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Research Paper

The Effect of Applying Bilimbi Juice (Averrhoa Bilimbi L.) as an Acidifier in Drinking Water on the Quality of Native Chicken Meat

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Abstract
Maintaining animal gut health by applying an acidifier directly impacts the performance of poultry production. This study aimed to determine the effect of adding Bilimbi (Averrhoa bilimbi L.) juice as acidifier to the drinking water of native chickens on meat quality. One hundred one-day old chickens were divided into a completely randomized design (CRD) with 5 treatments and 4 replications. The treatments were a mixture of drinking water and Bilimbi juice (v/v) as follows; P0 (control), P1 (drinking water + 4% Bilimbi juice), P2 (drinking water + 6% Bilimbi juice), P3 (drinking water + 8% Bilimbi juice), and P4 (drinking water + 10% Bilimbi juice) and applied for 60 days. The observed variables were pH, water-holding capacity, cooking-loss water, tenderness, meat fat and cholesterol. The results showed that applying Bilimbi juice up to 10% had no significant effect (P>0.5) on the pH, water holding capacity, cooking loss water, tenderness, fat and cholesterol of native chicken meat.

Keywords
Acidifier; Bilimbi juice; Drinking water; Meat quality; Poultry production

1. INTRODUCTION

The rapid expansion of the global broiler industry has been paralleled by increasing consumer concern over the prudent use of antimicrobials in animal production. Regulatory agencies in the European Union, United States, and several Asian countries have progressively restricted or banned antibiotic growth promoters (AGPs) in poultry feed (FAO, 2022). Consequently, researchers and producers have turned to alternative feed-additives that can sustain high growth rates while safeguarding bird health and product safety. Among the most promising candidates are organic acidifiers, which can be delivered not only through the feed but also directly via the drinking water. Water acidification offers logistical advantages—uniform distribution, rapid onset of action, and the ability to target the gut microbiota at the earliest stages of ingestion (Kemin Industries, 2023).

Organic acidifiers encompass a diverse group of short-chain fatty acids (SCFAs) (e.g., formic, propionic, lactic, citric acids) and their salts. Their antimicrobial efficacy primarily stems from pH-dependent dissociation. In acidic environments, a larger proportion of the undissociated acids penetrate bacterial cell membranes, collapses the proton gradient, and disrupts intracellular enzymatic processes (Dong et al., 2024). Importantly, SCFAs also act as signaling molecules that modulate host immune pathways, upregulating anti-inflammatory cytokines and enhancing the barrier function of the intestinal epithelium (Sharifuzzaman et al., 2024). This dual action—direct pathogen suppression coupled with host-mediated resilience—makes acidifiers an attractive option for maintaining gut health without risking the development of resistance.

According to Abdurrahman and Yanti (2018), improving the absorption of nutrients in feed will affect meat quality. Several methods can be employed to optimize the efficiency of absorption of food substances in the digestive tract; one of which is by utilizing *acidifiers* (Has et al., 2020). Adding organic acids (*acidifiers*) to drinking water or broiler feed has been shown to increase absorption by enhancing digestive enzymes function, thereby improving digestion and absorption, particularly of fiber and protein (Atapattu and Nelligaswatta, 2005; Fattah et al., 2008). Citric acid as a source of *acidifier* is able to create acidic conditions in the digestive tract. Acidic conditions in the intestine stimulate an increase in the uptake of cholesterol from the blood as an ingredient to form bile salts, which normalize the pH of the digestive tract (Yulianti et al., 2013). Acidifiers are feed additives in the form of organic acids that can be administered through feed or drinking water. Citric acid, an *acidifier*, can be purchased as a patented synthetic product or can be obtained from natural sources, such as star fruit juice (Has et al., 2020).

One type of tropical fruit with particular use is the be-

limbing wuluh (*Averrhoa bilimbi* L.) (Hernanto, 2012). Bilimbi fruit contains many organic acids often found in fruits, such as quinic acid, cyclic acid, oxaloacetic acid, tartaric acid, malic acid, acetic acid, fumaric acid, malic acid, citric acid, succinic acid, and oxalic acid (Muchtadi et al., 2011; Raflin et al., 2014). Decreasing the pH of the digestive tract by adding organic acids can preserve the microbial balance in the digestive system and promote protein absorption (Natsir, 2005). Furthermore, Sari et al. (2020) found that the application of acidifiers did not affect the quality of pegagan duck meat, despite the addition of 0.2% organic acid salt to the feed. Other studies have reported improvements in duck meat quality attributes, such as reduced ultimate pH, higher water holding capacity, and enhanced color stability by administering probiotic which promote acid condition in the digestion tract (Zhang et al., 2024). The variability appears to depend on the type of acid, dosage, and duration of administration. The present study investigated the effect of Bilimbi juice (*Averrhoa bilimbi* L.) as acidifier on the quality of native chicken meat.

2. MATERIALS AND METHODS

One hundred daily old chickens (DOC) were housed in a litter system cage of 150 x 100 x 70 cm (l x w x h). One feed container and one drinking water container were assigned in each plot.

Preparation for Bilimbi juice

The preparation process to obtain bilimbi juice was carried out according to the recommendations of Agustin and Putri (2014). The fruit that was taken was sufficiently ripe and had characteristics of a greenish yellow fruit. The bilimbi juice solution is made cleaning the fruit, cutting it into little pieces, weighing it up to one kilogram, and then mashing it in a blender with the addition of 100 cc of water.

Experimental Design

This study uses a Completely Randomized Design (CRD) approach and includes five different treatments. To guarantee the stability and dependability of the outcomes, every therapy is repeated four times. The five native hens in each of the experimental units are given the following treatments: P0 represents the control group, in which the chickens are given untreated drinking water; P1, P2, P3, and P4 represent the drinking water fortification groups, respectively, with 4%, 6%, 8%, and 10% bilimbi juice added to the water for 60 days. The animals were fed 2 times per day with non-Antibiotic Growth Promotor (AGP) commercial ration from PT. Wonokoyo Jaya Kusuma, each animal fed with 100 g ration per day. Nutrient content of the ration were dry matter max 88%, crude protein 13-14%, crude fat min 4%, crude fiber max 8%, ash max 22%, Ca 0.9-1.2%, P 0.6-0.8% and aflatoxin max 50 ppb.

Observed Variables

The Lieberman-Burchard method was used to analyze the meat's cholesterol levels, meat tenderness, pH value, water binding capacity, and meat tenderness (Prawesthirini et al., 2009; Soeparno, 2005; Wahyuni et al., 2016). The basic principle of the method is that a colored reaction will result from the reaction of concentrated sulfuric acid with acetic acid anhydride and cholesterol-containing chloroform extract.

2.1 Data Analysis

The one-way ANOVA was then used to evaluate the observation data. The Duncan Multiple Range Test was used in additional testing if the outcomes showed a substantial difference (Steel and Torrie, 1995).

3. RESULTS AND DISCUSSION

The Table 1 below shows the effects of bilimbi juice as acidifier in drinking water to meat quality of native chicken;

The variance results revealed that adding bilimbi juice to drinking water had no significant effect (P>0.05) on the pH of native chicken meat. According to the study's findings, the pH of native chicken meat ranged from 5.6 to 5.9. These values are higher than reported by Soeparno (2005), who found an average of 5.5, but lower than those of Sari et al. (2020), who reported an average of 6.53 - 6.70. This difference is thought to be due to the inability of organic acids to increase lactic acid levels in the digestive tract, which would otherwise create an ideal acidic environment for non-pathogenic bacteria to flourish and function optimally in preventing the growth of pathogenic bacteria in the intestine.

The variance analysis suggested no significant difference (P>0.05) in the cooking loss of local chicken meat when bilimbi juice was added to drinking water. According to the findings, average cooking loss ranged from 0.30% to 0.33%. The results showed an average of 2.36% - 16.53%, which is lower than that of Siti et al. (2016). Cooking loss ranges from 15% to 40%, with a value between 1.5% and 54.5%. The result suggesting that incorporating organic acids into drinking water did not produce the better results in terms of minimizing cooking loss of native chicken meat.

Variance outcomes of tests showed that administering bilimbi juice to drinking water had no significant effect (P>0.05) on the tenderness of native chicken. According to the study's findings, the average softness of free-range chicken meat was between 76.15gf and 139.15gf. The average of this study's findings is higher than Putri (2021), ranging from 24.20gf to 34.95gf. Table 1 shows that adding organic acids to drinking water did not produce the optimum results for the suppleness of free-range chicken flesh. This has been suggested to be the case since both ante-mortem (before slaughter) and post-mortem (after slaughter) factors influence the outcome.

Triglycerides consider the majority of the energy retained by chicken bodies. The analysis of variance results

Table 1. The effect of Bilimbi juice as acidifier to the parameters of native chicken meat quality

Treatments	pH Meat	Water binding capacity (WBC) %	Cooking Loss %	Tenderness gf	Meat Fat Content	Meat Cholesterol Level
P0	5,6±0,05	29,09±3,98	0,31±0,02	117,2±41,48	0.87±0.05	7.45±1.60
P1	5,7±0,10	33,62±6,09	0,33±0,02	76,15±23,04	0.89±0.08	9.47±4.18
P2	5,9±0,40	26,11±9,09	0,32±0,01	119,1±49,50	0.95±0.03	7.01±1.81
P3	5,7±0,08	30,34±4,96	0,30±0,02	179,1±50,99	0.93±0.05	7.12±1.98
P4	5,6±0,10	32,52±2,80	0,31±0,03	139,15±107,18	0.95±0.04	7.87±1.27

Type: P0= control, P1= Drinking water + 4% bilimbi juice, P2= Drinking water + 6% bilimbi juice, P3= Drinking water + 8% bilimbi juice, P4= Drinking water + 10% bilimbi juice.

revealed no significant variation in the fat content of native chicken meat when bilimbi juice was administered. According to Ismoyowati and Widiyastuti (2003), blood triglyceride and cholesterol levels influence meat fat content. When there is excess energy in the circulation, muscle and fat tissue store it as fat. In contrast, if there is a lack of energy or fat in the blood, the body will send signals to muscle or fat tissue to initiate the glycogenesis process. The acidifying Bilimbi juice may have an effect on meat fat levels. As previously explained, the body has a mechanism in place to compensate for the lack of cholesterol in the blood. The body creates cholesterol in the liver by breaking down fat storage in response to low blood cholesterol levels.

4. CONCLUSION AND SUGGESTION

The findings of this study demonstrate that administering bilimbi juice up to 10% to native chickens during 60 days of rearing did not lower the pH, increase the capacity for water binding, maximize cooking shrinkage, increase tenderness, or lower the levels of fat and cholesterol in the meat.

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