The Effect of the Used Liquid Probiotic as Feed Additive on Physical Carcass Quality of Cross-Breed Chicken

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Abstract. The purpose of this study was to evaluate the effect of the addition of probiotics in liquid form as feed additive on the physical carcass quality of cross-breed chickens. The material was used 180 DOC (Day Old Chick) non-sexing cross-breed chickens maintained for 60 days. This research method used a field experiment with a completely randomized design consisting of 5 treatments and 4 replications. The treatments consist of P0 = control feed, P1 = control feed + 0.25% liquid probiotic, P2 = control feed + 0.5% liquid probiotic, P3 = control feed + 0.75% liquid probiotic, P4 = control feed + 1% liquid probiotic. Data were analysed using analysis of variance (ANOVA) and if there was a significant effect will be tested with DMRT (Duncan Multiple Range Test). The variable consists of color indicator, texture, water holding capacity (WHC), and cooking loss. The results showed that probiotics had a significant effect ($P < 0.05$) on the color indicator L and a* and also texture, however did not significant effect ($P > 0.05$) on the color indicator b*, WHC, and cooking loss. It concluded that the addition of 1% liquid probiotics as a feed additive has the best results on the carcass quality of cross-breed chicken.

Keywords: carcass · chicken · cross-breed · probiotic

1 Introduction

Cross-breed chicken is a cross between a Bangkok Local male domestic chicken and a layer strain Lohmann Brown as a meat producer to fulfill the animal protein demand. Indonesian people's consumption of kampong chicken meat reached 777 g/capita/year, up 151 g (19.43%) from the previous year. There was a significant increase in the consumption of kampong chicken, because it has a savory taste, juicy texture, and lower fat composition than broilers. The increase demand was inversely proportional to the lack of kampong chicken meat supplies due to low domestic chicken productivity.

Cross-breed chicken is one of the methods to fulfill the demand for kampong chicken meat. Cross-breed chickens had a carcass quality similar to kampong chickens with a relatively shorter harvest, which was 60–65 with the average body weight 0.8–1.0 kg.

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The productivity and carcass quality were necessary to prepare feed that was following the nutritional requirements of cross-breed chickens to improve productivity, increase feed efficiency, and improve carcass quality [1]. Improving nutritional requirement of cross-breeds chicken was the addition of feed additive to optimize the condition of microorganisms in the digestive tract, it can be facilitating the absorption of nutrients in feed and would have an impact on improving the physical carcass quality of cross-breed chicken.

Feed additive is an additional feed in small amounts to adjusted to the requirements of livestock. AGP (Antibiotic Growth Promoter) is used by farmers to support livestock production, but the AGP could have a bad impact that was leaving residues on meat so it is dangerous for human consumption. Another alternative feed additive that can be used to increase productivity and carcass quality in livestock and the meat produced is safe for human consumption, namely probiotics.

Probiotics are live microbes that can optimize pathogenic and non-pathogenic microbes in the digestive tract of livestock so that they could improve livestock health, accelerate growth, and facilitate the absorption of nutrients in feed [2]. The effect of adding probiotics to crossbreed chickens is expected to be able to efficiently absorb the nutrient content of the feed so the probiotics can improve the physical carcass quality of cross-breed chickens. Fitri et al., [3] in their research showed that the addition of probiotics with a level of 0.5% could produce the texture of broiler meat with the lowest average value. The addition of probiotics with a level of 0.25% in feed could produce the highest average WHC value, at the level of addition of 1% it produced the lowest average cooking loss value in broiler carcass [4]. Okarini [5] added to his research by explaining that the addition of probiotics with a level of 1% could produce the highest average value for the color of the carcass of broilers. This study aimed to determine the effect of adding liquid probiotics as a feed additive on the physical quality of the cross-bred chicken carcass.

2 Materials and Method

2.1 Research Location

The study was conducted in vivo with maintenance starting from September 28th to November 28th, 2021 at UD. Berlin Farm is located at Maguan Village, Ngajum District, Malang Regency, East Java. Feed mixing is done at the same place. Feed proximate testing was carried out at the Animal Feed Laboratory of the Livestock and Fisheries Service Office of Blitar Regency, which was located at Jalan Cokroaminoto No. 22 Blitar and Laboratory of Nutritional and Animal Feed, Faculty of Animal Husbandry, Brawijaya University. Testing of texture, color, cooking loss, and water holding capacity of meat was carried out at the Laboratory of Animal Products Technology, Faculty of Animal Husbandry, Brawijaya University.

2.2 Research Materials

The material used 180 non-sexing cross-breed chickens (DOC) (Day Old Chick) produced by UD. Berlin Farm with an average weight of DOC was 40.91 ± 3.33 g/head and the coefficient of diversity was 8.13%. The cages used were 20 plots of opened house litter cages with a length x width x height were 1 x 1 x 2 m. Each cage plot is occupied by 9 cross-breed chickens. The basal feed used was arranged based on the nutritional requirements of crossbred chickens in the starter period (age 0–30 days) and the finisher period (age 31–60 days). The drink is provided in the form of clean water. Feed and water are provided ad libitum. The composition of the basal feed ingredients consisted of separator bran, soybean meal, yellow corn, corn DDGS, fish meal, copra meal, broiler concentrate, coconut oil, salt, and premix which were mixed independently using a vertical mixer.

2.3 Research Methods

The method was used the experimental method in vivo using a completely randomized design (CRD) with a unidirectional pattern using the treatment of adding commercial liquid probiotics with the composition of Lactic Acid Bacteria and Bacillus sp. Concentration of 2.58 x 109 CFU/ml in the feed according to the treatment, namely the difference in the level of administration, namely, 0%, 0.25%, 0.5%, 0.75%, and 1%. The study consisted of 5 treatments with each treatment consisting of 4 replications so that there were 20 experimental units. Each replication consisted of 9 crossbred chickens.

The treatments given in this study include:
P0 = Basal Feed.
P1 = Basal Feed + Probiotic 0.25%
P2 = Basal Feed + Probiotic 0.5%
P3 = Basal Feed + Probiotic 0.75%
P4 = Basal Feed + Probiotic 1%..

2.4 Research Variable

The variables measured in this study include:

a. Color indicator L a* b*

Color tests were used by the Hunter color system method; The color values displayed from the measurement of color intensity are L* (white), a* (red), b* (yellow) (Kaemba et al., 2014). Do deboning on the chest first to separate the meat from the bones using a knife. The results of the deboning are then put into a plastic clip and the color intensity test is carried out. The chromameter was turned on and calibrated with black and white standards, then three different perspectives were taken on the sample surface to determine the average of the values obtained.

b. Texture Test

Meat texture testing was using a warner-blatzer shear force. The breast meat that has been deboned and separated from the fat and then cut into the same size and thickness, that was 0.5 x 0.5 x 0.5 cm. The meat is placed on the knife of warner-blatzer shear force device and then cut slowly and the highest number appears on the digital screen

c. Water Holding Capacity (WHC)

The Water Holding Capacity (WHC) testing method was used the 0.3 grams of breast meat was weighed with a superior mini scale and then placed in the middle of Whatman filter paper no. 42 and then pressed with a press tool with a pressure of 35 kg/m^2 for 5 minutes. The water that comes out on the filter paper is then drawn using a pencil. The image of the inner circle is the pressed sample, while the outer circle is the water that comes out of the meat. Measurements were made using millimeter blocks to calculate the area of the wet area using the area of the outer circle minus the area of the inner circle [6], then the measurement results were entered into the Hamm formula:

$$\mathrm{MgH2O} = \left(\text{wet area area cm}^2/0.0948\right) - 8.0.$$

$$\mathrm{WHC} = (\mathrm{MgH2O}/300) \text{ x } 100\%.$$

d. Cooking Loss

The cooking loss test method was used 10 g whole meat is weighed and then put into polyethylene plastic and tightly closed and the air was removed from the plastic by pressing the air out of the plastic so that water cannot enter the plastic during the boiling process. The sample was boiled using a water bath filled with distilled water at 80oC for one hour. The boiled sample was then put into a beaker glass containing water at a temperature of 10oC for 15 minutes [7], then the sample was removed from the plastic and weighed for the final weight. Calculation of cooking loss using the formula:

$$\mathrm{CookingLoss} = \frac{(InitialW - FinalW.)}{InitialW.} \text{x}100\%$$

2.5 Data Analysis

The data obtained in this study were analyzed using ANOVA method by using a completely randomized design (CRD) with the help of Microsoft Excel. If the results of the analysis obtained data that are significantly different or very real, then proceed with Duncan Multiple Range Test (DMRT).

3 Results and Discussion

The results of observations and statistical analysis on the physical carcass quality of cross-breed chicken including indicators of color L* (white), a* (red), b* (yellow), Texture, water holding capacity, and cooking loss can be seen in Table 1.

Table 1. Effect of the addition probiotic on color, texture, WHC, and cooking loss on cross-breed chickens

Treatment	Color Indicator			Texture	WHC	Cooking Loss
	L*	a*	b*			
P0	45,28 ± 3,14^{a}	0,79 ± 0,54^{a}	6,79 ± 0,28	11,25 ± 2,56^{b}	10,08 ± 2,21	24,90 ± 1,22
P1	42,74 ± 0,85^{a}	1,61 ± 0,40^{b}	6,78 ± 0,28	9,45 ± 0,72^{ab}	7,44 ± 2,64	24,55 ± 1,17
P2	44,53 ± 2,23^{a}	1,77 ± 0,45^{b}	6,43 ± 1,06	8,30 ± 2,63^{a}	9,64 ± 2,49	23,20 ± 0,41
P3	46,67 ± 3,02^{a}	1,96 ± 0,59^{b}	6,21 ± 0,82	9,93 ± 1,44^{b}	10,52 ± 1,76	23,85 ± 0,70
P4	52,00 ± 5,28^{b}	1,98 ± 0,67^{b}	6,10 ± 0,28	6,83 ± 1,28^{a}	10,96 ± 2,64	23,83 ± 0,22

Notes: Different superscripts (a-b) between rows showed significantly different ($P < 0{,}05$) in the treatments

3.1 The Effect of addition Probiotic on Color Indicators

The L* color indicator was an indicator of lightness with a range of values between 0 (dark) to 100 (bright). The higher the value of L*, the sample has a brighter color. The results of statistical analysis in Table 1 show that the maintenance of crossbred chickens with the addition of probiotics as a feed additive in the feed had a significant effect ($P < 0.05$) on the color indicator L* (lightness). The light color of the meat is due to the sample used, which was breast meat. This is following the statement by Mobini (2013) that chicken breast was the type of light meat and chicken thighs were the type of dark meat. The color of chicken meat had light or red color characteristics [8]. The results of the average color indicator L from the lowest to the highest are P1 (42.74), P2 (44.53), P0 (45.28), P3 (46.67), and P4 (52.00) which indicate that P4 had the lightest color.

The mechanism of probiotics to increase the lightness indicator in meat was that lactic acid produced by lactobacillus could form bacteriocins as antimicrobials and short-chain organic acids that could inhibit the development of pathogenic bacteria that cause excessive oxidation reactions to myoglobin in cross-breed chicken meat. Determination of meat color was myoglobin pigment which could change shape due to a chemical reaction, that was, if meat is exposed to air, the myoglobin pigment would be oxidized to form oxymyoglobin which could produce a bright meat color [9].

The a* color indicator was a reddish indicator with a range of values from -80 (green) to + 100 (red). The negative scale indicated that the sample tends to have a green color, if it is positive then the sample tends to have a red color. Based on the results of statistical analysis in Table 1 showed that the addition of probiotics as feed additives in the feed had a significant effect ($P < 0.05$) on the color indicator a*. The increase in red color is suspected to be lactobacillus in probiotics producing lactic acid which could help the metabolic process in the body of livestock according to the nutritional requirements of livestock so that it has an impact on the animal welfare and healthy livestock. This was under the statement by Okarini [5], that several organic acids, essential amino acids contained in probiotics could improve the metabolic processes of the livestock body as needed. These conditions have an impact on animal welfare, and livestock health conditions, and produce chicken meat carcasses as expected. The average results of the a* color indicators from the lowest to the highest are P0 (0.79), P1 (1.61), P2 (1.67), P3 (1.96), and P4 (1.98) which indicate that P4 has the reddest color.

The mechanism of probiotics to increase the red color indicator in meat is when lactic acid bacteria could kill non-pathogenic bacteria in the digestive tract due to the acidic atmosphere, then the empty intestinal villi are occupied by non-pathogenic bacteria so that non-pathogenic bacteria can absorb feed nutrients properly. Then caused the metabolism that occurs to run well. Metabolism that occurs, one of which can form myoglobin which caused red color in meat so that the higher probiotics can form the myoglobin and had an impact of increasing the red color in meat [10].

The b* color indicator was a yellowish color indicator with a range of values from -70 (blue) to + 70 (yellow). The negative scale indicates the sample tends to have a blue color, if it is positive then the sample tends to have a yellow color. Based on the results of the statistical analysis in Table 1 showed that the addition of probiotics as a feed additive to the feed had a significant effect ($P > 0.05$) on the b* color index of cross-breed chicken meat. It was suspected that the microorganisms in probiotics cannot help completely absorbed the xantofill and carotenoid content in feed ingredients which caused yellow color in chicken carcasses. That was following the statement by Rini, Sugiharto, and Mahfudz (2019) that the yellow pigment in poultry is influenced by factors including genetics, a pigment in feed ingredients, post-mortem processes, and livestock health. The results of the average color indicator b* from the lowest to the highest are P4 (6.10), P3 (6.21), P2 (6.43), P1 (6.78), and P0 (6.79).

The difference in b* value in cross-breed chicken meat can be influenced by an antioxidant activity because it can inhibit haemoglobin oxidation. Abdurrahman et al. [11] explained that the mechanism of action of probiotics in influencing differences in b* values in meat was an increase in antioxidant activity which resulted in inhibition of the oxidation reaction of haemoglobin so that the absorption of the pigment that causes the yellow color in animal tissues increased. Changes in b* value can also be influenced by meat fat deposition because high meat fat caused the highest b* color values [12].

3.2 The Effect of addition Probiotic on Texture

The texture is one of the characteristics that indicated the level of the tenderness of the meat. Based on the result of statistical tests in Table 1 showed that the addition of probiotics as feed additives in the feed had a significant effect ($P < 0.05$) on the carcass texture of cross-breed chickens. This is due to a decrease in pathogenic bacteria so that non-pathogenic microbes could increase the absorption of protein content in the feed. High protein levels in feed can accelerate the growth process of cross-breed chickens so that meat fat will be formed [13]. The addition of probiotics can also cause changes in the shape of collagen, which is the main component of connective tissue that affects meat hardness. This is following the statement by Hidayat [14] that the animal that experience fast and optimal growth had young collagen (immature collagen) so that the texture value produced is lower than an animal that had slow growth at the same harvest weight. Texture mean value indicated that treatments P0 and P4 had a high texture with an average of 11.25 and 10.18, the treatments P1 and P2 had lower meat texture with an average of 9.45 and 8.30, and the treatment P4 had the lowest meat texture with an average of 6.83.

Abdurrahman [11] explained the mechanism of probiotics in effected the meat texture, the probiotics produced a lactic acid which could increase the absorption of protein content in feed optimally. The higher protein content in the feed could increase the fat and muscle meat formation, which resulted in more tenderness of chicken carcass texture [15]. Meat muscle contained connective tissue in the form of collagen which affected the texture of the meat, while the intramuscular fat in the meat would dissolve in the muscle fibers of the meat, resulting in more watery meat and a decreased texture value of cross-bred chicken meat [13].

3.3 The Effect of addition Probiotic on Water Holding Capacity (WHC)

Water Holding Capacity (WHC) was the ability of meat protein to bind water. Based on the result of the study, showed that the addition of probiotics as feed additives to the feed had an insignificant effect ($P > 0.05$) on the WHC value in cross-breed chickens. The higher the WHC value, the lower the amount of water that came out so the better the meat. The lower the water holding capacity of the meat, the more liquid it would lose, so the weight of the meat will decrease. Factors that affect water holding capacity include livestock breeds, pH, actomyosin formation during rigormotis, temperature and humidity, age, and feed (Astuti, 2018). The average results of the WHC color indicators from the lowest to the highest were P1 (7.44), P2 (9.64), P0 (10.08), P3 (10.52), and P4 (10.96).

The addition of liquid probiotics as a feed additive in feed could increase the WHC value using the lactic acid produced by LAB in the digestive tract causing a decrease in the acidity level of the meat so that positively charged molecules gain access to enter the meat and a surplus of negative molecules occurred resulting in rejection by microfilaments. This rejection provides more room for water molecules to enter the meat. The more water molecules that enter, the higher the WHC value, otherwise if the strength between adjacent molecules increases, it caused a decrease in the WHC value [13].

3.4 The Effect of Addition Probiotic on Cooking Loss

Cooking loss was an indicator of the nutritional value of meat, which was related to the level of meat juice, that the amount of water bound in and between muscle fibers (Lapase, Gumilar, and Tanwiriah, 2016). Based on the results of statistical analysis in Table 1 showed that the addition of liquid probiotics as a feed additive in the cross-breed chicken feed had an insignificant effect ($P > 0.05$) on the value of the cooking loss. The lower the cooking loss value, the carcass quality produced is better than other treatments, this is because the low cooking loss value caused some nutrients lost during boiling. The size of the cooking loss value could be influenced by the amount of cellular membrane damage, the amount of water that comes out of the meat, protein degradation, and the WHC value. The average cooking loss test results showed that the highest to the lowest values were P0 (24.90), P1 (24.55), P3 (23.85), P4 (23.83), and the lowest cooking loss value was in treatment P2 (23, 20).

The value of cooking loss in meat can be influenced by the ability of the protein to bind water during the heating process. The mechanism of probiotics in influencing the value of the cooking loss is that lactic acid bacteria produced high lactic acid then helped the absorption of crude fibre in the small intestine. Crude fibre would bind intramuscular fat which can inhibit the release of liquid in the meat during the heating process.

4 Conclusion

The conclusion of this research showed that the addition of 1% liquid probiotic as feed additive improved the physical carcass quality of crossbreed chicken meat.

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