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Original article

Potential Development of Cow Hair Waste as Alternative Feed Protein Source for Poultry in South Sulawesi Province, Indonesia

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Abstract

Cow hair waste (CHW) is one of the wastes produced by the cowhide cracker processing industry. In South Sulawesi Province, every year, approximately 55.6 tons of CHW produced from this industry. The problem, the digestibility of CHW is very low so that the process requires certain technologies. The low of digestibility caused by the presence of disulfide bonds (S-S) in the protein component (keratin). The application of CHW as a protein source feed affects the productivity and quality of poultry meat. The study was aims to evaluate the productivity and quality of poultry meat (quail) which was added with CHW meal at various levels. A total of four levels of CHW meal (0% (control); 2%, 4% and 6%)(w/w) were applied to the composition of the quail (*Coturnix-coturnix*) feed rations that were kept in cages for 6 weeks. The results showed no significant effect (p>0,05) on the body weight (BW), meat shear force (MSF) and cooking loss (CL) with increasing levels of CHW meal administration. In general, it can be concluded that CHW can be applied in the composition of poultry feed at level of 0-6% (w/w).

Keywords: Cow hide waste; Feed; Poultry; Protein; Meat.

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INTRODUCTION

In Indonesia, poultry is one type of livestock that has the largest population. The types of poultry that have the largest population include chickens, duck, and quail. Poultry is a producer of meat and eggs. Poultry has the largest population because it is supported by the largest consumption choices of people in Indonesia. Every year, the increase in the poultry population in Indonesia continues to grow along with the increase in the human population. The types of poultry that have the largest population are chickens and ducks, while the third largest population is quail (*Coturnix coturnix*).

Based on statistical data, in Indonesia, the population of poultry, especially quail, reaches 14,820,000 heads (Ministry of Agriculture of the Republic of Indonesia, 2021). The quail farming industry is dominated as a producer of eggs and meat. In developed countries such as Europe and Latin America, the development of quail is also growing rapidly (Ikhlas et al., 2011; Galíndez et al., 2010; Purohit et al., 2016). The need for feed for the quail farming industry has increased along with the increase in the quail population. One of the advantages of this bird is that it is easy to grow because it does not require a large place. Quail are livestock that produce meat and eggs as well as waste manure as organic fertilizer.

Feed is a basic need in a poultry industry. Feed requirements reach 70% of the total production cost. The most dominant nutrient in the composition of feed is protein. Sources of protein feed that are widely used are derived from fish and meat. Sources of protein derived from fish and meat have an expensive price. Therefore, efforts are needed to find alternative protein source feed ingredients that have lower prices. Quail type of poultry can utilize 70% of nutrients in the production process (Zancanela et al., 2015). The level of protein digestibility in quail is influenced by the process of gastric and pancreatic secretions (Yu et al., 2002). The level of protein consumption is also influenced by the digestibility of energy and amino acids (Cowieson and Ross, 2014). Protein levels in the blood are influenced by protein intake (Bovera et al., 2007).

Cow Slaughterhouse produces cowhide as one of its by-products. This hide is a raw material needed in the hide cracker processing industry. In the processing, the cowhide will be separated from the cow hair. The cowhide part will be produced into hide crackers (human food), while the cow hair waste (CHW) produced is the raw material that will be used for feed concentrate (poultry feed). Cow hair waste (CHW) is waste from cow that has the main component is protein. The results of previous studies showed that this waste had the following composition: protein content (60-80%), water (10%), fat (3-5%), fiber (0.5-3%), and ash (0.4-2%) (Gau, 2021). The composition of CHW shows a huge potential to be processed and developed as feed ingredients for livestock (poultry). The high protein content in CHW causes this by product to have the potential to be processed into protein source feed ingredients.

Cow hair waste (CHW) has a high protein content, but its digestibility is still very low. This is due to the presence of disulfide bonds (S-S) in the molecular structure of the protein (keratin). In Indonesia, CHW is obtained from the residue from the hide cracker processing industry. This waste has not been utilized and has the potential as a source of pollution. Therefore, this waste needs to be utilized optimally. The CHW has high crude protein content but low digestibility. Increased digestibility can be done through a physical process (heating accompanied by pressure). The CHW has the potential to be used as raw material for poultry feed, especially quail.

Poultry meat is the most consumed food product by the public, especially in Indonesia. In the process of forming meat in poultry, the intake of nutrients in feed ingredients is very decisive. Nutrient content in feed affects the composition and process of meat formation, especially in poultry meat. Nutrition is one of the most important factors and affects the composition of the carcass. Energy concentration and the ratio of energy to protein feed, additives and the proportion of nutritional content of feed can change the composition of the carcass. This of course will also affect the properties and quality of the meat poultry. The quality of quail meat is influenced by protein consumption during the production process. The purpose of this study was to examine the potential use of CHW as raw material for quail feed as a source of protein and its effect on the quality of quail meat.

MATERIALS AND METHODS

Materials Research

The study used local quail (*Coturnix coturnix*), mixed sex. Day old quail (DOQ) was obtained from the Quail Breeding Industry in Blitar Regency, East Java, Indonesia. The number of quail used was 100 heads. The composition of the feed used consisted of: 1) cow hair waste (CHW) meal; 2) corn meal; 3) rice bran, 4) coconut grout, 5) fish meal, 6) premix and 7) minerals. The research was conducted at the Animal Center Building, Faculty of Animal Science, Hasanuddin University, Makassar, Indonesia.

Research Methods

Preparation on CHW

CHW samples were obtained from the hide cracker processing industry of CV Akbar Jaya in Antang Village, Manggala District, Makassar City. Samples were collected and put into plastic bags. The CHW samples were washed using running water for 5 minutes. The initial processing of CHW uses a physical method, namely high pressure heating. CHW samples were dried in the sun for 24 hours. CHW samples were placed in an autoclave and heated for 10 hours at a pressure of 21 Psi. The samples were then dried in an oven at 100°C for 5 hours. The CHW sample was made into flour to be further mixed into the feed formulation.

Research design

The study was designed using a completely randomized design with a 4x5 unidirectional pattern. A total of four treatments (W_0=0% as control, W_1=2%, W_2=4% and W_3=6%) (w/w) (from the total of feed). Each treatment was repeated 5 times to obtain 20 experimental units. A total of 5 quails were placed in each cage. The time of the study lasted for six weeks. Feeding and drinking is done ad libitum. Feeding and weighing of body weight controlled. The composition of the feed ingredients applied presented in Table 1.

Table 1. Formulation of feed ingredients applied in research

Composition of Feed Ingredients	Level of Cow Hair Waste (CHW) Meal			
	W_0=0% (w/w)	W_1=2% (w/w)	W_2=4% (w/w)	W_3=6% (w/w)
Corn meal (%)	34.7	38.5	41.8	45.8
Rice bran (%)	2.8	2.7	3.2	2.9
Coconut grout (%)	56.3	52.6	48.8	45.1
CHW meal (%)	0	2	4	6
Fish meal (%)	6	4	2	0
Premix (%)	0.1	0.1	0.1	0.1
Mineral (%)	0.1	0.1	0.1	0.1
Total (%)	100	100	100	100
Feed Nutrients Component				
Crude Protein (%)	20.00	20.00	20.00	20.00
Metabolism Energy (Kcal/kg)	2,267	2,321	2,366	2,424
Fat (%)	7.85	7.65	7.48	7.26
Crude Fiber (%)	6.05	5.89	5.78	5.60
Water (%)	10.14	10.16	10.17	10.20
Ash (%)	3.42	3.16	2.94	2.66

Source : Converted from laboratory test, 2022

Preparation for in-vivo testing

A total of 100 quails aged 1 day were prepared. This amount is to fulfill the entire treatment, namely 4 treatments with 5 replications. Each treatment unit used 5 heads of quail (4 x 5 x 5). The cage is made in the form of plot with a length (46 cm) x width (30 cm) x height (30 cm). The first step is the process of disinfection of the cage using a disinfectant according to the predetermined dose. The lighting and heating system uses 25 watt incandescent lamps as much as 1 unit per cage unit (20 pieces for the whole cage). The process of washing and sterilizing eating and drinking water containers is carried out every day. The feeding and drinking system is carried out ad-libitum but controlled. Weighing of feed is done every day. Maintenance time for 6 weeks. In the 6th week, final weighing and calculation of carcass weight and meat quality testing were carried out. An overview of the maintenance model as presented in Figure 1.

Data Analysis

In this study, the parameters observed were: 1) body weight (BW), 2) meat shear force (MSF) and 3) cooking loss (CL). The research data were analyzed using ANOVA. Duncan's Multiple Range Test (DMRT) further test carried out if significant results are obtained in this study (Steel and Torrie, 1991).

Figure 1. The design of placing quail in a plot cage for testing in vivo during the 6-week rearing process

RESULTS AND DISCUSSION

Body Weight

Body weight (BW) in poultry is influenced by the quantity and quality of feed consumed (Rasyaf, 2003). The increase in BW is also related to the ability of livestock to convert food substances in feed into meat (Anggorodi, 1984). The results of weekly BW evaluation in quail reared for six weeks using different levels of Cow Hair Waste (CHW) meal presented in Figure 1.

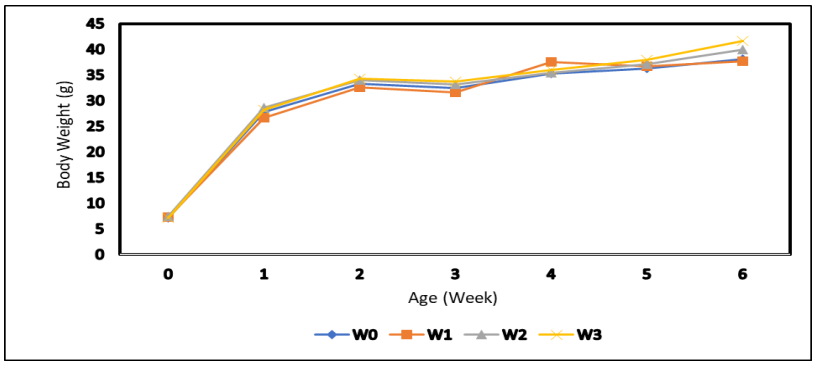

Figure 2. Description of body weight (BW) of quail (*Coturnix-coturnix*) using different levels of CHW meal treatment during 6 weeks of rearing.

Note : Level of CHW meal (W_0=0%; W_1=2%; W_2=4% dan W_3=6%)(w/w)

Based on Figure 2, for all treatments (W_0, W_1, W_2 and W_3), there was an increase in BW during six weeks of maintenance. The BW in W_3 treatment had the highest final of BW (41.63g) compared to the others (W_0; W_1; W_2) (38.09g; 37.68g; 39.94g) respectively. The W_3 treatment used the highest percentage of CHW meal (6%) compared to the others (0%; 2% and 4%). These data indicate that there is a correlation between increased levels of CHW meal use and BW in quail reared for six weeks. CHW meal is a hair concentrate product derived from cow hair. CHW meal has crude protein content ranging from 36-39% (wet basis) (Gau et al., 2021).

The BW is an accumulation of metabolic products. Metabolism results are supported by the amount of feed consumed and optimization of feed use. In general, birds need adequate nutritional intake to increase BW during growth. One of the efforts made is to increase feed consumption. According to Kartadisastra, (1997), BW of the livestock is directly proportional to ration consumption. High body weight will increase ration consumption. The ability of livestock to use rations to increase BW will decrease with increasing age of livestock. The ability of livestock to utilize the ration can be seen from the conversion value of the ration (Maynard et al., 1979).

Individuals in a breed of livestock have different responses to environmental influences, in this case nutritional and microbiological. Differences in these responses can cause differences in growth rates. The influence of nutrients on carcass composition may involve an interaction between consumption levels and feed composition. The increase and decrease in feed consumption is related to feed quality. As a result, this can affect the characteristics of the meat produced. The effect of different nutritional treatments on body composition or carcass was reflected mainly in differences in body fat and carcass levels. Utilization of energy and protein for growth and body composition or carcass in reality can not be determined with certainty (Soeparno, 2009)

Meat Shear Force

Meat shear force (MSF) parameter is one of the parameters to objectively assess meat quality. The value obtained describes the level of tenderness of the meat sample due to the application of the treatment. The higher the MSF value, the meat shows subjectively low tenderness. On the other hand, if the MSF value is low, the meat will show a high tenderness impression (Soeparno, 2009). The results of the MSF parameter testing presented in Figure 3.

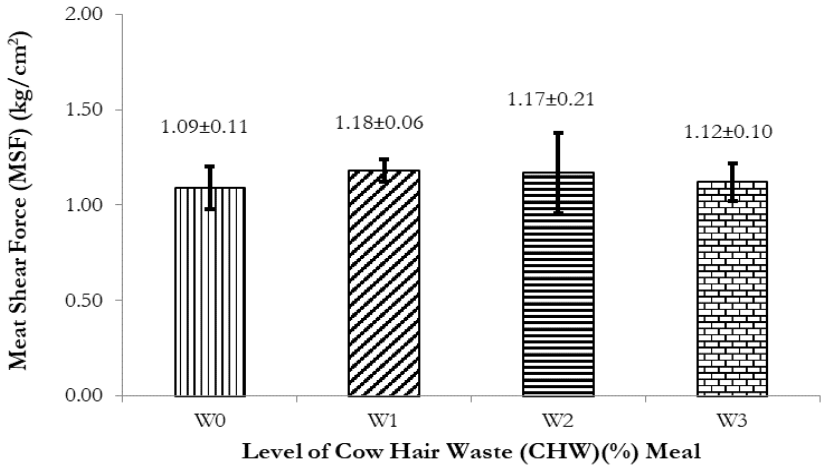

Figure 3. Comparison graph of the meat shear force (MSF)(kg/cm^2) value of quail (*Coturnix-coturnix*) meat given CHW meal at different levels during 6 weeks of rearing

Note : Level of CHW meal (W_0=0%; W_1=2%; W_2=4% dan W_3=6%)(w/w))

The results showed that the difference in the level of CHW meal in quail feed during six weeks of rearing did not show a significant effect ($p>0.05$) on the meat shear force (MSF) of quail meat. On average, MSF values are in the range of 1.09-1.17 kg/cm^2. In general, the MSF value of quail meat in the treatment of CHW (W1; W2 and W3) in the composition of the feed was higher than the control (W_0). This may be due to an increase in muscle mass due to an adequate supply of protein in the feed. The CHW meal is a feed ingredient that has a high protein content that can be converted into muscle mass so that it can increase the toughness of the meat. Increased toughness of the meat associated with high MSF values. The tenderness of the meat related to the results of the MSF test. High MSF values tend to have low tenderness. The palatability of meat is also related to tenderness. Palatability will greatly affect consumer acceptance (Miller et al., 2001; Savell et al., 1987; Savell et al., 1989).

Tenderness determines the quality of the meat. In general, factors that affect meat tenderness can be classified into two, namely antemortem and postmortem factors (Soeparno, 2009). Antemortem factors include genetics (breed), species and physiology, age, management, sex, and stress. Postmortem factors include chilling, refrigeration, withering, and processing methods. The older the age of the animal, the more connective tissue composition, so that the meat produced is tougher.

According to Hamm (1981), changes in the water holding capacity of meat are thought to be due to changes in the ions bound by meat proteins. The decrease in water holding capacity is caused by the increasing amount of lactic acid that accumulates as a result, many myofibrillar proteins are damaged. this is followed by a loss of the protein's ability to bind water. The high protein content of meat will be followed by higher water binding capacity.

Cooking Loss

The cooking loss (CL) parameter shows the amount of water molecules lost during the cooking process. In addition, The CL is also an indicator of a loss of nutritional value in meat. This is related because most of the nutrients in meat are dissolved in water molecules. Comparison of CL value of quail meat with CHW meal at different levels during six weeks of rearing presented in Figure 4.

Based on the data in Figure 4, it shows that there is no significant difference ($p>0.05$) in the CL value of quail meat due to differences in the level of CHW meal in the composition of the feed. The CL is in the range of values 22.92-24.32%. Based on these data, there is a tendency to increase the CL of quail meat along with the increase in the level of CHW meal. The increase in CL value was probably due to the addition of phenol groups in the feed (Mehdipour et al., 2013). This additional phenol group is thought to come from contamination of other materials which in turn will inhibit the occurrence of protein oxidation.

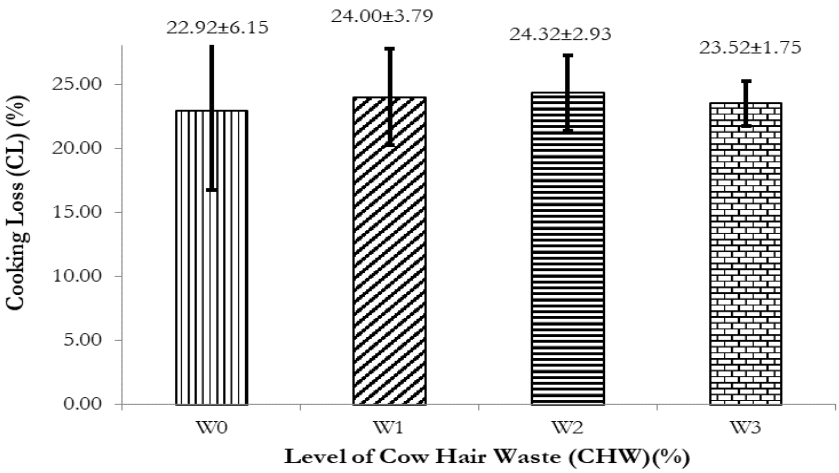

Figure 4. Comparison graph of the cooking loss (CL)(%) value of quail (*Coturnix-coturnix*) meat given CHW meal at different levels during 6 weeks of rearing

Note: Level of CHW meal (W_0=0%; W_1=2%; W_2=4% dan W_3=6%)(w/w))

One of the factors that can reduce CL is the presence of intramuscular fat. Intramuscular fat will inhibit and reduce the liquid meat that comes out during cooking. In general, the CL varies between 1.5%-54.5% with a range of 15%-40% (Soeparno, 2009). The mechanical properties of meat (cooking shrinkage) are an indication of the mechanical properties of myofibrils and connective tissue. Increasing the age of cattle causes an increase in the length of the sarcomere. This will affect the value of cooking loss on the meat. Cooking loss is affected by temperature and cooking time. The higher the cooking temperature, the greater the fluid content of the meat lost until it reaches a constant level. In addition, the amount of cooking loss is influenced by the amount of cellular membrane damage. A high cooking loss indicates more water is coming out of the meat.

Feed consumption can affect the amount of cooking loss. The mechanical properties of meat including cooking loss are an indication that the mechanical properties of myofibrils and connective tissue with increasing age of cattle are caused by an increase in sarcomere length (Soeparno, 2009). The cooking loss value is related to the water holding capacity (WHC) value. Feed is one of the factors that affect the WHC content of meat. The difference in the WHC value of meat is influenced by the carbohydrate and protein content of the meat (Ockerman, 1983). No different WHC value in this study is probably due to because the quail is slaughtered at the age and type same sex and protein content. The treatment rations were relatively the same, ranging from between 20% (Table 1) so as to produce the protein content of the meat did not differ.

CONCLUSION

Application of CHW meal in the composition of quail feed at different levels did not affect quail body weight (BW) during six weeks of rearing. Likewise with meat shear force (MSF) and cooking loss (CL). The CHW meal at the level of 0-6% can be applied in the composition of quail feed replacing fish meal as a protein source. The CHW meal has the potential to replace fish meal as a protein source.

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