiah Kuala to produce superior local meat chickens (SLMC). Until now, candidate of SLMC have been produced that have a faster growth pattern and a higher meat accumulation in skeletal muscles than their parents (Yaman *et al*. 2022). The advantage of SLMC as an alternative local meat chicken due the ability to grow faster to reach final body weight for marketing and achieve higher body weight gain than the original native chicken. SLMC was able to reach commercial weight at the age of 6 weeks with a more profitable selling value (Yaman 2010). This will be very interesting and profitable for local chicken farmers who are still competing with broiler chicken farmers. Currently, breeding program of SLMC is focusing to produce final strain with more optimal production capabilities by using genetic, production and reproductive approaches.

In meat type chicken, muscle growth is often used to evaluate the function of nutrients in promoting chicken growth which depends on strain, sex, age, growth stage, nutritional condition, nutrient density, dietary modification and condition of rearing environment (Kita *et al.* 2002; Chamruspollert *et al.* 2004; Angel *et al.* 2006; Lumpkins *et al.* 2007). Growth process of chicken muscle is largely determined by the ability of diet to provide protein and other nutrients to meet the rate of protein synthesis in muscle tissues (Zhai *et al.* 2012; Chrystal *et al.* 2020). It is well known that the growth of breast and thigh muscles in poultry is highly dependent on the amount of protein intake and protein synthesized during growth process. Previous studies have also shown that the rate of protein synthesis and breakdown in skeletal muscle is greatly influenced by completeness and adequacy of nutrients contained in the feed formulation especially

Revised 28-07-2022, Accepted 15-08-2022

ratio energy: protein, amino acids, vitamins and mineral (Saleh *et al.* 2012).

In a previous study, Jeksi *et al.* (2017) reported that feeding fermented feed containing 10% of Kiapu stimulated body weight gain and final body weight of SLMC equivalent to chicken fed on a commercial diet. Therefore, it is necessary to observe the role of the intracellular of growth mechanism on SLMC in relation to feeding function of fermented diet and protein synthesis in skeletal muscle as a main component of growth performance. Kiapu contains dry matter 82.5% Non-N Extract Matter 37.0%, crude protein 19.5%, ash 25.6%, crude fat 1.3% and crude fiber 11.7% (Yudhitstira 2013; Minggawati *et al.* 2019). It contains phytochemical compounds such as flavonoids, saponins, tannins, and antimicrobial compound, which are very useful for growing chickens. Therefore, it is necessary to further develop a diet formulation by utilizing a fermented diet contained non-conventional feed stuff such as Kiapu *(Pistia stratiotes* L.*)* It is expected to substitute commercial feed but contribute to growth of chicken and protein synthesis in muscle. The focus of present study was to evaluate the effect high level of fermented Kiapu (>10%) on total protein, DNA, and RNA contents in skeletal muscle of SLMC of different chicken sex.

MATERIALS AND METHODS

The present study has been carried out at the Field Laboratory of Animal Science (LLP) and Laboratory of Animal Reproduction Science, University of Syiah Kuala. It was designed with a factorial completely randomized design with 2 treatments, consisting of 3 feeding levels: fermented feed without Kiapu (control), fermented feed containing 10% Kiapu (P1) and fermented feed containing 20% Kiapu (P2) and the different sex groups of chickens (male and female). The Kiapu used was dried flour composed by stems and leaves. The formulation and nutrient contents of KFD used in the treatment of this study were presented in Table 1 and Table 2.

Each treatment has 4 replicates and each replication consisted of 3 SLMC. The nutritional requirement of chickens was adjusted to the growth phase based on the adequacy of the ratio of protein and energy (Yaman *et al.* 2000a; Scheuermann *et al.* 2003). Chickens were fed 3 times a day *ad libitum* according to the percentage of Kiapu Fermented Diet (KFD) substitution treatment.

The composition of the main ingredients of KFD were 40% of Kiapu, 22% of rice bran, 25% of soybean meal, 12% of corn, and 1% of probiotics. All materials of KFD were fermented an-aerobically for 2 weeks and then used according to the research treatments.

The parameters were measured in the present study included: feed consumption calculated on a weekly basis with accumulated data every day. Final body weight of chicken was measured by weighing at 7 weeks of age. DNA, RNA, protein and cholesterol contents of SLMC in breast muscle and thigh muscle obtained by enzymatic reaction method and then measuring by spectrophotometric.

RESULTS AND DISCUSSION

Final Body Weight, Breast Muscle Weight and Feed Consumption

The results showed that the difference in the substitution level of KFD in feed had significant ($P<0.01$) effect on FBW SLMC, both male and female. However, no significantly affected feed consumption and the weight of the chest and thigh muscles were detected. KFP decreased body weight on male but it increased body weight on female SLMC more than

Table 1. Formulation and nutrient contents of KFD

Materials	(%)
Kiapu	40.00
Rice brain	22.00
Soybean meal	25.00
Yellow corn	12.00
Probiotic	1.00
Nutrient contents	
Protein (%)	23.00
EM (kkal/kg)	2905.00
Fiber (%)	10.20
Fat (%)	5.53

Table 2. Composition and nutrient contents of feed treatments

Materials	Composition (%)		
	P1	P2	P3
Control diet	100	80	70
Kiapu Fermented Diet	100	10	30
Jumlah	100	100	100
Nutrient contents			
Protein (%)	23	23	23
EM (kkal/kg)	3200	3141	3112
Fiber (%)	5	5.03	5.05
Fat (%)	5	5.07	5.10

chicken fed on commercial diet. This result showed that protein and amino acid contained in the KFD was more suitable to support the growth of female SLMC at a growing phase. The body weight of male SLMC fed on 20-30% of Kiapu fermented diet was lower than commercial feed, but the female chickens had a higher body weight. The rate of feed consumption of male SLMC ranged from 214.42-221.57 g and female chickens as much as 219.51-221.93 g during 7 weeks.

It has been informed in previous research that genetically SLMC as a selected chicken has a different growth pattern and a better adapt to nutritional condition (Jeksi *et al.* 2017). Substitution of KFD has a positive impact in maintaining body weight gain comparable due to it has sufficient and balanced nutritional content according to the growth phase in female SLMC.

It indicated that nutrient content and composition of KFD is very suitable to support the growth of female SLMC. In line with the opinion of Magala *et al.* (2012) that in native fowls, the role of feed management will greatly affect the productive and reproductive performance of chickens. Protein and energy content have an influence on growth parameters such as weight gain, feed conversion and feed rate of chicken (Kuietche *et al.* 2014).

The content and balance of nutrients in different feeding treatment is responsible to chicken performances, both physically and qualitatively, especially. In this study, all treatment diet contained iso-protein and iso-energy (22-23% and 2900-3000 Kcl ME) and the amount of feed intake determined the amount of protein intake. According to Mbajiorgu (2011) feeding poultry aims to serve energy, protein and other nutrients, which is influenced by genetic factors (Tadelle *et al.* 2000). Forage-based diet used in limited quantities for local chickens and laying hens increased dry matter intake and improve feed palatability (Yaman and Zulfan 2019). Feeding chicken with KFD resulted in the same total feed consumption with those of chicken fed with commercial in term of growth.

Protein DNA, RNA Contents of Breast Muscle *(m. pectoralis major)* on SLMC

Muscle formation in poultry is strongly influenced by protein synthesis in tissue cells, namely the transcription and translation process which is determined by the amount of protein, DNA, RNA, and the ratio of RNA: protein in the muscle. The process of skeletal muscle formation of poultry varied depending on chicken breeds, genetics, sex growth phase and nutritional factors provided during its maintenance. The proportion of pectoral muscles (*m. pectoralis*) is the largest component in chicken carcasses, followed by thigh muscle and other body organs (Yaman *et al.* 2002; Culioli *et al.* 2003).

In male SLMC, although the amount of protein intake and protein content were not affected by KFD, there was a significant decreased in the total amount of DNA on breast muscle of female chicken by increasing KFD content (Table 3). However, the total RNA and protein: RNA ratio was not changed indicating transcription process of breast muscle, which was characterized by changes in total DNA by increasing KFD content. It indicated that transcription process occurs in the nucleus of breast muscle cells where DNA is stored. The results of this study also showed that there was an interaction between sex and feed differences to affect the total DNA of breast muscle. In line with the opinion of Kita *et al*. (2002) which states that the breast muscle is a muscle that is very responsive to changes in nutrition, especially in the content of protein and methionine. The formation of breast muscle protein is controlled by total mRNA, RNA and DNA contained in the chest muscle. Furthermore, Yaman *et al*. (2000b) stated that changes in feed protein will affect the average protein synthesis in slow-growing chicken breast muscles.

The muscle tissue of poultry is complex, highly specific and interconnected. Poultry muscle is a connective tissue in the body that has the main task to contract in order to move body parts and substances in the body. Skeletal muscles make up the bulk of the chicken carcass including breast muscle, upper thigh

Table 3. Muscle weight, protein content, DNA, RNA and RNA: protein ratio in breast muscle *(m. pectoralis major)* of SLMC fed on different level of Kiapu fermented diet

Parameter	% of KFD		
	P0 (0%)	P1 (20%)	P2 (30%)
Male SLMC			
Protein intake (g/d)	49.32	49.00	49.95
Protein muscle (g)	13.41	12.02	13.56
DNA content (mg)	2.24^{b}	2.06^{ab}	1.88^{a}
RNA content (mg)	0.10	0.06	0.06
RNA: Protein ratio (mg/g)	0.006	0.005	0.005
Female SLMC			
Protein intake (g/d)	50.49	50.96	51.04
Protein muscle (g)	11.41^{a}	16.05^{b}	17.09^{b}
DNA content (mg)	4.36^{b}	2.04^{ab}	1.68^{a}
RNA content (mg)	0.04	0.05	0.05
RNA: Protein ratio (mg/g)	0.004	0.003	0.003

$^{a, b, ab}$ Different superscripts in the same column indicate significant differences (P<0.01). P0= Control (100% commercial diet), P1= (80% commercial diet + 20% Kiapu fermented diet), and P2= (70% commercial diet + 30% Kiapu fermented diet)

muscle and lower thigh muscle (leg) which are important skeletal muscles in the chicken body (Tumova and Teimouri 2009; Saneyasu *et al.* 2019). In addition, chickens have two types of muscles, namely red muscle and white muscle. Red muscle contains myoglobin which functions as an iron binder and carrier of oxygen components in contrast to white muscle. The amount of protein in breast muscle is influenced by regulation of protein synthesis by nutritional factors, especially protein content, amino acids and feed digestibility (Haunshi *et al.* 2012; Ekmay *et al.* 2013).

When associated with other factors, muscle tissue high protein content is more sensitive to corticosterone administration, which results in decreased muscle mass and growth retardation in stressed chickens (Hara *et al.* 2002). Another study also showed that the effect of reducing feed nutrients had decreased protein synthesis in the liver of fasting chickens, as well as plasma albumin and total protein levels (Yaman *et al.* 2000). This condition causes depletion of free plasma amino acids, increased blood uric acid concentrations, decreased protein synthesis which can be reflected in decreased nitrogen retention and more active protein catabolism in broilers under conditions of high temperature maintenance (Temim *et al.* 2000; Dozier *et al.* 2008).

In addition, the performance of growth and production of chicken breast muscle also depends on sex, age, nutrient density, environmental maintenance and growth phase (Tesseraud *et al.* 2000; Lippin *et al.* 2010). This study proves that the regulation of total protein in the SLMC breast muscle is influenced by DNA changes and is highly dependent on the amount of essential amino acids, especially methionine and lysine in the protein intake available in diet.

CONCLUSION

From this study, it was concluded that substitution of fermented feed containing 20-30% Kiapu associated with the growth process of breast muscle protein is suitable for female but not suitable for male chicken.

ACKNOWLEDGMENT

On behalf of Poultry Research Team from the Department of Animal Science, Field Laboratory of Animal Science, University of Syiah Kuala, Banda Aceh-Indonesia, we thank you for the funding support through The Professor Candidate Scheme of Research Grant from Research and Community Service Institute, University of Syiah Kuala-Banda Aceh, Indonesia in 2022.

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