International Journal of Life Sciences
Available online at www.sciencescholar.us
Vol. 8 No. 3, December 2024, pages: 67-76
ISSN: 2550-6994
https://doi.org/10.53730/ijls.v8n3.15400

Chemical Quality, Antioxidant Capacity and Physical Quality of Broiler Meat Given Mangosteen Rip Extract (Garcinia Mangostana L.)

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Manuscript submitted: 09 September 2024, Manuscript revised: 18 October 2024, Accepted for publication: 27 November 2024

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Keywords

antioxidants;
broiler;
mangosteen;
meat quality;
peel;

Abstract

This study aimed to observe the chemical quality, antioxidant capacity, and physical quality of broiler meat given mangosteen rind extract in drinking water. The design used in this study was a completely randomized design (CRD) with 4 treatments and 4 replications. The four treatments were: P0 (drinking water without mangosteen rind extract as a control), P1 (1% mangosteen rind extract in drinking water), P2 (2% mangosteen rind extract in drinking water), and P3 (3% mangosteen rind extract in drinking water). The variables observed were chemical quality, antioxidant capacity of meat, and physical quality of meat. The results showed that giving 1%, 2%, and 3% mangosteen rind extract through drinking water on the chemical quality of meat showed a significant difference ($P < 0.05$) in protein and fat content, as well as in the antioxidant capacity of meat. The physical quality of meat showed a significant difference ($P < 0.05$) in the value of water holding capacity, cooking loss, and weep loss. This study concludes that the administration of mangosteen peel extract to broiler chicken drinking water increases meat protein levels, reduces fat levels, and increases meat antioxidant capacity. The administration of mangosteen peel extract to broiler chicken drinking water can improve the physical quality of meat as seen from the increased water holding capacity of meat and the decreased cooking loss and weep loss values.

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Contents

1 Introduction

Antibiotics are commonly used in feed additives, but it is known that the use of antibiotics in broilers has negative effects in the form of residues in the meat products produced so several countries in the world prohibit the use of antibiotics (Selle et al., 2010; Mehdi et al., 2018). Chicken meat containing antibiotic residues if consumed in the long term can cause bacterial resistance to antibiotics. The effect of synthetic antibiotic residues in food can cause the transfer of resistant bacteria to human organs, immunological effects, carcinogenic, mutagenic, hepatotoxic, reproductive disorders, and allergies (Nisha et al., 2008). Herbal additives can function as a substitute for antibiotics and antimicrobials that are natural, safe, and environmentally friendly. One of the potential herbal medicinal ingredients that is often used in antimicrobials is mangosteen (Garcinia Mangostana L). Mangosteen is a plant that comes from tropical forests in the Southeast Asia region. According to research by Herawati et al. (2020), mangosteen peel extract can function as a natural antibiotic in the growth and production performance of broiler chickens.

Of the various products on the market, xanthones found in mangosteen peel extract are the most widely used as the main ingredient. The Xanthone content in mangosteen rind shows that the riper the mangosteen fruit, the higher the Xanthone content (Gondokesumo, 2019). Xanthone in mangosteen rind causes hypolipidemic (Adnyana et al., 2016), and hypocholesterolemic activity (Hidanah et al., 2017). It is also explained that the decrease in blood cholesterol is caused by the inhibition of cholesterol synthesis in the body. Xanthone can also reduce stress levels in poultry. The use of mangosteen rind extract (Garcinia mangostana) can be used to inhibit the activity of pathogenic microbes and can be used as an antibacterial or antifungal (Sholechah et al., 2023). By reducing stress levels in broilers and conducive pathogenic bacteria in the broiler intestines, it is hoped that it can improve the chemical and physical quality of meat. The results of the study showed that mangosteen rind supplementation provided good benefits for production performance, blood lipid profiles, and abdominal fat in Cihatteup ducks (Kusumayadi et al., 2019). It is also explained that there is a linear relationship between the concentration of mangosteen peel extract and antioxidant activity, which means that the higher the concentration, the higher the antioxidant activity (Fauzana et al., 2021). This study was conducted to see the effect of mangosteen peel extract given to drinking water at different levels on the chemical quality, antioxidant capacity, and physical quality of meat, in broiler meat.

2 Materials and Methods

Materials

This study used 64 one-day-old broiler chickens (DOC) from PT. Charoen Pokphand Indonesia with homogeneous body weight and no sex discrimination (*unsexing*).

Research Ration

The research ration used in all treatments was the same, namely commercial broiler ration. The nutrient content of the ration is as follows:

Table 1
Nutrient content of commercial broiler ration

Types of Nutrition	Contents
Water content (%)	Max 14,00
Crude protein (%)	Min 20,00
Crude fat (%)	Min 5,00
Crude fiber (%)	Max 5,00
Ash (%)	Max 8,00
Calcium (%)	0,80-1,10
Total phosphorus with phytase enzyme ≥400FTU/kg (%)	Min 0,50
Total aflatoxin	Max 50 µg/kg
Amino acids	
Lysine (%)	Min 1,20
Methionine (%)	Min 0,45
Methionine+cystine (%)	Min 0,80
Tryptophan (%)	Min 0,19
Threonine (%)	Min 0,75

Source: Feed brochure PT. Charoen Pokphand Indonesia, TBK

Method

Research Design

The design used in this study was a Completely Randomized Design (CRD) with 4 treatments and 4 replications. Each replication used 4 broiler chickens. Thus, the number of chickens used was 64 broiler chickens. The treatments that will be used during the study consist of:

P0 = Broilers given drinking water without mangosteen rind water extract as a control
P1 = Broilers given drinking water with 1% mangosteen rind extract
P2 = Broilers given drinking water with 2% mangosteen rind extract
P3 = Broilers given drinking water with 3% mangosteen rind extract

Research Procedure

Mangosteen fruit extract was given to broilers at the age of 11 days until the harvest age of 35 days. By the treatment, namely, at P0 only water was given without mangosteen rind extract. P1 was given 10 ml of mangosteen rind extract in 990 ml of water. P2 was given 20 ml of mangosteen rind extract in 980 ml of water. P3 was given 30 ml of mangosteen rind extract in 970 ml of water. Meat sampling was carried out after the chicken was slaughtered, namely when the chicken was 35 days old. The part to be used was the chest (M. Pectoralis) weighing ± 300 g, and then the skin and bones were cleaned (lean meat).

Chemical Quality Procedure and Antioxidant Capacity of Meat

The chemical quality of meat and the antioxidant capacity of broiler meat observed in this study included water, ash, protein, and fat content. The chemical content of the meat was analyzed proximately with the procedure in SNI 01-2891-1992 (Indonesian National Standardization Agency, 1992), and measurement of antioxidant capacity was carried out using the DPPH method (Yun, 2001) at the Integrated Service Laboratory of the Faculty of Agricultural Technology, Udayana University

Meat Physical Quality Procedure

pH

Meat pH measurement using a pH meter which began with standardization of the pH meter with pH 4 and pH 7 buffer solutions. Then, a meat sample of ± 10g was crushed and then put into a beaker glass and added with distilled water with a ratio of meat sample: distilled water (1:1). The sample was stirred and then left for 1 minute. After that, the pH meter was dipped into the sample solution.

Water holding capacity

Measurement of water holding capacity (Water Holding Capacity) using a Clement 2000 centrifuge. A total of ± 10 g of meat sample was crushed, then weighed and recorded as the initial weight. Next, the meat is wrapped in Whatman 41 filter paper, and inserted into a centrifuge at a high speed of 36,000 rpm for 60 minutes. Then the sample is weighed without filter paper to obtain the final weight. The percentage (DIA) is calculated using the formula:

$$\text{Water Holding Capacity (\%)} = 100 - \left(\frac{(Meat\ Residue\ Weight)}{Sample\ Weight}\ x\ 100\right)$$

Cooking loss

The measurement of cooking loss of meat begins with preparing a meat sample of ±30 g, then the sample is put in a plastic bag. The plastic bag is folded and clipped, then boiled at a temperature of 80°C for 60 minutes. The sample is then taken and wiped with tissue without pressing it and weighed as the final weight. The percentage of cooking loss is calculated using the formula:

$$SM\ (\%) = \frac{(btight\ before\ cooking - heavy\ after\ cooking)}{\text{weight before cooking}} x\ 100\ \%$$

Weep loss

The measurement of raw meat loss begins by preparing a raw meat sample with a thickness of 2.0 cm without fat and connective tissue, then recording the initial weight of the sample of around ± 20 g. Furthermore, the meat is tied with a rope and hung in a tightly wrapped state and the meat should not touch the plastic bag. The meat is hung at room temperature for 24 hours. Before being weighed, the meat is wiped dry. Then the meat is weighed. Weep loss is calculated as the loss of meat weight with the formula:

$$weep\ loss\ \ (\%) = \frac{(initial\ weight - final\ weight)}{\text{initial weight}} x\ 100\ \%$$

3 Results and Discussions

The results of the analysis of the water content of broiler chicken meat in the study ranged from 71.05 to 71.73% and were statistically not significantly affected (P>0.05). This is because the administration of mangosteen peel extract to broiler chicken drinking water does not affect the pH of the meat. The pH value of the meat in this study ranged from a normal pH value of 5-6. In a normal pH value, the meat will be able to bind water well so that the water content can be maintained. A pH value that is too low causes the meat to lose its water binding capacity, the meat water will come out and this will reduce the water content of the meat. Siswantoro et al. (2021), stated that free water molecules, which amount to around 10%, which are bound between protein molecules, will decrease when the meat protein is denatured. This also proves that the administration of mangosteen peel extract to broiler chicken drinking water does not cause denaturation of meat protein (Ovalle-

Magallanes et al., 2017; Pedraza-Chaverri et al., 2008). The results of this study also show that the water content of broiler chickens is still in the normal range of 70-76%. Rahman et al. (2023), in their research, found that the water content of broiler meat ranged from 70.87-73.01%.

Table 2
Chemical quality of broiler meat given mangosteen peel extract

Variable	Treatment			
	P0	P1	P2	P3
Water content (%)	71,05 ± 0,34 [a]	71,28±0,24[a]	71,61± 0,51[a]	71,73 ±0,33[a]
Protein content	18,96 ± 0,88[a]	20,35 ± 0,21[b]	21,44± 0,3[c]	22,92 ± 0,26[d]
Fat content (%)	9,37±0,03[c]	8,77±0,07[b]	7,64±0,01[b]	6,89±0,01[a]
Ash content (%)	1,22±0,05[a]	1,20±0,19[a]	1,21±0,9[a]	1,31±0,10[a]
Antioxidant capacity mg/L GAEAC	32,04±1,27[a]	32,95±0,63[a]	34,35±0,55[b]	34,74±0,15[b]

Description:
P0 = Broilers given drinking water without mangosteen rind extract as a control
P1 = Broilers given drinking water with 1% mangosteen rind extract
P2 = Broilers given drinking water with 2% mangosteen rind extract
P3 = Broilers given drinking water with 3% mangosteen rind extract

The protein content of meat in this study ranged from 18.96 - 22.92% statistically significantly different (P <0.05). The results of this study indicate that administering mangosteen rind extract through broiler chicken drinking water can increase the protein content of meat. This is because mangosteen rind extract can function as a feed additive that functions as an antimicrobial, especially for intestinal pathogenic bacteria. Sultan et al. (2022), stated that from the results of a systematic review and meta-analysis, mangosteen is effective against many microbes including microbes that are resistant to antibiotics, and also produces microbial activity comparable to commercially available antibiotics. The antioxidant activity that functions as an antimicrobial contained in mangosteen rind causes the intestinal atmosphere of broiler chickens to become healthier so that nutrient absorption is optimal. Kim et al. (2023), in their research, mangosteen rind extract can improve intestinal health in pigs.

The protein content of meat is highly dependent on protein consumption. Decreased feed consumption will cause protein consumption to decrease and also result in decreased meat protein levels. Broiler chickens that experience stress will usually experience decreased consumption (Hidayah et al., 2019). In this study, of course, stress in broiler chickens can be avoided because mangosteen rind extract has activity comparable to antibiotics, where this antibiotic in maintenance also functions to suppress stress in broilers. The higher the administration of mangosteen rind extract also shows the higher levels of meat protein. At higher concentrations of mangosteen rind extract, the higher the antioxidant activity. This causes the intestinal health of broiler chickens to increase which causes nutrient absorption to increase. Fauzana et al. (2021), stated that there is a linear relationship between the concentration of mangosteen rind extract and antioxidant activity. The fat content of meat in this study decreased significantly from the control (P <0.05).

This shows that the administration of mangosteen rind extract at a concentration of 1-3% through broiler chicken drinking water can reduce fat levels in meat (Sanjaya et al., 2021). The xanthone content which has an antioxidant effect can function to inhibit lipid peroxides so that the fat content in meat becomes lower. Giving additives and supplements to broilers containing high antioxidants can reduce meat fat levels. In line with the research of Rahman et al. (2023), which provides turmeric extract supplements containing high antioxidants to broiler chickens can also reduce meat fat levels. According to research by Kusmayadi et al. (2019), supplementation of a combination of mangosteen peel and turmeric can improve the lipid profile and abdominal fat of Cihateup ducks.

The increase in antioxidant capacity in the results of this study was due to the content of xanthone compounds from mangosteen peel which were distributed into broiler chicken meat which functioned to maintain tissue integrity and function (Iradukunda et al., 2021; Chong et al., 2015). Velasco & Williams (2011),

stated that antioxidants derived from plants are very good at improving meat quality because they can inhibit or prevent damage due to the effects of free radicals. Xanthones can play a direct role in capturing free radicals in the body. As antioxidants, xanthone compounds can reduce fat peroxidation and improve meat quality (Moure et al., 2001; Lachance et al., 2001). Several plant extracts are excellent natural sources of antioxidants that can increase the shelf life and quality of meat, especially by slowing lipid oxidation and microbial growth. In the study by Alfian et al. (2018), broilers given pegagan flour and red spinach supplements which have high antioxidant content in their feed can increase the antioxidant content in their meat.

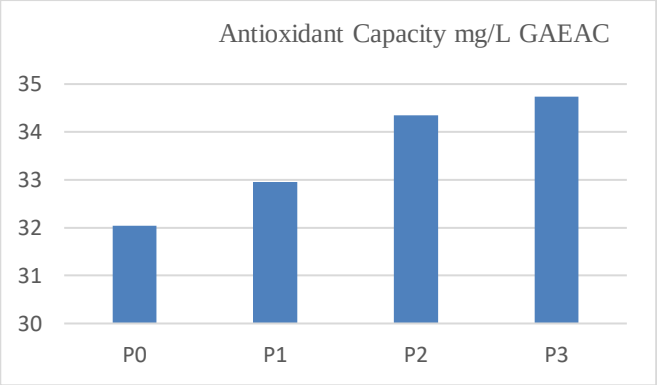

Figure 1. Graph of antioxidant capacity of broiler meat given mangosteen peel extract in drinking water

Table 3
Physical quality of broiler meat given mangosteen peel extract

Variable	Treatment			
	P0	P1	P2	P3
pH	5,60 ± 0,01[a]	5,61±0,13[a]	5,61± 0,01[a]	5,61 ±0,01a
Water Holding Capacity	46,59±0,15[a]	47,72± 0,05[b]	48,82±0,06[c]	50,06±0,07[d]
Cooking Loss	42,55 ±0,21[d]	41,34±0,08[c]	40,28±0,14[b]	39,45±0,18[a]
Weep Loss	10,15±0,05[d]	9,88±0,08[c]	9,12±0,06[b]	8,19±0,07[a]

Description:
P0 = Broilers given drinking water without mangosteen rind extract as a control
P1 = Broilers given drinking water with 1% mangosteen rind extract
P2 = Broilers given drinking water with 2% mangosteen rind extract
P3 = Broilers given drinking water with 3% mangosteen rind extract

Statistical analysis in this study showed that the pH value of the meat was not significantly different (P>0.05). The administration of mangosteen rind extract to broiler chicken drinking water did not affect the pH value. The pH value of the meat was within the normal pH range of meat 5.60-5.61. The results obtained were classified as normal. The ultimate pH value of the meat ranged from 5.4-5.8 (Soeparno, 2015). This was because the energy content of the ration in all treatments was the same and the administration of mangosteen rind extract did not have an impact on reducing feed consumption. This statement is supported by Soeparno (2015), that the pH of the meat 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 (Soeparno, 2015).

It is further explained that pH is related to water holding capacity, juice impression, tenderness, cooking loss, color, and mechanical properties of meat. The results of the meat pH study were within the range of the pH value of Broiler meat in the study of Kartikasari et al., 2018 which obtained a pH value of broiler meat ranging from 5.77-5.91. The results showed that the value of the Water Holding Capacity of the meat increased significantly from the control to the treatment (P <0.05) (Table 2). This shows that the administration of mangosteen rind

extract into the drinking water of broiler chickens increases the value of the Water Holding Capacity of the Meat. This is because the Xanthone content in the mangosteen rind which is an antioxidant can make the intestinal atmosphere healthier. With a healthy intestine, the absorption of nutrients including protein will be better and this causes an increase in the protein content of the meat and a decrease in the fat content of the meat. The increase in the protein content of the meat will increase the water-holding capacity of the meat. Water holding 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 the meat (Damez & Clerjon, 2008; Wood et al., 2008). This statement is supported by Kartikasari et al. (2019), that the percentage value of Water Holding Capacity in meat is positively correlated with the protein content in the meat and negatively correlated with the fat in the meat. The lower the fat content in the meat, the higher the protein content, and can increase the water-binding capacity of the meat.

The cooking loss value of broiler meat in this study decreased significantly ($P < 0.05$). This is due to the higher water holding capacity of the meat protein due to the high protein content and low-fat content. According to Kartikasari et al. (2019), cooking loss is influenced by the water content in the meat during the cooking process. According to Soeparno (2015), the cooking loss value of meat ranges from 15-54.5%. The cooking loss value in this study ranges from 39.45-42.55%. So, the cooking loss value in this study 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 the meat during the meat cooking process. The results of this study are supported by Sukmaningsih et al. (2019), who stated that the administration of a mixture of probiotics and herbs had a very significant effect ($P < 0.01$) on reducing the cooking loss value of broiler chicken meat. The results of statistical analysis showed that the weep loss value of meat in this study was significantly different ($P < 0.05$). There was a significant decrease in the weep loss value from P0 to P2. This is because the cooking loss value decreased. The weep loss value is directly proportional to the cooking loss value, if the cooking loss value decreases, the weep loss value also decreases.

4 Conclusion

The administration of mangosteen rind extract to broiler chicken drinking water increases meat protein content, reduces fat content, and increases meat antioxidant capacity. The administration of mangosteen rind extract to broiler chicken drinking water can improve the physical quality of meat as seen from the increased water holding capacity of meat and the decreased cooking loss and weep loss values.

Acknowledgments
Thanks are expressed to Udayana University through the Institute for Research and Community Service for the financial assistance provided. Thanks are also given to the staff of the Animal Product Technology and Microbiology Laboratory, Faculty of Animal Husbandry, Udayana University

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