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The Quality of Broiler Chicken Meat Fed with Dragon Fruit (*Hylocereus polyrhizus*) Peel Flour

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Abstract
The study aims to evaluate the effect of dragon fruit peel flour (DPF) on the meat quality of broiler chicken. A total of 96 DOCs of the Ross strain were randomly divided into 4 treatments and 6 replications. The treatments included T0=Basal diet (BD), T1=BD + 0.5% DPF, T2=BD + 1% DPF, and T3=BD + 1.5% DPF. Data were analyzed using ANOVA and Duncan Multiple Range Test. Observed variables were water content, dry matter, protein, and fat mass of the broiler chicken's meat. The results showed that there was an increase ($P<0.05$) in the meat weight, protein mass, and fat mass of broiler chickens fed with DPF, while pH, water content, dry matter, and the value of microbial respiration were not affected by the treatment ($P>0.05$). It was concluded that adding dragon fruit peel flour in broiler diets up to 1.5% could increase broiler meat's weight, protein, and fat mass.
Keywords: Broiler meat, fat mass, protein mass, microorganism respiration value, dragon fruit peel flour

Kualitas Daging Ayam Broiler Akibat Pemberian Tepung Kulit Buah Naga (Hylocereus polyrhizus)

Abstrak
Tujuan dari penelitian ini adalah untuk mengevaluasi pengaruh pemberian tepung kulit buah naga (Tkbn) yang dicampurkan dalam ransum basal terhadap kualitas daging ayam broiler. Total 96 ekor DOC broiler strain Ross digunakan dan secara acak dibagi kedalam 4 perlakuan, masing-masing perlakuan meliputi 6 ulangan. Perlakuan meliputi T0 = Ransum basal (RB), T1=RB+Tkbn 0,5%, T2=RB+Tkbn 1%, dan T3=RB+Tkbn 1,5%. Data dianalisis menggunakan ANOVA dan Duncan Multiple Range Test. Variabel yang diamati adalah kadar air, berat kering, berat daging, massa protein dan massa lemak daging ayam broiler. Hasil penelitian menunjukkan bahwa terdapat peningkatan (P<0,05) berat daging, massa protein dan lemak daging ayam broiler yang diberi pakan tambahan tepung kulit buah naga, sedangkan pH, kadar air, berat kering daging serta nilai respirasi mikroorganisme tidak dipengaruhi perlakuan (P>0,05). Disimpulkan bahwa pemberian tepung kulit buah naga dalam ransum 1,5% dapat menyebabkan peningkatan berat daging, massa protein dan lemak daging ayam broiler.
Kata kunci:* *Daging broiler, massa lemak, massa protein, nilai respirasi mikroorganisme, tepung kulit buah naga

Introduction

Efforts to produce safe carcasses with good quantity and quality are needed to ensure the safety and health of consumers. Giving antibiotics as feed additives have been proven to increase the productivity of broiler chickens but causes resistance and residue problems in the final product. One way to replace the role of antibiotics is by giving feed additives that contain active compounds such as antioxidants, such as red dragon fruit. Dragon fruit (*Hylocereus polyrhizus*) is a plant that is easy to grow and adapts to various tropical environments. Dragon fruit flesh contains high antioxidant compounds, so it is used for human consumption in fresh fruit and other processed products such as drinks, syrups, or jams. The fruit peel obtained from utilizing dragon fruit is around 30%, while dragon fruit peel flour is produced around 7-10% from the fresh peel (Yuanita *et al*., 2022). Dragon fruit peel in fresh form or flour still contains high levels of nutrients and antioxidant compounds.

The nutritional composition of fresh dragon fruit peel consists of 150.46 mg/100 g beta-cyanine, 92.65% water content, 6.2% carbohydrates, 0.95% protein, 0.1% fat, and 0.1% ash. The floured form contains 3,033 ppm lycopene, 5,569 ppm beta carotene, 108.55 mg/100 g anthocyanins, 9.47% water, 8.9%

crude protein, 3.18% fat, and 16.22% ash (Jamilah *et al*., 2011). Anthocyanins are phenolic compounds that include flavonoids**.** Flavonoids include polyphenol antioxidant components whose presence in the body depends on their achievement in the digestive tract until they are absorbed in the small intestine (Bouayed *et al*., 2011). Dragon fruit peel also contains oligosaccharides in the form of fructooligosaccharides (FOS) as prebiotics which are beneficial for the health of the digestive tract, stimulating the growth of *Lactobacillus* and *Bifidobacterium bacteria* (Wichienchot *et al*., 2010). A healthy digestive tract will impact the process of digestion, optimize nutrients absorption, and improve meat quality.

Previous research done by giving dragon fruit peel flour as an antioxidant feed additive possesses some performance advantages and maintains gut health as indicated by the increases in carcass percentage and the decreases in ileal coliform bacteria and fat percentage (Yuanita *et al*., 2022). It is also supported by research that found adding Dayak onion containing antioxidant flavonoids improved chicken performance and meat protein mass (Yulianti *et al*., 2019). Based on the potential of dragon fruit peel as an additive, this research is expected to improve carcass quality to produce carcass sources of safe and quality animal protein.

Materials and Methods

Preparation of Dragon Fruit Peel Flour

Dragon fruit peel flour (*Hylocereus polyrhizus*) was obtained by thinly slicing the fruits' peel and placing it in an aluminum container to dry under a tin roof for 1-2 days. The dried peels were then put in a blender and filtered to obtain flour with a homogeneous size. Dragon fruit peel flour was mixed as a feed additive with several doses in the basal broiler ration according to the chickens' nutritional needs.

Broiler Chickens and Research Rations

The subjects were *Ross* strain broiler chickens with an average initial DOC weight of 44.9 ± 1.85 g. Chickens were given BR1 commercial feed for the starter period and BR2 commercial feed for the finisher period as basal rations. The commercial feed consists of corn, bran, pollard, corn gluten meal, soybean meal, fish meal, palm oil, and essential amino acids, formulated according to the Indonesian National Standard (SNI), as shown in Table 1. Dragon fruit peel flour's content (DPF) at 0, 0.5, 1, and 1.5% was added to the basal diet and prepared as a dietary treatment. Each was coded as T0, T1, T2, and T3. Table 1 shows the nutrient content of the study rations.

Table 1. Nutrient Content of the Basal Ration

Nutrient Content	Composition	
	Starters (<21 days)*	Finishers (22-42 days)*
Water content %	Max 14	Max 14
Crude protein %	21-23	18-20
Crude fiber %	Max 5	Max 5
Crude fat %	Minimum 5	Minimum 6
ash %	Max 7	Max 8
Calcium %	0.8-1.1	0.8-1.1
Phosphorus %	Minimum 0.5	Minimum 0.45
Amino acid		
Lysine %	Min 1.20	Minimum 1.05
Methionine %	Minimum 0.45	Minimum 0.40
Methionine cysteine %	Minimum 0.80	Minimum 0.75
threonine %	Minimum 0.75	Min 0, 6 5
Tryptophan %	Minimum 0.19	Min 0, 18
Metabolic energy Kcal/kg **	3,000	3,100

* Based on the analysis of PT. Wonokoyo Jaya Corp
** Based on SNI 8173:2015

Maintenance of Broiler Chickens

A total of 96 broiler chickens were placed in 24 partition litter cages, each partition containing four chickens. During maintenance for 35 days, the chickens were fed with dragon fruit peel flour. At the end of the study, one chicken was slaughtered for each to test the meat's chemical quality. The meat sample includes the breast and thigh parts, which were mixed and mashed for quality testing.

Variables and Measurement Methods

The variables measured in this study included the chemical quality of broiler chicken meat: pH, water content, dry matter, protein mass, fat mass, and the microorganism respiration value of meat. The proximate analysis method was used to determine the water content, dry matter, fat, and protein in meat based on the AOAC method (2007). The percentage of protein content is then multiplied by the overall weight of meat to find protein mass meat (Suthama *et al*., 2018) and similarly for obtaining fat mass. The meat weight is obtained by weighing the breast and thigh meat.

Measurement of the degree of acidity (pH) was based on chemical analysis according to SNI (1992) with modifications. Ten grams of fresh meat were taken and mashed. The mashed meat was put in a beaker glass, added 25 ml of water (the ratio of meat and water was 1: 2.5), and stirred until homogeneous. The pH was then measured using a pH meter. Calculating the microorganisms' respiration values was done according to Anas (1989). The values of microorganism respiration were obtained by the following process: A hundred grams of fresh chicken meat was put inside a jar, and 10 ml of 0.1 N KOH solution in a film bottle was added. The jar was closed tightly, then taped on the edge of the lid. The jar was put in a black plastic bag to be incubated for 24 hours by placing it in a dark place. A blank sample was prepared, (an empty jar without meat) that was given a film bottle containing 10 ml of 0.1 N KOH solution. After 24 hours of incubation, the jar was opened, then a film bottle containing 0.1 N KOH solution was taken and 2 drops of phenolphthalein indicator solution were added until the KOH solution turned purple. Titration was carried out using 0.1 N HCl solution so the purple color disappeared, the HCl solution used was ignored and then given a methyl orange indicator until the color turned yellow. Titration was carried out using 0.1 N HCl solution so the yellow color changed to pink, and the used HCl volume was recorded. Titration was also carried out on a blank sample containing 0.1 N KOH solution. Microorganisms' respiration value was calculated using the formula below:

$$r = \frac{(a-b)\ x\ N\ x\ 120}{t}$$

Where:

r = amount of carbon in the form of $C0_2$-C produced per 100 g of meat
a = volume of HCl for meat samples (ml)
b = volume of HCl for blank (empty jar) (ml)
N = normality of HCl
t = time (number of incubation days).

Experimental Design and Statistical Analysis

This study used a completely randomized design (CRD) with four treatments and six replications (each consisting of 4 chickens). The treatment includes the addition of dragon fruit peel flour (DPF) in the basal ration, namely T0 = Basal Ration (RB); T1 = RB added DPF 0.5 %; T2 = RB added DPF 1 %; and T3 = RB added DPF 1.5 %.

Data were analyzed using analysis of variance. If there were a significant effect ($P<0.05$) between treatments, the analysis would be followed by the Duncan Multiple Range Test at a probability of 5%.

Results and Discussion

The chemical quality of broiler chicken meat-fed dragon fruit peel flour (DPF) can be seen in Table 2. Statistical analysis showed no difference in the effect of DPF addition on feed on the pH, water content, dry matter, and microorganisms' respiration value of chicken meat ($P>0.05$). At the same time, there was a significant increase in protein and fat mass ($P<0.05$).

Based on the statistical analysis results, there was no difference in the degree of acidity (pH) of the meat between treatments The pH value of the meat obtained in this study was 6.26-6.57. The pH value of broiler chicken meat in all treatments was still within the normal range according to SNI 3924-2009 chicken meat pH standards, namely 6-7 (BSN, 2009).

Table 2. Chemical Quality of Broiler Meat

Variable	Treatment			
	T0	T1	T2	T3
pH	6.26±0.24	6.33±0.17	6.28±0.29	6.57±0.17
Water content (%)	72.69±1.01	72.37±0.63	72.57±1.15	72.85±1,49
Dry matter (%)	27.31±1.01	27.63±0.63	27.43±1.15	27.48±1.49
Meat weight (g)	590.53±67.78 [a]	654.20±97.31 [ab]	660.24±48.67 [ab]	729.52±48.56 [b]
Protein mass (g)	157.48±16.57 [a]	175.15±27.79 [ab]	176.44±16.40 [ab]	195.15 ± 13.22 [b]
Fat mass (g)	14.46±1.99 [a]	15.81±2.23 [ab]	15.91±16.57 [ab]	17.48 ± 16.57 [b]
Meat's microorganism respiration value ($mgCO_2$)	5.79±0.66	5.17±1.90	6.45±2.47	4.5±2.73

Information: T0 = basal ration (RB); T1 = RB plus 0.5% DPF; T2 = RB plus 1.0% DPF; T3 = RB plus 1.5% DPF; Different superscripts in the same line show a significantly different effect (P<0.05)

Changes in meat pH generally occur due to stress conditions in chickens before slaughter. Buckle *et al*. (1987) states that the final pH value of chicken meat was due to the treatment given when the chicken was still alive, preferably before slaughtering. The chicken should be rested so as not to experience stress. Glycogen reserves in the muscle of slaughtered chicken under stress conditions will be low, so that the final pH will exceed the optimal pH of the meat. Post-slaughter biochemical processes in the meat due to excessive blood loss and oxygen supply stop, causing cell metabolism to change from aerobic to anaerobic metabolism. Aerobic and anaerobic metabolism will run slowly because it uses reserve energy, so anaerobic metabolism is less efficient, this causes the supply of *adenosine triphosphate* (ATP) to decrease (Huff-Lonergan and Lonergan, 2005).

Lukman (2010) states that a slow decrease in meat pH (high final pH) will produce dark firm and dry (DFD) meat, namely meat with dark color, hard texture, dry, and has high water holding capacity. Conversely, a rapid decrease in the pH of meat (low final pH) will produce pale soft, and exudative (PSE) meat, namely meat with a pale color, soft texture, and wet on the surface. Adding dragon fruit peel powder containing antioxidant compounds is assumed to be able to prevent stress in chickens, thus keeping the meat pH below SNI's normal-standard.

The weight of meat, protein, and fat mass of chicken meat added with DPF increased at 1.5% level of dragon fruit peel addition (P<0.05) indicating an increase in the digestibility and absorption of nutrients, especially protein and fat. The weight, protein, and fat mass indicate the meat quality. Giving dragon fruit peel flour containing antioxidant flavonoids and also prebiotic FOS can maintain intestinal acidity and suppress the growth of coliform bacteria (Yuanita *et al*., 2022). Flavonoids can affect the acidity of the small intestine by lowering the pH and increasing the total non-pathogenic bacteria. It can enhance digestion and absorption of nutrients in the broiler's digestive tract. The improvement in protein digestibility indicates a high substrate in the form of protein to increase the protein mass of meat. These results are also supported by previous research that chickens given Dayak onion extract which contains flavonoid compounds can improve protein mass, and lower the pH of the small intestine; increasing the lactic acid bacteria (LAB) population, while suppressing the total number of coliform bacteria (Yulianti *et al*., 2019; Yuanita *et al*., 2020). The condition of the digestive tract of healthy broiler chickens will lead to the digestion and absorption of feed nutrients, including the absorption of protein and fat. Absorption of protein and fat will lead to increased protein and fat intake, which are substrates for forming protein and fat mass in meat.

The respiration value of microorganisms in meat showed no significant difference (P>0.05) (Table 2). These results indicated that the number and activity of meat's microorganisms were relatively the same. Microorganisms carrying out aerobic respiration include *Bacillus* and *Pseudomonas bacteria*, thread fungi, yeasts, and facultative anaerobic bacteria such as *Enterobacteriaceae* and *Staphylococcus spp*. According to Suberata (2021), respiration is releasing stored chemical energy from organic compounds that produce the energy needed by these organisms. In

general, aerobic respiration requires free oxygen.

Respiration value is also affected by the degree of acidity (pH), organic matter, temperature, and humidity. If the pH of the meat is too acidic, the microorganisms' activities will decrease. Organic material will function as a food supply or energy for microorganisms to decompose to obtain their food. If the availability of organic matter is too small, it will cause a decrease in the microorganisms' activities. On the other hand, much organic matter will increase the activity of microorganisms, and increased activity will increase the respiration of microorganisms. Even though the protein and fat mass of meat treated with DPF were significantly higher, the respiration value of microorganisms tended to be numerically lower (T3). This result was assumed to be caused by the content of flavonoid antioxidants in DPF able to function optimally to reduce the oxidation process on the meat's surface and reduce the microorganisms' respiration process.

Conclusion

The addition of dragon fruit peel flour in broiler chicken rations can increase chicken meat's weight, protein, and fat mass.

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