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Protein Level Efficacy in Improving Meat Nutritional Contents in Cross-bred Local Chickens Aged 0 Month to 2 Month

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Abstract

Various types of local chickens (*Gallus gallus domesticus* Linnaeus, 1758) exist in Indonesia and are raised for their meat. Chicken meat is a favorite for its good taste, affordable price, higher protein content compared with other protein-containing agricultural products, and higher essential amino acids compared with non-poultry animals. This research was conducted from 6th December 2021 to 6th February 2022, worked in the cage installed explicitly in the precinct of the University of Muhammadiyah Malang, East Java, Indonesia. The research analyzed the dry meat matter, ash, protein, and fat contents in cross-bred chickens fed with different protein levels when aged 0 mo to 2 mo (mo = month). The research method was the experimental method. The research applied an experimental method with a randomized block design, involving four groups in each of the four treatments. T0, T1, T2, and T3 were fed with protein contents of 17 %, 18 %, 19 %, and 20 %, respectively. Analysis of variance (ANOVA) with a chance of Least Student Differences (LSD) test was employed to analyse the data. Conclusively, different protein levels in feed do not affect the nutrition contents such as dry meat matter, ash, protein, and fat contents formed in cross-bred local chickens. It is therefore suggested that the lowest protein content of 17 % for cross-bred local chickens aged 0 mo to 2 mo should be the most efficient.

Keywords: Domestic fowl, Feed efficiency, *Gallus gallus domesticus* (Linnaeus, 1758), Nutrition efficiency, Nutritional needs, Poultry, Productivity increase, Protein ratio

1. Introduction

Various local chickens, both native and adopted, have existed in Indonesia from tens to hundreds of years ago. Local chickens without special characteristics are referred to as native chickens, and they are generally raised in rural communities for their meat, eggs, or savings (Iriyanti *et al.*, 2014). Three classes of local chickens are broiler (*pelung*, *nagrak*, *gaok*, *sedayu*), layer (black *kedu*, white *kedu*, *nusa penida, nunukan, merawang*, *wareng*, *sumatra*), and dual-purpose (*sentul, bangkalan, olagan, ayunai, melayu*, *siem*). Some other chickens are considered fighter (*banten, ciparage, tolaki*, *bangkok*) and ornamental (*pelung*, *gaok*, *tukung*, *burgo*, *bekisar*, *walik*) (Diwyanto *et al.*, 2007). Finally, there are also cross-bred local chickens, which are the outcomes of cross-breeding male native chickens with female laying local chickens.

Feed is one of the important aspects of poultry (Wahyudi *et al*., 2021). Before this paper was completed, the nutritional needs of cross-bred local chickens were unknown. Since poultry feed quality is determined by its protein contents (Sabate *et al*., 2014; Wahju, 2015), it is safe to assume that adding various protein sources in feeds should help reveal the nutritional needs rates according to age. Bodyweight gain in livestock relies heavily on protein intake, and protein-based feed should contain complete amino acids in a balanced amount to ensure efficiency. The body will then absorb the amino acid to form the meat and increase its mass. The protein efficiency ratio will show the level of the coefficient of chicken to convert every gram of protein consumed into body weight gain (Bai *et al*., 2015; Khan, 2018).

Meat is a food source for humans as it is the most significant protein source compared to other protein-containing agricultural products (Sekhar *et al*., 2020). While chicken meat contains 18.71 % protein, tempeh has 18.44 %, and tofu 13.84 % (Sidadolog, 2006). Chicken meat is one of the people's favorite choices due to its good taste and affordable price, which drives the chicken meat consumption rate higher yearly. Since protein content in meat depends on protein consumption and amino acid balance in the feed (Gultom *et al*., 2016; Parolini *et al*., 2020), this research aims to find out if different protein levels in feed affect meat nutrition contents. Cross-bred

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local chicken has become the focus of it since 2020 as potential laying native chicken, and the age range of 0 mo to 2 mo ((mo = month) is essential in the starter period.

2. Research Methods

This research was conducted from 6th December 2020 to 6th February 2021; worked in the cage installed explicitly in the precinct of the University of Muhammadiyah Malang, East Java, Indonesia, to study poultry. The materials were 80 cross-bred local chickens one-day-old with an average weight of 34.22 g. Variables studied were (i) meat dry matter content, (ii) meat ash content, (iii) meat protein content, and (iv) meat fat content by employing proximate analysis (Widodo, 2019). In detecting the meat dry matter content, the material samples of breast meat were dried in an oven (Memmert UN 30, Germany) at 105 °C to get rid of water and then calculated as per Equation (1):

$$\text{Dry matter content (\%)} = \left((C - A) / B \right) \times 100\ \% \quad (1)$$

Descriptions:

A = Weight of empty container (g)
B = Sample weight (g)
C = Weight of container and sample after oven drying (g)

To discover the meat ash content, the material samples were kilned (Furnace Neytech Jff 2000, USA) at a temperature of 600 °C for 1 h and computed according to Equation (2):

$$\text{Ash content} = \left((C - A) / B \right) \times 100\ \% \quad (2)$$

Description:

A = Weight of empty container (g)
B = Sample weight (g)
C = Weight of container and sample after charring (g)

The three stages of the Kjeldahl method – digestion, distillation, and titration – were performed to observe the meat protein content. First, samples were boiled into solutions, and then the components in the solutions were separated before their concentrations were assessed by the following Equation (3):

$$\text{Crude Protein (\%)} = \text{Nitrogen Content (N)(\%)} \times 6.25 \quad (3)$$

Soxhlet extractor (Apparatus – 64826 Sigma-Aldrich Pte. Ltd.) was employed to determine the meat fat content. Each solvent containing fat was placed in the extractor and then heated in an oven at 105 °C to evaporate the solvent, leaving fat free of it. The crude fat content was then assessed in line with Equation (4):

$$\text{Fat content} = \left((C - A) / B \right) \times 100\ \% \quad (4)$$

Descriptions:

A = Weight of empty fat container (g)
B = Sample weight (g)
C = Weight of fat container and sample after heating (g)

The research procedure has been approved by the Ethical Commission of the Faculty of Medicine, University of Muhammadiyah Malang (No.5.a/048.a /KEPK-UMM/III/2022) with an experimental method, randomized block design due to different types of cross-bred local chicken involved.

Four treatments were prepared, detailed as: T0 = feed with 17 % protein content, T1 = feed with 18 % protein content, T2 = feed with 19 % protein content, and T3 = feed with 20 % protein content (Fitasari *et al*., 2016). Each treatment was of four groups: K1 = male *wareng* with female *lurik*, K2 = male *ranupani* with female white *kedu*, K3 = male white *kedu* with female *ranupani*, and K4 = male *ranupani* with female *wareng*. Each group held five chickens. The data obtained were calculated using analysis of variance (ANOVA). Should there be a significant effect, Least Student Differences (LSD) test would be performed (Adinurani, 2016, 2022). The feed compositions for all treatments are detailes as per Table 1.

Table 1. Ingredients and nutrient content of feed

Feed ingredients	Treatment			
	T0	T1	T2	T3
CGM	2.00	3.23	4.45	5.68
DDGS	10.00	8.94	7.87	6.81
Fish meal (Menhaden)	1.90	2.27	2.63	3.00
MBM	5.20	5.13	5.07	5.00
Corn	49.65	47.55	45.45	43.35
Rice bran	22.57	22.32	22.06	21.81
Bone meal	0.10	0.07	0.03	0.00
soy sauce flour	5.20	7.17	9.15	11.12
Metionin	0.41	0.41	0.41	0.41
Lysin	0.29	0.28	0.26	0.25
Cooking oil	0.30	0.30	0.30	0.30
Salt	0.25	0.25	0.25	0.25
Herbal	1.00	1.00	1.00	1.00
Lime	1.13	1.08	1.02	0.97
Dicalcium phosphat	0.00	0.02	0.04	0.06
Total	100 %	100 %	100 %	100 %
Nutrient Feed				
ME	2900	2900	2900	2900
Protein	17.00	18.00	19.00	20.00
Fat	5.00	5.00	5.00	5.00
Crude Fiber	5.00	5.00	5.00	5.00
Ca	1.00	1.00	1.00	1.00
P	0.45	0.45	0.45	0.45
Na	0.15	0.15	0.15	0.15
Arginin	1.20	1.20	1.20	1.20
Histidin	2.00	2.00	2.00	2.00
Feed ingredients	Treatment			
	T0	T1	T2	T3
Isoleusin	0.60	0.60	0.60	0.60
Leusin	1.00	1.00	1.00	1.00
Lisin	1.10	1.10	1.10	1.10
Metionin	0.75	0.75	0.75	0.75
Fenilalanin	0.54	0.54	0.54	0.54
Treonin	0.68	0.68	0.68	0.68
Triptofan	0.17	0.17	0.17	0.17
Valin	0.62	0.62	0.62	0.62

3. Results and Discussion

The meat nutritional content findings in cross-bred local chickens fed with different protein levels are presented in Table 2 below.

Table 2. Meat nutritional contents in cross-bred local chickens fed with different protein levels

Variable	Treatments (%) T1	T2	T3	T4
Dry matter	91.90 ± 1.92	93.95 ± 0.74	93.41 ± 1.42	92.58 ± 0.33
Ash	8.35 ± 2.88	9.19 ± 0.88	8.38 ± 1.40	8.72 ± 1.65
Protein	80.20 ± 2.81	82.06 ± 4.95	82.78 ± 2.46	82.04 ± 1.26
Fat	3.24 ± 2.00	2.41 ± 0.72	2.23 ± 1.03	2.15 ± 0.69

Poultry meat comprises food components, such as protein, fat, carbohydrates, vitamins, water, and minerals (Giannenas *et al.*, 2017). Meat quality depends on the amount of nutrients consumed, and the feed consumption rate is related to the property of the available feed. Moreover, feed compositions and other factors such as age, species, nation, sex, additives, slaughter weight or carcass weight, growth rate, type of livestock, and treatment before and after cutting also affect the meat characteristics. Further, post-cutting handling, storage, and preservation by withering, processing by cooling, freezing, drying, heating or cooking, and additives can influence the change of chemical composition in meat (Grashom and Serini, 2006).

Meat dry matter is the total feed ingredients other than water. Referring to Table 1, feeding with different protein levels does not significantly affect meat dry matter content ($P > 0.05$). The causative factors can be changes in environmental temperature, biosecurity systems, uncomfortable cage conditions, and high humidity. It is in line with Widodo *et al.* (2019) opinion that the most significant factors that affect the number of lymphocytes are high temperature, the environment, and stress. An increase in temperature reduces the weights of lymphoid thymus and bursa Fabricius, resulting in a lower number of lymphocytes which then impedes the digestive tract from working optimally.

Digestible dry matter and absorbable nutrient contents also have some bearing on the value of dry matter content in meat. According to Suryanto *et al.* (2009), the body does not absorb dry matter excreted in the feces. In this study, the amount of dry matter in the ration used was almost the same, so the results of the nutritional content in local chicken meat were relatively the same.

Meat ash is a group of mineral substances found in food or animal tissue determined by burning organic substances and then weighing the rest. Measuring ash content is a way to quantify the amount of mineral content in food (Daniel *et al.*, 2018; Niken, 2012). Table 1 indicates that feeding with different protein levels has no significant effect ($P > 0.05$) on meat ash content. Such an event may occur when the protein content in the feed is of low quality or when the protein mixture is of lower quantity than necessary. Mineral absorption often requires specific carrier proteins, of which synthesis plays an essential role in regulating bodily mineral levels. Transporting and storing minerals also demand specific binding to the carrier proteins; its deficiency should send lots of the minerals to the kidneys, digestive tract, and bile, which are then lost in secretions (Widodo *et al.*, 2021).

The most significant dry matter component in meat (Dhama *et al.*, 2011), protein is a complex organic substance with high molecular weight. Chicken meat contains high-quality protein because it is easily digested and absorbed; it also has a larger number of essential amino acids than non-poultry animals (Bai *et al.*, 2015). As revealed in Table 1, feeding different protein levels has no significant effect ($P > 0.05$) on meat protein content. That the different protein levels suffice to keep all treatments in normal conditions is the apparent cause. Hidayat (2017) and Rana *et al.* (2020) have stated that protein intake goes along with ration consumption, where the higher the protein value, the lower the ration conversion value. Furthermore, Gultom (2016) and Soglia *et al.* (2021) agree that high protein consumption affects protein absorption in meat and provides adequate amino acids to ensure normal cellular metabolism. While low protein treatment results in low meat protein content (Kartikasari *et al.*, 2001; Sutanto *et al.*, 2019), Anang (2017) and Iriyanti *et al.* (2014), it was emphasized that local chicken meat has decent nutritional values and high protein contents.

Meat fat is a high-energy food for every gram provides more energy than carbohydrates or protein (Ruben *et al.*, 2017). Fat also acts as insulation and protection in the tissues of the subcutaneous and around certain organs, solvent vitamins A, D, E, K, and food reserves in the body (Van, 2019). Table 1 shows that feeding different protein levels has no significant effect ($P > 0.05$) on meat fat content. This is due to the nearly identical nutritional content of the feed in each treatment, especially the additional herbs, so the crude fat digestibility levels are similar.

The low rates of crude fat digestibility happen when chickens avoid increasing the ambient temperature. Instead, feed is stored in the cache to be digested gradually later. When the cage is comfortable enough, chickens reduce the burden of digesting fat. While the increase in temperature and heat stress can reduce the digestibility of dry matter, crude protein, and carbohydrates, they are barely effective to fat digestibility (Tolimir *et al.*, 2010).

4. Conclusions and Suggestions

It was concluded that feed with different levels of protein does not present significant changes in dry matter, ash, protein, and fat contents of cross-bred local chicken meat. Therefore, the lowest feed protein content of 17 % for cross-breed local chickens aged 0 mo to 2 mo should be of the highest nutrition contents.

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