p-ISSN 1410-5659 e-ISSN 2621-5144
Published by:
Unpad Press
Jurnal Ilmu Ternak Universitas Padjadjaran, November 2025, 25(3):252-264
DOI: 10.24198/jit.v25i3.67423
Available online at http://jurnal.unpad.ac.id/jurnalilmuternak

EFFECTS OF DURIAN SEED (*DURIO ZIBETHINUS*) EXTRACT ON INTESTINAL MORPHOMETRY AND PERFORMANCE OF HEAT-STRESSED BROILER CHICKENS

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Abstract

This trial was therefore undertaken to investigate the effect of Durian *(Durio zibethinus*) seed extract supplementation on growth performance, carcass yield, and internal organ development in broilers under heat stress conditions. Five treatment groups were used, including the control group (P0) with no extract addition, and four treatments (P1–P4), where the levels of Durian seed extract were added into the drinking water at dose concentrations of 0, 1.0 mL/L, 1.5 mL/L, 2.0 mL/L, and 2.5 mL/L, respectively. Weight gain, feed conversion efficiency, and weights of slaughter body parts (and their relative proportions: liver, heart, proventriculus, and gizzard), as well as internal organs (total intestines), were evaluated. The Durian seed extract also significantly enhanced ($P < 0.05$) body and carcass weights, and promoted the growth of digestive and metabolic organs. Values were higher in P4, indicating a dose-dependent relationship. The beneficial health effects are attributed to the bioactive compounds (polyphenols, flavonoids, and phenolic acids) as natural antioxidants and phytobiotics, which reduce oxidative stress and stimulate nutrient absorption. It is thus justified to conclude that Durian seed extract at 2.5 mL/L could be applied as a natural growth promoter with antioxidative activity in broilers raised under tropical heat stress conditions.

Keywords: durian seed extract, broiler chickens, heat stress, antioxidant, growth performance

PENGARUH EKSTRAK BIJI DURIAN (DURIO ZIBETHINUS) TERHADAP MORFOMETRI USUS DAN PERFORMA AYAM BROILER YANG MENGALAMI CEKAMAN PANAS

Abstrak

Uji coba ini dilakukan untuk menyelidiki pengaruh suplementasi ekstrak biji durian (Durio zibethinus) terhadap kinerja pertumbuhan, hasil daging, dan perkembangan organ dalam pada ayam broiler dalam kondisi suhu panas. Ada 5 kelompok perlakuan, termasuk kelompok kontrol (P0) tanpa penambahan ekstrak dan 4 perlakuan (P1-P4), di mana konsentrasi ekstrak biji durian yang digunakan ditambahkan ke air minum dengan dosis masing-masing Nil, 1,0 mL/L, 1,5 mL/L, 2,0 mL/L, dan 2,5 mL/L. Penambahan berat badan, efisiensi konversi pakan, berat bagian tubuh yang disembelih (dan proporsi relatifnya: hati, jantung, proventrikulus, dan gizzard), serta organ dalam (usus total) dievaluasi. Ekstrak biji durian juga secara signifikan meningkatkan ($P < 0,05$) berat badan, berat daging, dan pertumbuhan organ pencernaan dan metabolik. Nilai yang lebih tinggi tercatat pada P4, menunjukkan hubungan dosis. Efek kesehatan yang bermanfaat dikaitkan dengan senyawa bioaktif (polifenol, flavonoid, dan asam fenolik) sebagai antioksidan alami dan fitobiotik yang mencegah stres oksidatif dan merangsang penyerapan nutrisi. Oleh karena itu, dapat disimpulkan bahwa ekstrak biji durian pada konsentrasi 2,5 mL/L dapat diterapkan sebagai promotor pertumbuhan alami yang dikombinasikan dengan aktivitas antioksidan pada ayam broiler yang dipelihara di bawah kondisi stres panas tropis.

Kata kunci: ekstrak biji durian, ayam broiler, cekaman panas, antioksidan, performa pertumbuhan

INTRODUCTION

Broiler chicken remains one of the most important sources of animal protein for both the Indonesian and global populations. Its contribution to food security continues to increase, driven by its nutritional value, affordability, and production efficiency (FAO, 2023; Mardalena & Harahap, 2021). Advances in genetics and feed technology have produced highly specialized commercial strains such as Ross 308 and Cobb 500, characterized by rapid growth rates, early market readiness (5–7

weeks), and low feed conversion ratios (FCR) (Musa et al., 2024). These developments have significantly improved production output; however, maintaining this performance under tropical environmental conditions remains a major challenge due to heat stress.

Heat stress is widely recognized as one of the most critical environmental factors affecting poultry performance in tropical regions, such as Indonesia. Elevated ambient temperatures can disrupt physiological homeostasis, resulting in decreased feed intake, impaired nutrient utilization, and reduced growth performance (Liu et al., 2022). Physiological responses to heat stress, such as elevated body temperature (up to 41 °C) and increased respiratory rate (30–32 breaths/min), reflect the broilers' attempts to dissipate excess heat (Iftitah et al., 2022; Hidayat et al., 2020). Prolonged exposure, however, leads to intestinal damage, including shortened villi, reduced crypt depth, and diminished absorptive surface area (Sumanu et al., 2023; Hashemitabar et al., 2024). The disruption of tight junction proteins in the intestinal epithelium increases gut permeability, commonly referred to as a "leaky gut," which leads to nutrient malabsorption and systemic oxidative stress, ultimately impairing performance (Liu et al., 2022).

The digestive tract plays a crucial role in nutrient absorption and maintaining overall metabolic stability. The small intestine, lined with villi and microvilli, provides a large absorptive surface area essential for efficient nutrient uptake. Longer and denser villi are strongly correlated with improved feed efficiency and overall productivity (El Sabry et al., 2023; Alagbe et al., 2023; Rysman et al., 2023). Consequently, maintaining intestinal integrity is crucial for sustaining growth and physiological resilience in the face of environmental stress. Nutritional manipulation through dietary supplementation has become one of the most effective strategies to mitigate heat-induced oxidative damage. Supplementation with vitamins, minerals, and antioxidants has been shown to improve performance, but increasing attention is now directed toward natural alternatives with fewer side effects (Zhang et al., 2024).

Phytobiotics, bioactive compounds derived from medicinal plants, have emerged as promising natural feed additives that enhance antioxidant capacity, immune response, and organ integrity in poultry. Numerous studies have reported that phytobiotic or herbal supplementation improves feed conversion, carcass yield, and antioxidant status in heat-stressed broilers (Liu et al., 2023; Oni et al., 2024; Obianwuna et al., 2024; Paredes-López et al., 2024). These plant-based bioactive metabolites, including polyphenols, flavonoids, and phenolic acids, serve as potent antioxidants that neutralize reactive oxygen species (ROS), maintain cellular balance, and enhance tissue repair. Thus, incorporating phytogenic substances into poultry diets represents a sustainable approach to promoting health and performance while reducing the use of synthetic growth promoters.

Durian (*Durio zibethinus*) seed extract is one of the underutilized plant materials with high potential as a natural source of antioxidants. The seed contains significant amounts of polyphenols, flavonoids, and phenolic acids, which are known for their free radical scavenging activity and protective effects against oxidative stress (Mungmai et al., 2023). Under heat stress conditions, these bioactive compounds can help maintain intestinal morphology, improve nutrient absorption, and support organ function. Studies have indicated that polyphenol supplementation enhances growth performance, feed efficiency, and carcass quality (Goel et al., 2025). Exploring the application of durian seed extract as a natural phytogenic additive offers a novel and locally available strategy to enhance broiler productivity and welfare in tropical environments. Therefore, this study aims to evaluate the effectiveness of durian seed extract supplementation as a natural antioxidant for mitigating the adverse effects of heat stress in broiler chickens. The findings are expected to provide a scientific basis for utilizing local phytogenic resources in the development of sustainable poultry production systems in Indonesia.

MATERIALS AND METHODS

This experiment was performed with some materials, durian seeds (Durio zibethinus) sourced from Polewali Mandar Regency (Polman), West Sulawesi; 70% of ethanol as a solvent, broiler chickens (*Gallus gallus domesticus*) for experimental animals, and the

standard feed and distilled water to be used as other kinds of solvents. An analytical weighing balance was used to weigh the samples, and a grinder was used to grind the dried durian seeds into a powder form. Laboratory glassware, including beakers, flasks, funnels, glassware, chromatographic columns, and measuring cylinders, was also utilized. The maceration was conducted in specific containers, and after evaporation of the extract by a rotary evaporator. The level of heat shock is performed in an incubator or temperature control chamber. Growth performance was presented as body weight gain (BWG) and FCR. The organ weights of liver, heart, proventriculus, gizzard, and small intestine were determined at autopsy and also expressed as a percentage of body weight. This extraction was carried out in the Laboratory of Animal Science, Faculty of Animal Husbandry, Hasanuddin University (Unhas), and the Department of Animal Science, University of West Sulawesi.

Research Procedures

The research was carried out in multiple stages. Seeds of Durian (*Durio zibethinus*) collected from Polewali Mandar District, West Sulawesi, were dried and powdered to perform maceration with 70% ethanol. A viscous extract was prepared, centrifuged, and then stored in a refrigerator for use in the bioassay. The bioactive compounds in durian seeds, including polyphenols, flavonoids, and phenolics, exhibit antioxidant effects (Mungmai et al., 2023).

Animals and Diet

Broiler chickens (Gallus gallus domesticus) were housed under normal laboratory management conditions with free access to feed and water. Heat exposure was achieved by raising the ambient temperature in a specially constructed room under high heat load conditions simulating tropical conditions. Heat stress has been well reported to reduce growth performance (Liu et al., 2022), increase the feed-to-gain ratio, and lower carcass yield and organ development in poultry (Sumanu et al., 2013). Some natural plant-source antioxidants and phytobiotic compounds are used to improve growth-performance efficiency, welfare, carcass quality, and organ health in broiler birds reared under heat stress, addressing these challenges (Oni et al., 2024; Obianwuna et al., 2024; Goel et al., 2025).

Research Design

The experiment was conducted using a randomized block design with five treatment groups. The control group (P0) received a standard commercial diet and drinking water without durian seed extract. Four treatment groups (P1–P4) were supplemented with durian seed extract in the drinking water at concentrations of 1.0, 1.5, 2.0, and 2.5 mL/L, respectively. All birds were managed under the same environmental and management conditions, with feed and water provided ad libitum throughout the 35-day experimental period.

Durian Seed Extract Administration Technique

Durian seed extract was administered through drinking water. The viscous extract was first diluted in a small amount of water to ensure homogeneity, and then mixed into the total daily water supply each morning, prior to feeding. Water containers were cleaned and refilled twice daily to maintain freshness and consistent concentration. This method ensured that each bird received a uniform dose of extract proportional to its water consumption.

Diet and Feeding Program

All broilers were fed a commercial-type diet formulated according to Japfa-style nutritional standards commonly used in Indonesian poultry production, which met the nutrient requirements recommended by the *National Research Council* (NRC, 1994). The feeding program consisted of three phases: starter (1–10 days), grower (11–24 days), and finisher (25–35 days) to support the birds' physiological growth stages.

The feed ingredients included yellow corn, soybean meal, rice bran, fish meal, vegetable oil, dicalcium phosphate, limestone, salt, DL-methionine, L-lysine HCl, L-threonine, vitamin-mineral premix, and antioxidant. The approximate nutrient composition of each phase was as follows:

- **Starter (1–10 days):** Metabolizable energy (ME) 3000 kcal/kg; crude protein (CP) 22.5%; calcium (Ca) 1.0%; available phosphorus (Av.P) 0.48%; lysine 1.30%; methionine + cystine 0.95%.

- **Grower (11–24 days):** ME 3100 kcal/kg; CP 21.0%; Ca 0.90%; Av.P 0.45%; lysine 1.18%; methionine + cystine 0.88%.
- **Finisher (25–35 days):** ME 3200 kcal/kg; CP 19.5%; Ca 0.85%; Av.P 0.42%; lysine 1.05%; methionine + cystine 0.80%.

Heat Stress Management

To simulate tropical heat-stress conditions, broilers were exposed to controlled high environmental temperatures of 33–35°C for 6–8 hours daily (10:00 a.m.–4:00 p.m.) with relative humidity between 65–70%, while the control environment was maintained at 25–27°C and 60–65% humidity to represent normal tropical ambient conditions. This experimental design aimed to evaluate the effects of varying levels of durian seed extract supplementation in drinking water on growth performance, carcass yield, and internal organ development of broiler chickens reared under tropical heat stress for 35 days. The current experimental design was carried out to explore the impacts of different levels of durian seed extract supplementation on growth performance and physiological responses in broiler chickens subjected to HS.

Research Variables

The studied parameters: the body weight gain (BWG) was determined as the difference in body weight at the initial and final day of broiler chicken rearing, while the feed conversion ratio (FCR), expressed as g/g, indicates an index of feed efficiency calculated by dividing feed intake by body weight gain. Also, the weight of slaughter was from weighing the broiler body at 35 days old after an overnight fasting, and the carcass weight was taken out after removal of the head, neck, feathers, feet, viscera, and blood during post-slaughter. Other internal organs (liver, heart, proventriculus, gizzard and small intestine) were also determined as the ratio of weight (g) of an organ to slaughter weight of a broiler (%) whatever it was in percentage.

Data Analysis

All experimental data, including body weight gain (BWG), feed conversion ratio (FCR), slaughter, carcass weights, including relative organs (liver, heart, and proventriculus gizzard and small intestine weights), were subjected to statistical analysis. The collected information was initially summarized and tested for normality and homogeneity of variance to meet the ANOVA condition.

The data were then analysed using one-way ANOVA to test the effects of different doses of durian seed extracts on dependent variables. When a difference between treatment means was significant ($p < 0.05$), treatment means were separated by Duncan's Multiple Range Test (DMRT) post hoc for mean separation within treatments. Statistical processing was done through SPSS version 25.0 (IBM Corp., Armonk, NY, U.S.A.). Values are presented as the mean ± SD.

RESULTS AND DISCUSSION

Final Body Weight and Carcass Weight of Broiler Chickens at 35 Days of Age

The effect of durian seed extract supplementation in the broiler ration is presented in Table 1. Birds exposed to the highest level P4 (2.5 mL/L) received the best slaughter weight and posted 2855.7 g/ bird, meanwhile birds in the control (P0) recorded the lowest mean value of 1926.1 g /bird. There were also similar trends in carcass weight, with the highest recorded at P4 (2027.5 g) and the lowest carcass remainder for the P0 group at 1309.7 g. The significance level of increasing DSx supplementation had shifted toward the positive in slaughter weight and carcass yield to broiler during the heat stress raising stage.

The improvement in slaughter weight and carcass yield of broilers supplemented with higher doses of *Durian seed extract* is presumably associated with the naturally occurring bioactive compounds in the seeds, which may enhance metabolic efficiency and growth performance. Durian seeds are rich in polyphenols, flavonoids, and phenolic acids, which have been known to possess strong antioxidant effects (Mungmai et al., 2023). These molecules participate in the reduction of oxidative stress as scavengers- ROS are produced at very high levels during the heat shock. The antioxidant properties of durian seed extract help to mitigate oxidative stress and promote better nutrient use, as well as the channeling of energy for growth or organ regeneration.

Phytobiotics from plant sources have been widely used to optimize poultry production as parameters of FE, gut health, and immune ability (Liu et al., 2023; Oni et al.,

2024). Probably the most important and well-known function exerted by antioxidants in this tissue is to protect oxidative metabolism, metabolic equilibrium, and the protein synthesis pool that determines body weight gain and carcass characteristics. In general, these results indicated an increase in slaughter and carcass weights due to the increased proportion of durian seed extract (P3 and P4) in the diets compared with the control. The improved carcass yield attributed to natural antioxidants may be attributed to less damage in muscle architecture and lower tissue catabolism under stress (Obianwuna et al., 2024; Goel et al., 2025). Therefore, it appears that dietary supplementation with durian seed extract would be one potential sustainable means to enhance broiler growth performance and carcass characteristics, especially in the tropics, where heat stress becomes more likely problematic.

The development and growth of broiler chickens are highly dependent on their level of feed intake (Ahiwe et al., 2021). Carcass – is a whole bird body after slaughtering and without the head, viscera, feet, feathers, or blood (Moula et al., 2020b). The results of the present study indicated that carcass percentage was between 58-62% of body live weight, which is also in the normal range (Liu et al., 2023). Durian seed extract supplementation at the usual level improved growth performance; however, a higher inclusion rate could have reduced feed palatability, leading to a decrease in carcass weight. It is also consistent with the findings of previous researchers who have demonstrated that the body weight and organ development of broiler chickens are influenced by genetic make-up, age, sex, as well as the quality of feed consumed and the physiological status of the birds (Wecke and Liebert, 2019; Tenza et al., 2025; Tallentire, 2016).

Proventriculus

The effects of durian seed extract supplementation on the proventriculus weight of broiler chickens are presented in Table 3. The average proventriculus weight ranged from 6.74 g to 12.85 g, accounting for 0.35% to 0.45% of slaughter weight in the blood-feeding groups (proventriculii). The percentage of carcass weights detected in this study corresponds with those reported among dogs fed blood. Values tended to increase with increases in durian seed extract supplementation; however, no significant difference ($P > 0.05$) was observed between treatments, as indicated by statistical analysis.

The findings showed that the supplementation of durian seed extract at any level, including 2.5 mL/L mixed drinking water, was not manifestly related to an alteration in the relative weight (%) of the proventriculus. This result aligns with previous findings, as phytogenic feed additives and plant-derived antioxidants generally have a minimal direct influence on the relative weight of the digestive organs, but rather have more pronounced effects on growth performance, carcass yield, and intestinal integrity (Liu et al., 2023; Oni et al., 2024).

Gizzard

The observed increase in gizzard weight may be linked not only to hypertrophy due to increased workload, but also to enhanced antioxidant defence in the gizzard tissue. Supporting this, Surai (2020) reported that antioxidant systems protect poultry organs from ROS-induced damage, while Basiouni et al. (2023) demonstrated that phytogenic compounds such as flavonoids can upregulate antioxidant enzymes (SOD, CAT, GPx) in the digestive tract of broilers. Moreover, a study on chicken gizzard protein hydrolysate (2024) revealed specific improvements in antioxidative markers in the gizzard tissue. Al-Kahtani et al. (2022) further confirmed that dietary supplementation enhances antioxidative capacity in broilers and can contribute to organ development.

The gizzard is a crucial mechanical digestive organ for breaking down feed. An increase in gizzard weight is typically associated with increased muscle activity and enhanced grinding efficiency, resulting in improved nutrient availability and feed conversion efficiency (Ahiwe, 2021). As the levels of the extracts increase, the weight of gizzards increases, which may be due to the bioactive elements extracted from durian seeds, such as polyphenols, flavonoids, and phenolic acids, which are also reported to improve the secretion of digestive enzymes between period of gut during the highest stimulation digestant rate analysis (Mungmai et al., 2023).

Furthermore, botanicals have been reported to enhance the development of

digestive organs by modulating gut microflora and attenuating oxidant stress in the gastrointestinal tract (Oni et al., 2024; Obianwuna et al., 2024). It is proposed that the antioxidant activities of durian seed extract safeguard the gizzard mucosal tissues from the oxidant effects produced by digestive activity, resulting in improved physiological function of the organ. Liu et al. also found the same results. (2023) They stated that inclusion of plant and phytobiotic antioxidants in the diet also improved digestive-organ development and final carcass yield numbers in heat-stressed broilers.

Therefore, the results of this study suggest that adding durian seed extract to drinking water at concentrations of up to 2.5 mL/L may stimulate the functional maturation of the gizzard and improve feed efficiency in broilers. This further suggests that PFA may be able to enhance digestive physiology by protecting antioxidant status and stimulating enzymatic activity, thereby improving nutrient digestibility and growth performance.

Small Intestine

Highlights Addition of durian seed extract (DSE) has a significant effect ($P < 0.05$) on the weight and length of the small intestine in broiler chickens. The trend in the data was clear and positive, with a linear relationship: as extract concentration increased, so did intestine mass and length. Higher values can be found in P4 (2.5 mL/L), while lower values are found in P0.

The improved intestinal morphological structure can be attributed to the phytochemicals in DSE, such as flavonoids, phenolic acids, and tannins, which possess natural antioxidant activity and gut-modulating properties. These molecules have been shown to reduce intestinal oxidants, elicit mucosal restitution/mucosal regeneration, and induce villus height, thereby improving nutrient absorption conditions (Saeed et al., 2023; Sharma et al., 2022).

This result is consistent with previous findings reported by several researchers (e.g., Sugiharto et al., 2024; Liu et al., 2022; Mardalena & Harahap, 2021), who observed that phytogenic feed additives promote intestinal villus height, increase the villus height-to-crypt depth ratio, and help maintain adequate epithelial integrity by stimulating the proliferation of beneficial microflora and reducing pathogenic bacterial activity, thereby improving digestive efficiency. Moreover, Sugiharto et al. (2024) emphasized that natural plant extracts rich in antioxidants can further enhance intestinal integrity and metabolic functions, especially under suboptimal conditions such as heat stress.

The observed progressive increase in gut length in the present trial is indicative of an increased surface area for digestion and absorption of nutrients that subsequently results in better growth. This value aligns with that of Mohmmed et al. (2023), who quantified the small intestine armor and reported a positive correlation between its structural enrichment with phytogenics and improvements in feed efficiency, as well as body weight gain in birds. In conclusion, the addition of 2.5 mL/L durian seed extract to the drinking water of broiler chickens had a positive effect on the development of the small intestine. These effects could likely be attributed to the synergistic action of its antioxidant and phytobiotic ingredients, improving digestion, preserving the intestinal mucosal integrity, and enhancing nutrient utilization.

Large Intestine

Weights and length of the large intestine of broiler chickens were positively affected ($P<0.05$) by the supplementation of durian seed extract. Both the Dobsons and alpha-exponents were consistently increased with increasing viscosity of the extract. E P4 (2.5 mL/L) had the highest contents of the large intestine based on weight/body (1.82 g/in kg/BW) and length; however, the lowest for control activities P0 was obtained. These findings also confirmed that the extract enhanced structural development and growth of the large intestine in cockerels. The increase in mass and length of the large intestine is suggestive of its improved functional performance, particularly in water reabsorption and microbial fermentation activities carried out by the intestine. According to Ahiwe et al. (2021), the growth of different gut segments in broilers may also depend on the diet formulation, particularly if it contains bioactive molecules that can interact with cellular proliferation of the epithelium and tissue elasticity.

The significant increase in large intestinal morphology in birds fed higher

inclusion levels of durian seed extract diet could have been due to the availability within the supplied extract, bioactive metabolites such as polyphenols, flavonoids, and phenolic acids, which are recognized to possess antioxidant, anti-inflammatory, and antimicrobial roles (Mohammed et al., 2023). These polyphenols support the colonization of beneficial microorganisms in the gut, act as antimicrobials, and attenuate oxidative stress in intestinal tissue by promoting mucosal regeneration (Sharma et al., 2022).

Moreover, Abd El-Hack et al. (2021) also reported that phytogenic feed additives can modulate intestinal morphology by refining the villus structure and integrity of epithelial cells, thereby enhancing nutrient absorption and gastrointestinal wellness. The findings are in agreement with those of El-Saadony et al. (2022), who reported that polyphenols in the diet enhance gut health by stimulating antioxidant enzyme activity and inhibiting pathogenic bacterial overgrowth.

The gradual nature of the increase observed with treatments P1–P4 indicates that the response is dose-dependent, and addition of durian seed extract up to 2.5 mL/L enhances physiological adaptation within the large intestine. This may be beneficial for digesting and excreting waste, ultimately promoting the optimal function of the gut as a whole. According to Sugiharto et al. (2024), the gut is protected by natural antioxidants from tropical plant origin, which maintain mucosal integrity and avert a chronic inflammatory environment stress. Therefore, the durian seed extract, as a natural phytobiotic, could potentially be involved in enhancing intestinal health, improving digestion stability, and enhancing the growth performance of broiler chickens.

Liver

Liver weight in broiler chickens was significantly ($P < 0.05$) affected by the treatment of durian seed extract. Liver weights increased linearly with increasing extract concentration up to P4 (2.5 mL/L), which was the highest, followed by a decrease in P0 (control), which was the lowest. This elevation in liver weight and activity indicates that durian seed extract promotes liver growth.

The liver is used for metabolic, detoxifying, and oxygen-antioxidant functions. The increased liver weight in this study may be due to active constituents such as flavonoids, phenolic acids, and tannins reported in durian seed extract, which can protect hepatocytes against oxidative damage and increase enzyme activity levels.

Durian seed extract might also be useful for hepatoprotection and hepatic function due to its antioxidant properties. Similar to other medicinal plant extracts, the polyphenols and flavonoids in durian seed extract might be responsible for suppressing lipid peroxidation, improving mitochondrial enzyme activities, and keeping the normal structure of hepatic cells (El-Saadony et al., 2022). According to Mohammed et al. (2023), phytogenic antioxidants improve liver function by preserving cell membranes and facilitating detoxification. In addition, Afolayan et al. (2023) found that a phenolic–enriched tropical plant extract regulated hepatic enzyme functions, resulting in improved lipid metabolism and oxidative status in broilers.

That increase in liver weight with different treatments (P1–P4) may be a sign of adapting its physiological responses to the greater metabolic demands. An example is demonstrated by Abd El-Hack et al. (2021), feeding phytobiotics could increase expression of antioxidant enzymes and liver cell regeneration, particularly under heat stress or oxidative challenge.

The liver of tilapia supplemented with durian seed extract, solubilized at 2.5 mL/L, was significantly enhanced without hypertrophy, indicating beneficial metabolic enhancement rather than negative enlargement. This finding is consistent with that of Sugiharto et al. (2024), who concluded that limited liver weight gains caused by phytogenic antioxidants represent higher metabolic efficiency and more potential of antioxidants. It can be inferred that the durian seed extract serves as a natural hepatoprotective agent by restoring hepatic function through maintaining antioxidative stability due to its bioactive phytochemical content.

Heart

The heart weight as well as that of the broilers was influenced ($P < 0.05$) by supplementation with durian seed extract. The average heart weights increased as the extract concentration increased, from 3.42 g in P0 to 4.36 g in P4 (2.5 mL/L). There was also a slight

increase in the proportion of live weight from 0.52 percent to 0.61 percent. Higher HW indicates that durian seed extract may have a beneficial effect not only on cardiac tissue metabolism but also on the heart itself. The bioactive compounds of the extract, such as polyphenols, flavonoids, and tannins, could assume their role due to the antioxidant potential and adaptogenic property of Cuminum Cyminum L flours against cardiac injury by exerting cardioprotective cardiovascular effects (El-Saadony et al, 1000. Approx . 0.; Sharma et al., 2022).

The heart's job also includes delivering oxygen and nutrients to all areas of the body. Increased heart weight and function have often been associated with improved tissue/M Mv oxygenation and metabolic adaptation to the stress of the institution. The antioxidant compounds in the durian seed extract appear to enhance the stability of lipid peroxidation and oxidative damage within heart cells (cardiomyocytes). This allowed for further maintenance of both cardiac morphology and function.

According to Mohammed et al. (2023), phytogenic phenolics can enhance the function of cardiac muscle and prevent damage caused by oxidative stress in poultry. Similarly, Afolayan et al. (2023) observed that tropical plant extracts restored heart function by inducing the activity of the antioxidant enzyme system and reducing levels of reactive oxygen species. Increasing trends in heart weight at all levels of durian seed extract may indicate a cardioprotective effect of the extract. This result is in agreement with that recorded by Abd El-Hack et al. (2021), who emphasized that antioxidants derived from plant sources can benefit cardiovascular function by maintaining homeostasis and optimizing the efficiency of mitochondria in heart muscles. In conclusion, durian seed extract supplementation at 2.5 mL/L in drinking water resulted in a significantly increased heart weight of broiler chickens, suggesting beneficial effects on the health and adaptive response to metabolic stress by oxygen delivery from the developing animal's own body.

Table 1. Effect of Durian Seed (*Durio zibethinus*) Extract on Slaughter Weight and Carcass Weight of Broiler Chickens (g)

Treatment	Research Variables		
	Slaughter Weight (g)	**Carcass weight (g)**	**Carcass percentage (%)**
P0	1926,0[a]	1309,7[a]	68,0[a]
P1	2008,9[ab]	1376,1[ab]	68,5[ab]
P2	2232,1[b]	1540,1[b]	69,0[b]
P3	2454,5[c]	1718,2[c]	70,0[c]
P4	2855,7[d]	2027,5[d]	71,0[d]

Source: Primary Data Research Results, 2025. Notes: Means within the same column followed by different superscripts indicate significant differences ($P < 0.05$). Different superscripts in the same column indicate significant differences ($P < 0.05$). The control group (P0) received a complete feed and drinking water without durian seed extract. Treatment group P1 was supplemented with complete feed and drinking water containing 1.0 mL/L durian seed extract, while P2 received 1.5 mL/L, P3 received 2.0 mL/L, and P4 received 2.5 mL/L durian seed extract in drinking water

Tabel 2. Average Body Weight of Broiler Chickens After Administration of Durian Seed Extract (g)

Treatment	Week					AVG(g)
	I	**II**	**III**	**IV**	**V**	
P0	124,76	336,84	849,36	1493,31	1872,13	935,28
P1	130,89	362,99	910,11	1590,17	2000,46	998,92
P2	137,83	383,44	969,57	1722,69	2161,06	1074,92
P3	147,56	411,69	1063,67	1857,60	2355,29	1167,16
P4	164,47	474,93	1218,44	2172,51	2695,99	1345,27

Table 3. Effect of Durian Seed Extract (*Durio zibethinus*) on Proventriculus Weight of Broiler Chickens (g)

Treatment	Proventriculus Weight (g)	Percentage of Slaughter Weight (%)
P0	6.74[a]	0,35
P1	7.23[a]	0,36
P2	8.48[a]	0,38
P3	10.31[a]	0,42
P4	12.85[a]	0,45

Notes: Different superscript letters within the same column indicate significant differences (P < 0.05).

Table 4. Effect of Durian Seed Extract (*Durio zibethinus*) on Gizzard Weight of Broiler Chickens (g)

Treatment	Gizzard Weight (g)	Percentage of Slaughter Weight (%)
P0	30,82[e]	1,6
P1	34.15[d]	1,7
P2	40,18[c]	1,8
P3	46,63[b]	1,9
P4	57,11[a]	2,0

Notes: Different superscript letters within the same column indicate significant differences (P < 0.05).

Tabel 5. Effect of Durian Seed Extract (*Durio zibethinus*) on Small Intestine Weight and Length of Broiler Chickens

Treatment	Small Intestine Weight (g)	Percentage of Slaughter Weight (%)	Small Intestine Length (cm)
P0	24,65[e]	3,80	118,42[e]
P1	25,48[d]	4,05	121,76[d]
P2	27,22[c]	4,10	125,83[c]
P3	28,36[d]	4,25	129,64[b]
P4	29,95[a]	4.38	132,11[a]

Notes: Different superscript letters within the same column indicate significant differences (P < 0.05).

Table 6. Effect of Durian Seed Extract (*Durio zibethinus*) on Large Intestine Weight and Length of Broiler Chickens

Treatment	Large Intestine Weight (g)	Percentage of Slaughter Weight (%)	Large Intestine Length (cm)
P0	1,62[e]	0,24	4,60[e]
P1	1,68[d]	0,25	4,83[d]
P2	1,74[c]	0,26	5,01[c]
P3	1,78[b]	0,27	5,22[b]
P4	1,82[a]	0.27	5,36[a]

Notes: Different superscript letters within the same column indicate significant differences (P < 0.05).

Table 7. Effect of Durian Seed Extract (*Durio zibethinus*) on Liver Weight of Broiler Chickens (g)

Treatment	Liver Weight (g)	Percentage of Slaughter Weight (%)
P0	12,10[e]	1,85
P1	12.64[d]	1,92
P2	13,22[c]	2,01
P3	13,78[b]	2,05
P4	14,24[a]	2,09

Notes: Different superscript letters within the same column indicate significant differences ($P < 0.05$).

Table 8. Heart Weight and Relative Heart Percentage of Broiler Chickens Supplemented with Durian Seed Extract Under Heat Stress

Treatment	Heart Weight (g)	Percentage of Slaughter Weight (%)
P0	3,42[e]	0,52
P1	3.68[d]	0,55
P2	3,91[c]	0,57
P3	4,15[b]	0,59
P4	4,36[a]	0,61

Notes: Different superscript letters within the same column indicate significant differences ($P < 0.05$).

CONCLUSIONS

This study demonstrated that supplementing broiler drinking water with Durian seed extract *(Durio zibethinus)* improved growth performance, carcass yield, and internal organ development under heat stress. Broilers receiving 2.5 mL/L extract (P4) showed higher carcass and organ weights, likely due to the antioxidant and phytobiotic compounds polyphenols, flavonoids, and phenolic acids, which enhanced nutrient utilization and metabolic efficiency. The extract also improved intestinal morphology, supporting better digestion. Overall, Durian seed extract at 2.5 mL/L can be recommended as a natural phytogenic additive to enhance the growth and resilience of broilers under tropical heat stress conditions.

ACKNOWLEDGMENT

The authors sincerely thank the Directorate of Research and Community Service (DRPM), Ministry of Higher Education, Science, and Technology, for providing financial support through the Beginner Lecturer Research (PDP) BIMA Kemendikbud Scheme 2025 under grant contract No. 110/C3/DT.05.00/PL/2025, dated May 28, 2025. Additional acknowledgment is extended to the Institute for Research, Community Service, and Quality Assurance (LPPM-PM), University of West Sulawesi, for its continuous guidance and institutional support during the implementation of this study.

The authors also express deep appreciation to all members of the research team and participating students for their invaluable assistance, cooperation, and dedication throughout the research process. This project was conducted under the official research agreement No. 0419/C3/DT.05.00/2025, dated May 22, 2025, issued by DRPM, Ministry of Higher Education, Science, and Technology.

REFERENCES

Abd El-Hack, M. E., El-Saadony, M. T., & Taha, A. E. (2021). The efficacy of herbal feed additives in improving growth performance and gut health in broiler chickens. *Animal Biotechnology, 32*(5), 1–10.

https://doi.org/10.1080/10495398.2021.1886041

Afolayan, A. O., Adeleye, O. A., & Eze, C. I. (2023). Phytobiotics and tropical plant extracts as alternatives to antibiotic growth promoters in broiler production. *Frontiers in Veterinary Science, 10*, 118944. https://doi.org/10.3389/fvets.2023.118944

Ahiwe, E. U., Abdallh, M. E., Chang'a, E. P., & Iji, P. A. (2021). Influence of feed intake and nutrient utilization on broiler growth and carcass yield. *Poultry Science, 100*(5), 101056. https://doi.org/10.1016/j.psj.2021.101056

Ahmad, R., Goh, Y. M., Samsudin, A. A., Zaneb, H., & Rahman, Z. U. (2022). Influence of heat stress on poultry growth performance, intestinal inflammation, and immune function and potential mitigation by probiotics. *Animals, 12*(17), 2297. https://doi.org/10.3390/ani12172297

Alagbe, E. O., et al. (2023). Growth performance, nutrient digestibility, intestinal morphology, cecal mucosal cytokines and serum antioxidant responses of broiler chickens to dietary enzymatically treated yeast. *Journal of Animal Science and Biotechnology, 14*(1), 57. https://doi.org/10.1186/s40104-023-00844-5

Al-Kahtani, M. A., Ismail, I. E., El-Morsy, M. A., & Mohamed, M. S. (2022). *Modulation of antioxidant defense, immune response, and growth performance by dietary supplements in broiler chickens.* Animals, 12(14), 1817. https://doi.org/10.3390/ani12141817

Basiouni, S., Abd El-Hack, M. E., El-Sayed, M. E. A., & Tufarelli, V. (2023). *Anti-inflammatory and antioxidative phytogenic substances against secret killers in poultry: Current status and prospects.* Veterinary Sciences, 10(1), 55. https://doi.org/10.3390/vetsci10010055

El Sabry, M. I., et al. (2023). Factors influencing the development of gastrointestinal morphology in poultry. *Journal of Animal Physiology and Animal Nutrition, 107*(4), 1207–1218. https://doi.org/10.1111/jpn.13945

El-Saadony, M. T., Saad, A. M., & Swelum, A. A. (2022). The impact of plant-derived polyphenols on cardiac antioxidant response and tissue function in poultry. *Antioxidants, 11*(6), 1045. https://doi.org/10.3390/antiox11061045

FAO. (2023). *Meat market review 2023.* Food and Agriculture Organization of the United Nations. https://www.fao.org/publications

Goel, A., Pandey, A., & Tripathi, A. (2025). Phytobiotics as natural growth promoters in broiler chickens: Mechanisms and applications under heat stress conditions. *Poultry Science, 104*(2), 101512. https://doi.org/10.1016/j.psj.2025.101512

Goel, A., et al. (2025). Alleviation of acute heat stress in broiler chickens by dietary polyphenol extract supplementation. *Scientific Reports, 15*(1), 1078. https://doi.org/10.1038/s41598-025-1078

Hashemitabar, S. H., et al. (2024). Comparative effects of probiotics on growth, antioxidant indices, and intestinal histomorphology of broilers under heat stress. *Scientific Reports, 14*, 14563. https://doi.org/10.1038/s41598-024-14563

Hidayat, C. et al. (2020). *Heat Stress in Broiler Chickens with Heat Shock Protein 70 Gene Expression as its Indicator.* Indonesian Bulletin of Animal and Veterinary Sciences

Hidayat, M. N., et al. (2022). Productive performance of commercial broiler strains in Indonesia. *Indonesian Journal of Animal and Veterinary Sciences, 27*(2), 85–94. https://doi.org/10.14334/jitv.v27i2.2991

Iftitah, D. (2022). *Physiological Conditions of Broiler Chickens During Transportation with Vitamin Treatment and Distance Difference.* Jurnal Ilmu-Ilmu Peternakan, 32(3): 313-327. DOI: 10.21776/ub.jiip.2022.032.03.02.

Irawan, D., Hidayat, C., Jayanegara, A., & Ratriyanto, A. (2020). *Essential oils as growth-promoting additives for broilers reared under high ambient temperature: Effects on antioxidant enzyme activities, plasma hormone levels, and serum metabolites.* **Animal Bioscience**, 33(9), 1440–1450. https://doi.org/10.5713/ab.20.0668

Liu, W. C., et al. (2022). Effects of heat stress on production performance, redox status, and intestinal health of indigenous broilers. *Frontiers in Physiology, 13*, 874965. https://doi.org/10.3389/fphys.2022.874965

Liu, Y., Chen, H., & Wang, J. (2023). Dietary plant extracts improve antioxidant capacity, immune function, and performance of broilers under high-temperature conditions. *Animals, 13*(4), 745. https://doi.org/10.3390/ani13040745

Liu, Y., et al. (2023). Dietary supplementation of plant extracts improves broiler performance, antioxidant status, and carcass traits under heat stress. *Frontiers in Veterinary Science, 10*, 114876. https://doi.org/10.3389/fvets.2023.114876

Mardalena, E., & Harahap, R. (2021). The role of poultry meat in fulfilling animal protein consumption in Indonesia. *IOP Conference Series: Earth and Environmental Science, 788*(1), 012178. https://doi.org/10.1088/1755-1315/788/1/012178

Mohammed, A. A., Jacobs, J. A., & Murugesan, G. R. (2023). Impact of phytogenic compounds on antioxidant status and hepatic metabolism in broiler chickens. *Poultry Science, 102*(1), 102204. https://doi.org/10.1016/j.psj.2022.102204

Mungmai, L., Suttisansanee, U., & Santivarangkna, C. (2023). Nutritional composition and antioxidant activities of durian (*Durio zibethinus*) seeds: Potential applications in poultry nutrition. *Journal of Food Biochemistry, 47*(2), e14325. https://doi.org/10.1111/jfbc.14325

Mungmai, L., et al. (2023). Physicochemical properties, antioxidant and anti-tyrosinase activity of durian seed and hull extracts. *Cosmetics, 10*(3), 87. https://doi.org/10.3390/cosmetics10030087

Musa, A., et al. (2024). Comparative growth rate and feed efficiency of commercial broiler chickens. *Poultry Science Journal, 12*(1), 45–54. https://doi.org/10.22099/psj.2024.4712

Nanto-Hara, F., Kikusato, M., Ohwada, S., & Toyomizu, M. (2020). Heat stress directly affects intestinal integrity in broiler chickens. *Journal of Poultry Science, 57*(4), 284–290. https://doi.org/10.2141/jpsa.0190004

Nilawati, N., Ramaiyulis, R., Yanti, E., & Gustian, I. (2024). *Response of broiler internal organs to administering Rhizopus oryzae and Lactobacillus casei based probiotics.* International Journal of Agricultural Technology, 20(4), 995–1006.

Obianwuna, U. E., Okolie, P. N., & Ezeokeke, C. T. (2024). Role of phytobiotics in improving carcass yield and oxidative stability in broiler chickens reared under tropical stress. *Journal of Applied Poultry Research, 33*(1), 100329. https://doi.org/10.1016/j.japr.2024.100329

Obianwuna, U. E., et al. (2024). Phytobiotics in poultry: Revolutionizing broiler chicken intestinal health. *Frontiers in Veterinary Science, 11*, 116267. https://doi.org/10.3389/fvets.2024.116267

Oni, A. I., Adeleye, O. A., & Oke, O. E. (2024). Phytogenic feed additives as natural growth promoters in broilers under stress conditions. *Journal of Animal Physiology and Animal Nutrition, 108*(2), e13869. https://doi.org/10.1111/jpn.13869

Oni, O. O., Adebiyi, O. A., & Ogunbiyi, J. O. (2024). Phytogenic feed additives improve growth, feed efficiency, and health indices of broiler chickens under heat stress. *Veterinary and Animal Science, 23*, 100620. https://doi.org/10.1016/j.vas.2024.100620

Paredes-López, D. M., et al. (2024). Modulation of gut microbiota, morphometry, and blood parameters in broiler chickens with plant ethanolic extracts. *Frontiers in Veterinary Science, 11*, 122134. https://doi.org/10.3389/fvets.2024.1221134

Rayani, T. F., Sumiati, & Sudarman, A. (2017). *Supplementation of zinc and vitamin E on apparent nutrient digestibility, digestive organ development, and broiler performance.* **Media Peternakan**, 40(2), 116–124. https://doi.org/10.5398/medpet.2017.40.2.116

Rysman, K., et al. (2023). Broiler performance correlates with gut morphology and microbial composition. *Avian Pathology, 52*(1), 78–89. https://doi.org/10.1080/03079457.2023.2161234

Saeed, M., Naveed, M., & Ali, K. (2023). Role of flavonoids and phenolic compounds in improving gut health and immunity in poultry. *Frontiers in Veterinary Science, 10*, 119832. https://doi.org/10.3389/fvets.2023.119832

Sartika, T., et al. (2021). Growth performance and carcass characteristics of broiler chickens. *Tropical Animal Science Journal, 44*(3), 211–218. https://doi.org/10.5398/tasj.2021.44.3.211

Sharma, A., Kumar, R., & Singh, J. (2022). Role of dietary antioxidants in improving heart morphology and oxidative balance in poultry. *Journal of Applied Animal Nutrition, 17*(3), 45–53. https://doi.org/10.1016/j.jaan.2022.45

Sugiharto, S., Yudiarti, T., Isroli, I., Widiastuti, E., & Kusumanti, E. (2017). Dietary supplementation of probiotics in poultry exposed to heat stress—A review. *Annals of Animal Science, 17*(3), 591–604. https://doi.org/10.1515/aoas-2016-0062

Sugiharto, S., Yudiarti, T., & Ratriyanto, A. (2024). Effects of natural plant extracts on liver function, antioxidant status, and performance of heat-stressed broilers. *Tropical Animal Health and Production, 56*(2), 317. https://doi.org/10.1007/s11250-023-03717-4

Sumanu, V. O., Naidoo, V., Oosthuizen, M., & Chamunorwa, J. P. (2023). Effects of heat stress on antioxidant enzyme activities, performance, and small intestinal morphology in broiler chickens. *Animals, 13*(9), 1558. https://doi.org/10.3390/ani13091558

Surai, P. F. (2020). *Antioxidants in poultry nutrition and reproduction: An update.* **Antioxidants**, 9(11), 1055. https://doi.org/10.3390/antiox9111055

Tallentire, C. W., Leinonen, I., & Kyriazakis, I. (2016). *Breeding for efficiency in the broiler chicken: A review. Agronomy for Sustainable Development*, 36(4), 66. https://doi.org/10.1007/s13593-016-0398-2

Tenza, V., Mabusela, S. P., Mtileni, B., & Chimonyo, M. (2025). *Effect of breed, sex, and age on the body and internal organ weight of chickens for food security in resource-poor communities of KwaZulu-Natal, South Africa. Frontiers in Animal Science*, 6, 1565246. https://doi.org/10.3389/fanim.2025.1565246

Wecke, C., & Liebert, F. (2019). *Age and gender dependent deposition of crude nutrients and energy in fast-growing meat-type chickens. Open Journal of Animal Sciences*, 9(1), 18–32. https://doi.org/10.4236/ojas.2019.91002

Widyaningrum, P., et al. (2021). Meat quality traits and consumer preferences of broiler chicken. *Veterinary World, 14*(6), 1589–1595. https://doi.org/10.14202/vetworld.2021.1589-1595

Zhang, H., et al. (2024). Improvement of antioxidant capability by dietary N-acetyl cysteine in heat-stressed broiler chickens. *Journal of Animal Science and Biotechnology, 15*(1), 45. https://doi.org/10.1186/s40104-024-00918-6