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Blood lipid profile and meat quality of broiler chickens Fed fermented Jamu Makarens

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Abstract
The study aimed to examine the effect of Jamu Makarens in rations on blood lipid profile and broiler meat quality using a completely randomized design (CRD) consisting of 4 treatments and 3 replications, so that there were 12 experimental units. Each unit used 8 broiler chickens. The treatment ie: ration without Jamu Makarens, as a control (P0), commercial ration + 2% Jamu Makarens (P1), commercial ration + 4% Jamu Makarens (P2), and commercial ration + 6% Jamu Makarens (P3). The variables observed were: blood lipid profile and meat quality (physical and chemical). The results showed that broilers given Jamu Makarens had blood cholesterol, triglycerides, LDL, and HDL levels, cooking loss, water content, fat and meat cholesterol levels lower than control, while water binding capacity, protein content and meat redness levels were higher than control. Conclusion: Jamu Makarens can improve blood lipid profile and meat quality of broiler chickens.

Keywords: Broiler, Jamu Makarens, meat quality, blood lipid profile

Introduction
Broiler meat is one type of poultry meat that is in great demand by the public because the price is quite affordable, can be consumed by all people, is easily processed into various kinds of dishes and has a soft and thick texture. Another advantage of broiler chickens is that they have a very short maintenance time, within 30-35 days they can be harvested with a body weight of 1.5-2 kg. Rapid growth in broiler chickens is also followed by fat growth, so broiler meat tends to be fatty. Triyantini *et al*. (1997) [21] states that among poultry meat, broiler meat has the highest fat, both in the chest, thighs, and skin. The fat content of breast meat in broilers is as much as 1.30%; while in free-range chickens 0.80%; ducks and entok 0.50%.

Fat in meat is a major consideration for consumers in choosing products of animal origin because it is closely related to cholesterol. Under normal circumstances, cholesterol is needed by the body as a precursor to steroid compounds such as corticosteroids, sex hormones (estrogen, progesterone, testosterone, corticosterone and aldosterone), bile acids and vitamin D (Murray *et al*., 2012) [14]. Consumption of broiler meat with high fat and cholesterol content can cause artherosclerosis in humans which eventually causes coronary heart disease (Meliandasari *et al*., 2015) [12]. In addition, the colour, aroma and texture of meat are also usually taken into consideration in choosing the quality of meat. Soeparno (2015) [17] states that the deterioration of meat odor and flavor is a direct result of fat oxidation. To prevent oxidation it is necessary to have antioxidant compounds, such as phytochemical compounds and vitamin C. According to some research results, antioxidants can affect the color, taste, aroma, texture and cholesterol of meat. Meat cholesterol can also be reduced by administering probiotics. The most commonly used probiotic is lactic acid bacteria. One product that contains phytochemical compounds and lactic acid bacteria is Jamu Makarens.

Jamu Makarens is a fermented herbal medicine made from ripe maja fruit, old coconut water, palm sugar and rice washing water. This herb contains phytochemical compounds, such as: alkaloids, phenols, saponins, tannins and flavonoids. Jamu Makarens also contains vitamin C and lactic acid bacteria so that it has potential as a probiotic. Julianto (2019) [10] states that phytochemical compounds are useful as antibacterial, anti-inflammatory and antioxidant. In the body, antioxidants can prevent the oxidation of unsaturated fatty acids in muscle tissue so that damage to the aroma and flavor of meat can be prevented (meat is not fishy and bright red

in color). Antioxidants also inhibit collagen tissue biosynthesis and the activity of HMG-Ko. A reductase enzyme in the process of cholesterol formation (Muchtadi, 2012) [13]. The formation of cholesterol can also be reduced by the presence of lactic acid bacteria, because these microbes produce lactic acid which causes a decrease in the pH of the digestive tract so that it will stimulate the release of bile salts to normalize pH. As a consequence, blood cholesterol will be reduced because it is widely used to form bile salts. Low blood cholesterol will have an impact on meat cholesterol.
Based on this description, this study needs to be carried out to examine the effect of giving Jamu Makarens in the ration on blood lipid profile and meat quality of broiler chickens.

Materials and Methods

Experimental design, animals, housing and diets

A total of 96 broilers were kept in battery colony cages for 35 days. The ration given is a commercial ration supplemented by Jamu Makarens according to the treatment. The experimental design used was a completely randomized design (CRD) consisting of four treatments and four replications. The treatments were: broilers fed commercial rations without Jamu Makarens (P0), broilers fed commercial rations + 2% Jamu Makarens (P1), broilers fed commercial rations + 4% *jamu* makrens (P2), and broilers fed commercial rations + 6% Jamu Makarens (P3).

Preparation of Jamu Makarens

Jamu Makarens are made from several ingredients i.e, ripe maja fruit (*Aegle marmelos* L.), old coconut water, palm sugar and rice washing water. Before mixing, ripe maja fruit is blended first until it is in the form of juice and palm sugar is diluted by heating then left until it cools. After that, all the ingredients are put in a barrel and fermented naturally for a month. After a month, the makarens herbs are filtered and ready to be given to the broiler. The administration of Jamu Makarens is carried out by mixing in the ration according to the treatments.

Blood sampling and blood lipid profile test

Blood samples are taken in the wing veins (brachial veins) using a 3ml disposable syringe. Blood is put into a vacuum tainer without anticoagulants, then centrifuge for 5 minutes to separate the serum. Furthermore, serum is pipettes as much as 500 µl to be analyzed using the principle of color change that occurs after mixing serum and reagents. The observed blood lipid profiles include: total cholesterol, triglycerides, LDL and HDL. All of these variables were measured using modification reflovet plus (Rosche). The blood sample taken by reflotron pipette (30 µ L) than melted in stick test as the parameters observed. Stick contains sample inserted in reflovet plus which has already ignited first. After 2-3 minutes the result can be read on the screen. The stick that has been read take out and continue with the other stick.

Meat sampling and laboratory tests

Meat samples for physical and chemical quality tests were taken from the chest as much as 200g and then put into a labeled plastic bag. The meat sample is then taken to the Laboratorium to be analyzed physical qualities include: pH, cooking loss, water binding capacity, and meat color, while chemical qualities include: water content, protein, fat, and cholesterol.

Statistical analysis

All data were analyzed using one-way ANOVA to determine the differences among treatments. If differences were found ($p<0.05$), then further analysis was performed with Duncan's multiple range test (Steel and Torrie, 1993)

Results and Discussion

Result

The provision of Jamu Makarens in the ration generally has a positive effect on the blood lipid profile and meat quality of broiler chickens. The statistical analysis showed that Jamu Makarens had a significant effect ($p<0.05$) on reducing total cholesterol, triglyceride, LDL, and HDL of blood, cooking loss, moisture content, fat content and cholesterol content of meat. Jamu Makarens is also able to increase the water binding capacity, meat protein content and meat redness level. Data on the effects of giving Jamu Makarens in the ration on blood lipid profile and meat quality of broiler chickens aged of 5 weeks are shown in Table 1.

Blood Lipid Profile

The average of total cholesterol in P0 treatment (commercial rations without Jamu Makarens) was 169.76 mg/dl (Table 1), while in treatment P1 (commercial rations + 2% Jamu Makarens), P2 (commercial rations + 4% Jamu Makarens) and P3 (commercial rations + 6% Jamu Makarens) significantly ($p<0.05$) lower than P0 (control), respectively by 6.79%; 22,48%; and 25,57%. Total cholesterol of blood in the P2 and P3 treatments respectively 16.84% and 20.25% significantly ($p<0.05$) lower than P1, and P3 treatment 3.98% significantly lower than P2.

Table 1: The effect of Jamu Makarens on blood lipid profile and meat quality of broilers chickens aged of 5 weeks

Variable	Treatment [1]				SEM[2)]
	P0	P1	P2	P3	
Blood lipid profile:					
Total cholesterol (mg/dl)	169.76^{d}	158.23^{c}	131.59^{b}	126.35$^{a3)}$	1.99
Triglyceride (mg/dl)	81.42^{c}	81.15^{c}	80.28^{b}	78.67^{a}	0.23
LDL (mg/dl)	46.05^{b}	41.90^{b}	18.13^{a}	15.21^{a}	2.20
HDL (mg/dl)	107.43^{c}	100.00^{b}	97.41^{a}	95.40^{a}	1.09
Physical quality of meat					
pH	6.89^{a}	6.89^{a}	6.89^{a}	6.89^{a}	-
Cooking loss (%)	38.15^{b}	34.19^{a}	37.08^{b}	33.65^{a}	1.13
Water binding capacity (%)	24.53^{a}	30.20^{bc}	26.38^{ab}	33.58^{c}	2.32
Colour:					
• Brightness level (L*)	11.16^{a}	8.39^{a}	9.90^{a}	9.08^{a}	1.18
• Redness level (a*)	13.49^{a}	13.21^{a}	13.98^{ab}	15.78^{b}	0.92
• Yellowness level (b*)	6.95^{b}	5.95^{ab}	5.88^{ab}	4.02^{a}	0.99
Chemical quality of meat					
Moisture content (%)	74.75^{b}	74.47^{b}	73.31^{a}	73.22^{a}	0.15
Protein content (%)	19.41^{a}	19.43^{a}	21.52^{b}	21.78^{b}	0.68
Fat content (%)	1.89^{d}	1.77^{c}	1.54^{b}	1.21^{a}	0.04
Cholesterol content (%)	0.35^{c}	0.32b^{c}	0.28^{b}	0.16^{a}	0.26

Note
1) Treatment:
P0 = Commercial rations without Jamu Makarens (control)
P1 = Commercial rations + 2% Jamu Makarens
P2 = Commercial rations + 4% Jamu Makarens
P3 = Commercial rations + 6% Jamu Makarens
2) SEM = Standard Error of the Treatment Means
3) Values with different letters on the same line show significantly different ($p<0.05$)

The average of blood triglyceride level in the P0 treatment was 81.42 mg/dl (Table 1), but in the P1 treatment were not significantly different ($p>0.05$) lower than the controls, while the P2 and P3 treatments were 1.40% and 3.38% significantly lower ($P<0.05$) than the controls (P0), respectively. Blood triglyceride levels among the treatments that received Jamu Makarens were significantly different ($P<0.05$), where P2 and P3 treatments were 1.08% and 3.06% lower than P1, respectively, and P3 was 2% lower than P2.

The average of blood LDL levels in the control treatment (P0) were 46.05 mg/dl (Table 1), while in the P1 treatment it was 9% lower than P0, but statistically was not significantly different ($P>0.05$), while the P2 and P3 treatments, respectively, 60.4% and 66.96% were significantly lower than P0. Blood LDL in P2 and P3 treatments was 56.74% and 63.70% significantly ($P<0.05$) lower than P1, respectively, while P3 treatment was 16.07% not significantly ($P>0.05$) lower than P2.

The average of blood HDL levels in the control treatment (P0) were 107.43mg/dl (Table 1), while the P1, P2 and P3 treatments were 6.92%, 9.33%, and 11.20% significantly ($P<0.05$) lower than the control (P0). Blood HDL in P2 and P3 treatments was 2.59% and 4.60% significantly ($P<0.05$) lower than P1 respectively, but in P3 treatment was 2.06% not significantly lower than P2.

Physical qualities of meat

The physical qualities of meat observed in this study include: pH, cooking loss, water binding capacity and meat colour. The pH of meat in all treatments showed the same value of 6.89 (Table 1). The average cooking loss of meat in P0 treatment was 38.15%, while in P1 and P3 treatment was significantly ($P<0.05$) lower than the P0 treatment respectively by 10.38% and 11.81%. The cooking loss value in the P2 treatment was also lower than the control by 2.82%, but statistically was not significantly different ($P>0.05$). The cooking loss value of broiler meat in P1 treatment was significantly lower than P2 by 7.78% and higher than P3 by1.59%, but statisticaly not significantly different ($P>0.05$). The cooking loss in P2 treatment was significantly higher than P3 by 9.25%

The average of water binding capacity of broiler meat in P0 treatment was 24.53% (Table 1), while in P1 and P3 treatment respectively 18.76% and 26.95% significantly ($P<0.05$) higher than the P0, while in P2 treatment, the water binding capacity was 7.01% not significantly ($P>0.05$) higher than P0. The water binding capacity in P3 treatment was significantly higher than P2 by 21.44%.

The average brightness level (L*) of broiler meat in the control treatment (P0) was 11.16 (Table 1), while in the P1, P2, and P3 treatments were lower than the controls respectively by 24.82%; 11.29% and 18.64%, but statistically not significantly different ($P>0.05$). The average redness level of meat (a*) in the P0 treatment was 13.49 (Table 4.1). The redness level of broiler meat in P1 treatment was 2.04% lower than P0 and the P2 treatment was 3.51% higher than P0, but statistically not significantly different ($P>0.05$), while in P3 treatment it was 14.54% significantly ($P<0.05$%) higher than P0. Broiler meat in P1 treatment had an insignificant redness lower than P2 by 5.47%, and 16.29% significantly lower than P3. The reddish rate of meat in the P2 treatment was 11.14% significantly lower than the P3

The yellowness level (b*) of broiler meat in the control treatment (P0) was 6.95 (Table 1). The yellowness level in the P1 and P2 treatments were not significantly lower than the control by 14.40% and 15.41% respectively, while the P3 treatment was significantly lower than the control by 42.12%. Broiler meat in P1 treatment had a higher yellowness level by 1.18% and 32.38% compared to P2 and P3, but statistically not significantly different ($p>0.05$). Meat in the P2 treatment was 31.57% higher than P3, but statistically was not significantly different ($p>0.05$).

Chemical qualities of meat

The chemical qualities of meat observed in this study include: water content, protein, fat and cholesterol. The average moisture content of broiler meat in P0 treatment (control) was 74.75% (Table 1). The moisture content of broiler meat in the P1 treatment was 0.38% not significantly lower than the control, while in the P2 and P3 treatments it was 1.93% and 2.05% respectively significantly lower than the control. The average moisture content of meat in P2 and P3 treatments was significantly lower than B by 1.56% and 1.68% respectively. The treatment of P3 is 0.12% not significantly lower than that of P2.

The protein content of broiler meat in the control treatment (P0) was 19.41% (Table 1), while in the P1 treatment was not significantly lower than the control by 2.45%, while the P2 and P3 treatments were significantly higher than the control by 9.83% and 10.88% respectively. The average meat protein content in P2 and P3 treatment was 12.04% and 13.07% respectively significantly higher than P1, while meat protein content in P3 treatment was not significantly higher by 1.17% compared to P2.

The fat content of broiler meat in P0 treatment was 1.89% (Table 1), while in P1, P2 and P3 treatments it was significantly lower ($P<0.05$) by 6.37%, 18.57%, and 36.07% respectively. The fat content of broiler meat in the P2 and P3 treatments was significantly lower by 13.03% and 31.73%, respectively than P1, while the P3 treatment had a meat fat content of 21.50% significantly lower than P2.

The cholesterol content of broiler meat in the P0 treatment (control) was 0.35% (Table 1), while the P1 treatment was not significantly lower by 9.94% and the P2 and P3 treatments were significantly lower than P0. Meat cholesterol levels in P2 and P3 treatments were significantly higher than P1 by 10.65% and 47.89% respectively. The P3 treatment was 41.68% significantly ($P<0.05$) lower than the P2.

Discussion

Blood lipid profile

The result of statistical analysis show that giving Jamu Makarens in broiler rations can reduce total cholesterol, triglycerides, LDL (Low Dencity Lipoprotein) and HDL (High Dencity Lipoprotein) in the blood (Fig. 1). Total blood cholesterol in this study ranged from 126.35 -169.76 mg/dl with the highest value in P0 treatment (control), which was as much as 169.76 mg/dl (Table 1). Giving 2%, 4% and 6% fermented Jamu Makarens in the ration can reduce total blood cholesterol levels respectively by 6.79%; 22,48%; and 25.57%. This result shows that the more Jamu Makarens given in the ration, the lower the level of cholesterol contained in the blood. This is due to the presence of lactic acid bacteria (LAB) in fermented Jamu Makarens that function as probiotics. LAB produces lactic acid which causes the pH of the small intestine to be low. To normalize

intestinal pH, the body will remove more bile and pull cholesterol from the blood as a bile forming material so that blood cholesterol will decrease (Astuti *et al.*, 2009) [4].

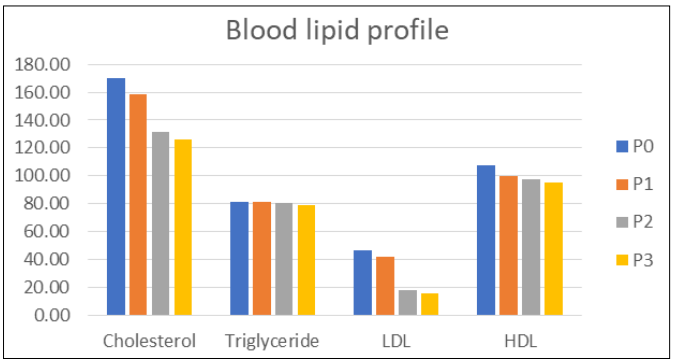

Fig 1: Comparison of total cholesterol, triglyceride, LDL and HDL in broiler blood

In addition, lactic acid bacteria also absorb cholesterol in the intestine to form cell membranes so that they are more resistant to lysis, thus cholesterol absorbed into the blood becomes reduced. Probiotic cells are also capable of producing Bile Salt Hydrolase (BSH) enzymes, enzymes that catalyze the hydrolysis of glycine- and bile salts conjugated into amino acid residues and free bile salts (bile acids). The BSH enzyme will hydrolyze or break the C-24 N-Acyl amide bond formed between bile acids and amino acids in conjugated bile salts to produce deconjugated bile salts and glycine/taurine. Deconjugated bile salts have a low solubility so they cannot be absorbed and secreted with feces. BSH also plays a role in the removal of water molecules between glycine/taurine and cholic acid which produces free cholic acid. The higher the activity of BSH in deconjugating bile acids, the more bile acids will be excreted. The body will take cholesterol in the blood to be used as a precursor to the synthesis of new bile salts, so that cholesterol levels in the blood will drop (Astuti *et al.*, 2009) [4]. The results of this study are in accordance with Andriani *et al.* (2020) [3] which stated that the administration of probiotics *L. casei* and *L. rhamnosus* doses of 0.05 grams/kg of feed, 0.01 grams/kg of feed, 0.025 grams/liter of drinking water and 0.05 grams/liter of drinking water as a substitute for AGP can reduce total cholesterol and LDL and increase blood HDL levels of broiler chickens.

Blood LDL levels in this study ranged from 15.21-46.05 mg/dl with the highest value in P0 treatment as much as 46.05 mg/dl and the lowest in P3 treatment as much as 15.21 mg/dl (Table 1). Giving fermented Jamu Makarens in broiler rations was reduce broiler blood LDL levels by 9% (P1), 60.4% (P2) and 66.96% (P3). This is due to a decrease in total cholesterol levels. LDL is one type of plasma lipoprotein that functions to transport cholesterol and phospholipids from the liver to various tissues for the formation of cell membranes and the formation of steroid hormones, such as: progesterone, glucocorticoids, mineralocorticoids, androgens and estrogens. Blood LDL levels are influenced by the feed consumed, the speed of the process of cholesterol biosynthesis in the blood, and the genetics of livestock (Murray *et al.*, 2003) [14].

HDL is a dense and small (8-10 micron) lipoprotein particle that synthesized in the liver and intestines. HDL is often referred to as a good fat because in its operation it clears excess cholesterol from the walls of blood vessels by transporting it back to the liver thus protecting the blood vessels against atherosclerosis. These good fats can remove cholesterol from foam cells in atherosclerosis wounds or protect LDL from oxidation modification. HDL levels of broiler blood in the study ranged from 95.40-107.43 mg/dl (Table 1) with the highest value in P0 treatment (107.43 mg/dl) and the lowest in P3 (95.40 mg/dl). Giving fermented Jamu Makarens in the ration turned out to cause a decrease in broiler blood HDL levels by 6.92% at P1 treatment; 9.33% at P2 and 11.20% at P3. This is due to decreased levels of LDL and cholesterol. This opinion is in accordance with Hasanuddin *et al.*, (2014) [9] who stated that HDL has a positive correlation with LDL and both are influenced by cholesterol levels in the blood. High and low HDL in the blood is associated with cholesterol levels and the activity of synthesis of steroid compounds and bile salts (Murray *et al.*, 2003) [14].

The last type of blood lipids are triglycerides. Triglycerides are one type of fat circulating in the blood formed by the liver from fat and carbohydrate feed, so its existence depends on its absorption in the digestive tract. Triglyceride levels in this study ranged from 78.67-82.42 mg/dl (Table 1). Giving fermented makarens herbs in the ration can reduce triglycerides in broiler blood with the lowest value at the level of 6% (P3) followed by 4% (P2), 2% (P1) and the highest at the control (P0). Reduced triglyceride levels in the blood of broilers who consume fermented herbal medicine are caused by the presence of lactic acid bacteria in herbs, which produce the enzyme esterase that converts fatty acids into ester forms so that their absorption into the blood is reduced. Citrawidi *at al.* (2012) [7] states that blood triglyceride levels are strongly influenced by feed carbohydrate levels and free fatty acid circulation in the body. Triglyceride levels are influenced by changes in the synthesis of fatty acids derived from the ration consumed by the chicken. The higher the fatty acids produced from the process of lipogenesis of carbohydrates and proteins and amino acids, the triglycerides synthesized in the liver also increase and directly affect the conservance of triglycerides in blood serum.

Physical qualities of meat

The physical quality of broiler meat given Jamu Makarens is generally better than those not given Jamu Makarens. Physical qualities of meat observed in this study include: pH, cooking loss, water binding capacity, and meat color. A graph of the effect of *jamu* makrens in the ration on the physical quality of meat is shown in Fig. 2

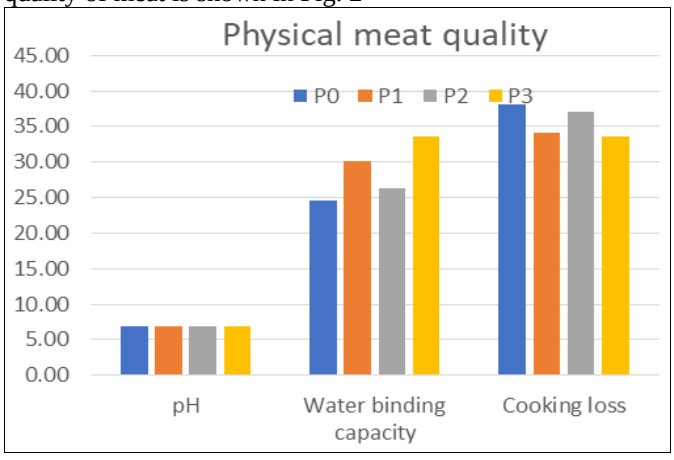

Fig 2: Comparison of pH, water binding capacity and cooking loss of broiler meat

The pH of the meat

Giving Jamu Makarens in the ration has no effect on the pH value of the broiler meat, but it can increase the water binding capacity and reduce cooking loss, as well as produce redder meat. The pH of broiler meat in all treatments showed the same value, which was 6.89 (Table 1). This is due to the same energy content of the ration in all treatments, so that the muscle glycogen content that forms lactic acid at the time of postmortem is also the same. This statement is supported by Soeparno (2015) [17], that meat pH is influenced by feed consumption, the muscles of livestock that consume low-energy feed will have a higher pH than livestock that consume high-energy feed. It is further explained that pH value is related to water binding capacity, the impression of juice, tenderness, cooking loss, colour and mechanical properties of meat.

Water binding capacity

Giving fermented Jamu Makarens in the rations can increase the water binding capacity of meat with the highest value at the P3 treatment, which is 33.58% (Table 1). Water binding capacity is one of the determining factors of meat quality because it is directly related to the ability of meat protein to bind free water in meat. The increased of meat water binding capacity in broilers that consume Jamu Makarens is caused by the higher protein content of meat and lower fat, so that the ability to bind water is higher. This statement is supported by Kartikasari *et al*. (2018) [11] that the percentage value of water binding capacity in meat is positively correlated with protein content in meat and negatively correlated with fat in meat. The lower the fat content in the meat, the protein content will increase and can increase the water binding capacity in meat.

Cooking loss

The percentage of meat cooking loss in broiler that consumes Jamu Makarens decreased significantly ($P<0.05$) with the lowest value at the level of 6% (P3) by 33.65%, followed by P1 (34.19%), P2 (37.08%) and P0 treatments (38.15%). This is due to the higher water binding capacity of meat protein due to the high protein content of meat and low fat content. In addition, the low water content in broiler meat that consumes Jamu Makarens also affects meat cooking loss. According to Kartikasari *et al*. (2018) [11], cooking loss is influenced by the water content in the meat during the cooking process. According to Soeparno (2015) [17], the value of meat cooking loss ranges from 15-54.5%. The cooking loss value in this study ranged from 33.65%-38.15%, so it is still within the normal range. Meat that has low cooking loss is relatively better than meat that has higher cooking loss because meat that has low cooking loss is less likely to lose nutrients in meat during the meat cooking process. The results of this study are supported by Sukmaningsih *et al*. (2019) [19] who stated that giving a mixture of probiotics and herbs had a very significantly effect ($p<0.01$) on reducing the value of broiler chicken meat cooking loss.

Meat colour

Giving fermented Jamu Makarens as much as 2-6% in broiler chicken rations has no effect ($p>0.05$) on the brightness level of meat, but has a redder meat color and a lower yellowness level with the increasing of Jamu Makarens levels (Fig. 3).

This is due to the presence of phytochemical compounds and vitamin C in Jamu Makarens which function as antioxidants. Antioxidants are compounds that can inhibit oxidation reactions by binding free radicals and highly reactive molecules so that cell damage can be inhibited. According to Soeparno (2015) [17], oxidation is considered the main cause of deterioration in meat quality, which affects colour, flavor and nutritional value. It is further mentioned that meat color is influenced by several factors, including: ration, race, species, age, sex, muscle activity, pH and oxygen which directly affect the concentration of myoglobin which is the main pigment determining meat color. The redness of the meat ranged from 13.49 to 15.78 with the highest value at the level of 6% (P3) and the lowest in the control. The lower the level of Jamu Makarens was given, the colour of the meat leads to yellow and tends to be brighter.

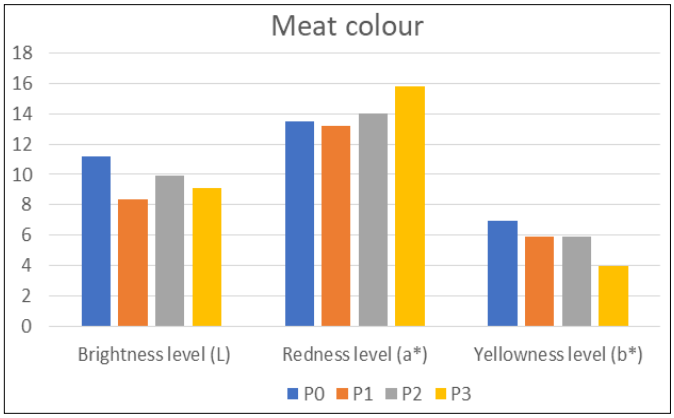

Fig 3: Comparison of broiler meat colour

Chemical qualities of meat

The chemical quality of broiler meat in this study is seen from several indicators, including: water content, protein, fat and cholesterol. Giving Jamu Makarens in the ration as much as 2-6% was found to increase the protein content of broiler chicken meat and reduce the level of moisture, fat and cholesterol along with the increase in the level of Jamu Makarens that given (Table 1). The graph of chemical quality of meat is shown in Fig. 4.

Moisture content of meat

Moisture content is the percentage of water content of a material that can be expressed based on wet weight or dry weight (Retno *et al.*, 2013) [16]. The moisture content of broiler meat in this study ranged from 73.22%-74.75% with the highest value in the control treatment (P0) which was 74.75%; followed by P1 treatment (74.47%); P2 (73.31%) and the lowest in P3 treatment (73.22%). This result is slightly lower than the results of previous studies, ranging from 74.75%-75.98% (Estacia *et al*., 2012) [8] and 74.135 ±0.92% (Susanty *et al*., 2021) [20]. Low moisture content in meat aims to reduce the level of spoilage in chicken meat. Anam *et al.*, (2003) [1] stated that high moisture content of meat is a factor that supports the development of fungi and microorganisms, so that high-quality meat, the moisture content must be within normal limits.

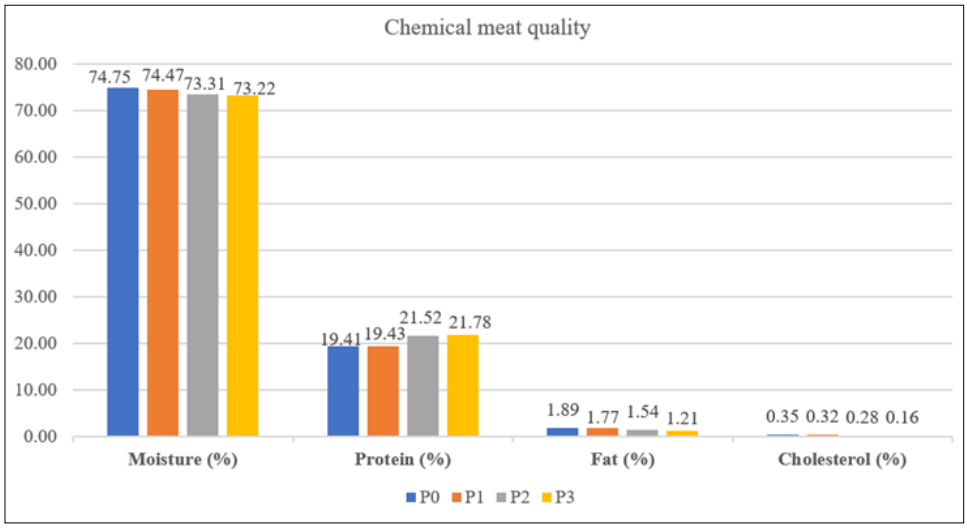

Fig 4: Comparison of moisture content, protein, lipid and cholestrol of broiler meat

Protein content of meat

The protein content of broiler meat in this study ranged from 18.93%-21.78% (Table 1). Statistical analysis showed that giving fermented Jamu Makarens as much as 2-6% in the ration significantly (p<0.05) increase broiler meat protein content with the highest value at the level of 6% (P3). This is caused by the presence of lactic acid bacteria in fermented Jamu Makarens that produces proteolytic enzymes so that it can increase the digestibility of feed protein into amino acids as raw material for the formation of meat protein. Lactic acid bacteria are also known to be able to maintain the health of intestinal villi so that the absorption of food substances becomes optimal. The results of this study are in accordance with those reported by Abdurrahman *et al*. (2016) [2] that the protein mass of native chicken meat from cross breed is very significantly increased with feed plus dahlia tuber powder combined with *Lactobacillus sp*.

Fat content of meat

The results of statistical analysis of meat fat content in broiler chickens given fermented Jamu Makarens as much as 2-6% showed a significant effect (p<0.05) with a range of 1.21-1.89% (Table 1). Giving fermented Jamu Makarens causes a decrease in fat content along with increasing levels of the Jamu Makarens given. This is related to lactic acid bacteria that produce short-chain fatty acids such as: acetate, propionate and butyrate. Propionate is an inhibitor of the process of lipogenesis in the liver so that meat fat levels decrease (Beylot, 2005) [5]. Probiotics can also reduce the activity of acetyl-CoA carboxylase, an enzyme responsible for the rate of fatty acid synthesis, by producing statins as inhibitors of fat formation in the liver. Statins are substances as inhibitors of 3-hydroxy-3-methyl-glutarin CoA reductase that function as enzymes regulating the biosynthesis of fat, cholesterol, and triglycerides (Cavallini *et al*., 2009) [6].

Cholesterol levels of meat

Cholesterol levels of broiler meat that consumed fermented Jamu Makarens as much as 2% did not show a significant decrease (P>0.05), but in administration 4-6% decreased by 20-54.29% compared to the control (treatment without Jamu Makarens, P0). This decrease is associated with decreased blood cholesterol levels as a result of the presence of lactic acid bacteria in fermented Jamu Makarens. Lactic acid bacteria produce statins which are inhibitors of the enzyme 3-hydroxy-3-methyl-glutarin CoA reductase which plays a role in the biosynthesis of fats, cholesterol, triglycerides (Cavallini *et al.* (2009) [6]; the enzyme bile salt hydrolase (BSH) which causes the deconjugation of bile acids into deconjugated bile salts that are difficult to dissolve so that they are wasted with feces. This leads to increased absorption of cholesterol from the blood for bile formation so that blood cholesterol is reduced and will ultimately lower cholesterol levels in meat. Another mechanism is the absorption of cholesterol in the intestine for the formation of lactic acid bacterial cell membranes so that its absorption into the blood will be reduced and have an impact on decreasing meat cholesterol levels (Astuti *et al*., 2009) [4].

Conclusion

Based on the results of this study, it can be concluded that giving Jamu Makarens in the ration as much as 2-6% can reduce blood cholesterol, triglycerides, LDL and HDL levels; lowering the value of cooking loss, moisture content, fat content and cholesterol of meat; increases protein and water binding capacity of meat, and does not affect the pH of meat. Giving Jamu Makarens at the level of 2-4% is enough to improve the blood lipid profile and meat quality of broiler chickens.

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Conflict of interest declaration

We certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

References

1. Anam C, Rahayu NS, Baedowi M. The activity of the enzyme bromelin on the physical quality of meat. National Seminar and Annual Meeting of the Indonesian Association of Food Technology Experts (IAFTE) The

Role of Industry in the Development of Indonesian Food Products. Yogyakarta; cc2003.
2. Abdurrahman ZH, Pramono YB, Suthama N. Feeding effect of inulin derived from dahlia tuber combined with lactobacillus sp. on meat protein mass of crossbred kampong chicken. Journal of the Indonesian Tropical Animal Agriculture. 2016;41(1):37-44
3. Andriani AD, Lokapirnasari WP, Karimah B, Hidanah S, Al-Arif MA, Soeharsono Harijani N. Effectiveness of Probiotics *Lactobacillus casei* and Lactobacillus rhamnosus as a substitute for Antibiotic Growth Promoter against Total Cholesterol, Low Density Lipoprotein and High Dencity Lipoprotein Broiler Chickens. Journal of Veterinary Medicine. 2020;3(1):114-122
4. Astuti, Bachruddin Z, Supadmo, Harmayani E. The effect of giving lactic acid bacteria Streptococcus thermophilus on blood cholesterol levels of broiler chickens Lohman strain". Proceedings of the National Seminar, Education and Application of Mathematics and Natural Sciences, Faculty of Mathematics and Natural Sciences, Yogyakarta State University, Yogyakarta; c2009.
5. Beylot M. Effects of inulin-type fructans on lipid metabolism in man and in animal models**.** British Journal of Nutrition. 2005;93(1):163-168
6. Cavallini DC, Bedani R, Bomdespacho LQ, Vendramini RC, Rossi EA. Effects of probiotic bacteria, isoflavones and simvastatin on lipid profile and atherosclerosis in cholesterol-fed rabbits: a randomized double-blind study. Lipids Health Dis. 2009;8:1-8. http://dx.doi. org/10.1186/1476-511X-8-1
7. Citrawidi TA, Murningsih W, dan Ismadi VDYB. The effect of curing with papaya leaf juice on blood cholesterol and total fat of broiler chickens. Animal Agriculture Journal. 2012;1(1):529-540.
8. Estancia K, Isroli, Nurwantoro. The influence of turmeric (*Curcuma domestica*) extract on the level water, protein, and fat meat of broiler chickens. Animal Agriculture Journal. 2012;1(2):31-39.
9. Hasanuddin S, Yunianto VD, dan Tristiarti. Blood fat profile of broiler chickens given step-down protein feed with the addition of lime juice as an acidifier. Journal of Animal Science and Technology. 2014;(3):11-17.
10. Julianto TS. Phytochemical Review of Secondary Metabolites and Phytochemical Screening. Prints I. Publisher Universitas Islam Indonesia; c2009.
11. Kartikasari LR, Hertanto BS, Pamungkas ASD, Saputri IS, Nuhriawangsa AMP. Physical and Organoleptic Quality of Meatballs Based on Broiler Chicken Meat Fed with Purslane Flour Supplementation (*Portulaca oleraceae*). Animal Science Animal Husbandry. 2020;18(1):66-72.
12. Meliandasari D, Dwiloka B, Suprijatna E. Kayambang leaves (*Salvinia molesta*) for meat cholesterol reduction and fatty acid quality improvement Astuti, Bachruddin, Z., Supadmo, Harmayani, E. 2009. Effect of giving lactic acid bacteria Streptococcus thermophilus to blood cholesterol levels of broiler chickens "Lohman strain". Proceedings of the National Seminar, Education and Application of Mathematics and Natural Sciences, Faculty of Mathematics and Natural Sciences, Yogyakarta State University, Yogyakarta; c2015.
13. Muchtadi D. Functional Food and Bioactive Compounds. CV. Alfabeta, Bandung. c2012.
14. Murray RK, Bender DA, Bothan KM, Kennelly PJ, Weil PA, Rodwell VW. Harper's Illustrated Biochemistry. The Mc Graw-Hill Companies. Inc. USA; c2012.
15. Pujaningsih RI, Hadi BW, Mukodiningsih S, Iskandar B, Utama CS. Study of moisture content level and particle size of feed ingredients on the physical appearance of wafers. Journal of Agripet. 2013;13(1):16-21.
16. Retno, Bambang IP, Sri WHE, Baginda M, Cahya ISU. Study of Water Content Level and Particle Size of Feed Ingredients on Wafer Physical Appearance. Journal Agripet. 2013;13(1):16-21.
17. Soeparno. Meat Science and Technology. 6thEd. Gadjah Mada University Press, Yogyakarta; c2015.
18. Steel RGD dan Torrie JH. Principles and Procedures of Statistics. Translator Bambang Sumantri. Gramedia Pustaka, Jakarta; c1993.
19. Sukmaningsih T, Rahardjo AHD. The effect of probiotic and herbs mix to performance, carcass, and physical quality of broilers. Jurnal Nukleus Peternakan. 2019;6(2):88-95.
20. Susanty A, Adji D, Tafsin M. Analysis of The Quality of Broiler Chicken From Modern and Traditional Market in Medan, North Sumatera. Journal of Veterinary Science. 2021;39(3):224-232.
21. Triyantini, Abubakar, Bintang IAK, Antawidjaja T. Comparative Study of Preferences, Quality and Nutrition of Several Types of Poultry Meat. Journal Livestock Science and Veterinary. 1997;2(3):157-163.