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Growth Performance, Lipid Profile, and Fat Deposition of Broilers Fed Avocado and Carrot Leaf Extract

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Abstract. This study aimed to evaluate the effects of avocado leaf extract (AE) and carrot leaf extract (CE) on the nutrient intake, growth performance, blood lipid profile, and fat deposition of broilers. Different concentrations of AE and CE were used in this study, namely 2.5% and 5%. T0 = 100% standard diet (control); T1 = 95% standard diet + 2.5% AE + 2.5% CE; T2= 92.5% standard diet + 5% AE + 2.5% CE; and T3 = 92.5% standard diet + 2.5% AE + 5% CE. One hundred one-day-old broilers were randomly assigned to four groups with five replicates of five chickens each and were treated during the grower-finisher period, from 14 to 35 days of age. The results showed that up to 2.5% AE and CE in the diet increased protein intake, energy intake, carcass weight and percentage, and high-density lipoprotein (HDL) ($P<0.05$), but reduced feed conversion, low-density lipoprotein (LDL), cholesterol, abdominal fat weight, and the percentage of abdominal fat. Body weight was highest at 5% AE, while cholesterol and LDL levels were lowest at 5% CE ($P<0.05$). In conclusion, avocado and carrot leaf extract up to 2.5% significantly improved nutrient intake, growth performance, and blood profile, and reduced fat deposition in broilers.

Keywords: broiler, avocado leaf extract, carrot leaf extract, growth, fat deposition

Abstrak. Tujuan penelitian ini adalah mengevaluasi pengaruh ekstrak daun alpukat (AE) dan ekstrak daun wortel (CE) terhadap konsumsi nutrien, performa pertumbuhan, profil lipid darah, dan deposisi lemak ayam broiler. Dalam penelitian ini digunakan berbagai tingkat konsentrasi AE dan CE, yaitu 2,5% dan 5% sebagai berikut: T0 = 100% diet standar (kontrol); T1 = 95% diet standar + 2,5% AE + 2,5% CE; T2 = 92,5% diet standar + 5% AE + 2,5% CE; dan T3 = 92,5% diet standar + 2,5% AE + 5% CE. Seratus ekor ayam broiler umur satu hari secara acak dibagi ke dalam empat perlakuan dengan lima ulangan. Setiap ulangan terdiri atas 5 ekor dan diberikan perlakuan selama periode grower-finisher, dari umur 14 hingga 35 hari. Hasil penelitian menunjukkan bahwa AE dan CE hingga 2,5% dalam ransum secara signifikan ($P<0,05$) meningkatkan konsumsi protein, konsumsi energi, berat badan, berat karkas, persentase karkas, dan kadar high-density lipoprotein (HDL), serta menurunkan konversi pakan, low-density lipoprotein (LDL), kolesterol, berat lemak abdominal, dan persentase lemak abdominal. Berat badan paling tinggi terdapat pada AE 5% ($P<0,05$). Disimpulkan bahwa pemberian AE dan CE pada konsentrasi 2,5% secara signifikan ($P<0,05$) meningkatkan konsumsi nutrien, performa pertumbuhan, dan profil darah, serta menurunkan penimbunan lemak abdominal pada ayam broiler.

Kata kunci: broiler, ekstrak daun alpukat, ekstrak daun wortel, pertumbuhan, deposisi lemak

Introduction

Commercial broilers are characterized by their rapid growth rates and low feed conversion ratio. Growth rate is associated with fat deposition in the carcass (Rezai et al., 2018). The fat content and fatty acid composition of broiler meat are important health considerations for consumers, since high levels of fat, saturated fatty acids, and cholesterol are associated with systemic metabolic diseases. This highlights the need for greater attention to fat control in broiler meat production. While fat contributes to the nutritional value, tenderness, and flavor of meat, excessive fat presents a significant challenge for the poultry industry. Fat from abdominal and subcutaneous tissues is considered waste, which reduces carcass quality (Schumacher et al., 2022).

Achieving high productivity in broilers requires proper nutrition. This, in turn, depends on high-quality feed. One way to improve feed quality is to use phytobiotics, which are natural plant-based ingredients containing bioactive compounds (Deminicis et al., 2021; Krauze, 2021). Phytobiotics positively affect animal health and productivity by balancing the microflora in the digestive tract and improving broiler performance as growth promoters (Ren et al., 2019).

Avocado leaves (*Persea americana*) contain bioactive compounds such as flavonoids, saponins, and tannins (Abd Elkader et al., 2022). Flavonoids affect the lipase enzyme, converting excess fat into fatty acids and glycerol and increasing appetite, thereby enhancing carcass weight (Huang et al., 2018; Zaikina et al., 2022). Saponins reduce abdominal fat by inhibiting fat absorption in the small intestine and reducing pancreatic lipase activity. They also inhibit microbial growth in the digestive system, thereby improving nutrient absorption and promoting optimal growth in livestock (Luo et al., 2020). Tannins have a positive effect on digestive tract performance (Rahman et al., 2022). Carrot leaves (*Daucus carota*) contain flavonoids, polyphenols, steroid compounds, saponins, and tannins (Prasad et al., 2017). These compounds benefit digestive health and reduce cholesterol and triglyceride production (Ismail et al., 2023; Ikram et al., 2024).

Previous research has not examined the combination of avocado and carrot leaf extracts. Therefore, the novelty of this study lies in combining avocado and carrot leaves, which maximizes bioactivity and improves growth performance while reducing fat deposition. The objective of this study was to evaluate the effect of combining avocado and carrot leaf extracts in broiler diets during the grower-finisher period on growth performance, lipid profile, and fat deposition.

Materials and Methods

Research Procedure

The extract was prepared by drying avocado and carrot leaves. The leaves were mashed, and then macerated in 70% ethanol at a ratio of 1:5 for 24 hours. The resulting precipitate was placed in a laminar flow cabinet under ultraviolet light for 120 minutes to evaporate the ethanol. It was dried in an oven at 60 °C to obtain an extract using the method described by Utami et al. (2023). The avocado leaves yielded an extract of 26.99 g/100 g of sample, while the carrot leaves yielded an extract of 32.81 g/100 g of sample. This study was conducted in the Animal Production and Feed Technology Laboratories of the Department of Animal Science at Politeknik Negeri Jember, Indonesia, and was approved by the Animal Ethics Committee (approval number 503/PL17.4/PG/2023).

One hundred one-day-old broiler chickens were randomly assigned to four groups of five replicates (five chickens per replicate) and treated from days 14 to 35 of age. The treatment groups received different levels of avocado leaf extract (AE) and carrot leaf extract (CE), at 2.5% and 5%, respectively. The treatments were as follows: T0= 100% standard diet (SD) as the control; T1= 95% standard diet + 2.5% AE + 2.5% CE; T2= 92.5% standard diet + 5% AE + 2.5% CE; and T3= 92.5% standard diet + 2.5% AE + 5% CE.

The diets were formulated based on the nutritional composition of the standard diet (SD). The nutrient composition of the avocado leaf extract (AE) and carrot leaf extract (CE) is shown in Table 1. Feed intake was recorded daily by calculating the amount of feed remaining in the feeder for each experimental unit. Body weight was determined by weighing each bird weekly, and the feed conversion ratio was calculated by dividing the average feed intake of each group by its average body weight.

On the 35th day of the study, twenty chickens were bled, and their blood samples were centrifuged at 1600 x g for ten minutes to obtain plasma. Low-density lipoprotein (LDL), high-density lipoprotein (HDL), and total cholesterol were analyzed using the method described by Haryanto et al. (2016). The chickens were then slaughtered, and carcass weight and percentage, as well as abdominal fat weight and percentage, were calculated using the method of Singh and Pathak (2016).

Table 1. Nutrient composition of avocado leaf extract (AE) and carrot leaf extract (CE)

Nutrients	Avocado Leaf Extract (AE)	Carrot Leaf Extract (CE)
Energy (kcal/kg)	3570	2487
Crude protein (%)	8.85	7.45
Fat (%)	2.96	1.26
Ash (%)	13.08	17.66

Note: Analyzed at the Integrated Testing Laboratory, Jember University

Data Analysis

The data were analyzed using a one-way ANOVA and Duncan's Multiple Range Test in the Statistical Package for the Social Sciences (SPSS) 25.0 software for Windows, to determine the differences between the treatment groups. Differences were considered statistically significant at P<0.05.

Results and Discussion

Nutrient Intake and Growth Performance

Table 2 shows the nutrient intake and growth performance of the experimental groups. The results showed that AE and CE significantly increased feed intake (P<0.05); the lowest feed intake occurred in the control group (P<0.05). Protein intake was higher using AE and CE than in the control (P<0.05). Average energy intake differed significantly between the AE and CE groups (P<0.05). Energy and protein intake followed similar patterns. The highest energy and protein intake were observed at 5% AE and 2.5% CE, though no significant difference was found between the AE and CE groups. These results support the view of Classen (2017) that increased feed intake leads to higher protein intake in chickens.

Dietary protein is broken down into amino acids, which are then used for tissue synthesis and can lead to an increase in body weight. According to Simeneh (2019), body weight is affected by the quantity and quality of feed consumed. The highest body weight was found in the group receiving 5% AE and 2.5% CE, and body weights differed significantly between experimental groups (P<0.05). The feed conversion ratios of the AE- and CE-supplemented groups were significantly lower than that the the control (P<0.05). The feed conversion results followed a pattern similar to that of protein intake. No significant difference was observed between 2.5% AE and 2.5% CE; however, up to 2.5% of either enhanced feed intake. The AE and CE extracts contain bioactive flavonoids, which, as reported by Tan et al. (2022), increase feed intake.

Body weight can be increased through the consumption of metabolizable energy (Utami et al., 2023). Adding 5% AE produced the greatest body weight gain of all the treatments. Increasing protein and energy intake through AE and CE significantly improved body weight through the combination of bioactive compounds and increased metabolism in the digestive system. A low feed conversion ratio indicates efficient feed utilization and satisfactory body weight gain. The lowest feed conversion ratio was observed with the diet containing 5% AE and 2.5% CE, which was highly efficient at converting feed to body weight gain. This supports the view of Deminicis et al. (2021)'s view that phytobiotics enhance the absorption of nutrients from feed in poultry.

The 2.5% AE and 2.5% CE group had the lowest conversion value of 1.47, and the highest weight gain in the 5% AE and 2.5% CE group was 1951.10 grams. Using 5% AE resulted in higher body weight and energy intake than using 5% CE. Body weight gain includes changes in weight, linear dimensions, and carcass composition (Iwujia et al., 2022).

Table 2. Nutrient intake and growth performance of the experimental groups

Parameters	T0	T1	T2	T3
Feed intake (g)	2818.91±5.21[a]	2832.25±4.32[b]	2849.36±5.64[b]	2839.01±5.84[b]
Energy intake (kcal/d)	231.08±1.14[a]	234.67±1.76[b]	241.03±0.03[b]	238.21±2.85[b]
Protein intake (g/d)	17.22±0.02[a]	17.90±0.14[b]	17.93±0.26[b]	18.09±0.03[b]
Body weight (g)	1919.40±5.43[a]	1935.24±6.02[b]	1951.10±6.89[c]	1930.94±5.68[b]
Feed conversion	1.55±0.13[b]	1.47±0.02[a]	1.52±0.02[a]	1.49±0.08[a]

Note: T0: 100% standard diet (SD); T1: 95% SD + 2.5% avocado leaf extract (AE) + 2.5% carrot leaf extract (CE); T2: 92.5% SD + 5% AE + 2.5% CE; T3: 92.5% SD + 2.5% AE + 5% CE); [abc] Different superscripts in the same row indicate significant differences (P<0.05)

Table 3. Blood profile of the experimental groups

Parameters	T0	T1	T2	T3
LDL (mg/dL)	75±6.23 [c]	59±5.48 [b]	54±6.28 [b]	40±4.34 [a]
HDL (mg/dL)	40±4.41 [a]	54±5.26 [b]	60±4.32 [b]	69±5.37 [b]
Cholesterol (mg/dL)	149±8.92 [a]	134±6.24 [b]	128±5.39 [b]	110±5.86 [c]

Note: T0: 100% standard diet (SD); T1: 95% SD + 2.5% avocado leaf extract (AE) + 2.5% carrot leaf extract (CE); T2: 92.5% SD + 5% AE + 2.5% CE; T3: 92.5% SD + 2.5% AE + 5% CE); [abc] Different superscripts in the same row indicate significant differences (P<0.05)

Blood Profile

As shown in Table 3, there was a significant decrease in LDL with AE and CE. Similar results were obtained for the decrease in cholesterol (P<0.05), with the lowest LDL level achieved with 5% CE (P<0.05) compared to the other treatments. Conversely, HDL increased in the dietary treatments containing AE and CE compared to the control (P<0.05).

Avocado leaves contain linoleic and palmitic acids. These acids have been shown to reduce cholesterol and inhibit fat deposition (Jiménez et al., 2021). LDL levels decrease when AE and CE are included in the diet due to the presence of flavonoids, which are phenolic compounds with antioxidant properties that reduce low-density lipoprotein in the blood. Avocado also contains a higher concentration of these acids than carrot (7.02% linoleic acid compared to carrot: 5.7% linoleic acid) (Almeida et al., 2009; Agunloye et al., 2025).

Studies have reported that linoleic acid reduces blood cholesterol levels by increasing membrane fluidity, LDL receptor activity, and LDL catabolism (Perona, 2017). This process converts cholesterol to bile acids in the liver (Chiang and Ferrell, 2018). Other studies have reported that linoleic acid consumption increases HDL levels (Yanai and Tada, 2018). This is due to cholesterol being converted into a form that can be readily incorporated into HDL, allowing it to be transported through the bloodstream from body tissues to the liver (Bali and Utaal, 2019). A reduction in LDL levels was correlated with an increase in HDL levels, which were significantly higher than in the control group. Previous research has reported that phenolic compounds cause a significant reduction in cholesterol production and triglyceride levels when a carrot-rich diet is consumed (Akhtar, 2017).

Carcass and Abdominal Fat

As shown in Table 4, AE and CE in the diet significantly affected (P< 0.05) the body weight, carcass weight, carcass percentage, abdominal fat weight, and abdominal fat percentage of the broilers. The highest average carcass percentage was obtained with 2.5% AE and 2.5% CE. Carcass percentage is influenced by strain, feed consumption, age, sex, and abdominal fat (Gafar et al., 2022). Abdominal fat weight correlates with fat deposition in chickens (Kang et al., 2022). The percentage of abdominal fat is an indicator of fat deposition in broilers (Zuo et al., 2024).

Table 4. Carcass and abdominal fat of the experimental groups

Parameters	T0	T1	T2	T3
Carcass weight, g	1322.0±5.55 [a]	1368.2±4.52 [b]	1351.40±7.17 [b]	1364.40±7.1 [b]
Carcass, %	68.92±0.19 [a]	71.16±0.03 [c]	70.10±0.19 [b]	70.15±0.36 [b]
Abdominal fat, g	18.33±2.13 [b]	13.02±2.09 [a]	14.42±0.92 [a]	14.13±0.42 [a]
Abdominal fat, %	0.96±0.27 [c]	0.67±0.11 [a]	0.78±0.02 [b]	0.77±0.17 [b]

Note: T0: 100% standard diet (SD); T1: 95% SD + 2.5% avocado leaf extract (AE) + 2.5% carrot leaf extract (CE); T2: 92.5% SD + 5% AE + 2.5% CE; T3: 92.5% SD + 2.5% AE + 5% CE); [abc] Different superscripts in the same row indicate significant differences (P<0.05)

Abdominal fat formation can be influenced by the nutrient content of feed (Akhtar et al., 2017). The main factors affecting lipid deposition are dietary energy, protein, and amino acids. Bioactive compounds in AE and CE contributed to the lowest abdominal fat weight. Flavonoids can affect the lipase enzyme, converting excess body fat into fatty acids and glycerol to prevent fat accumulation (de Araújo et al., 2017).

The combination of AE and CE improves protein efficiency; this is thought to enhance the birds' ability to convert protein intake into weight gain (Ayeni et al., 2018). The nutrients from these two ingredients can complement each other in the diets of broilers from the grower to the finisher phase, increasing absorption in livestock and improving growth performance. They can also reduce cholesterol, increase carcass weight, and decrease fat deposition in broilers.

Conclusions

The addition of up to 2.5% avocado and carrot leaf extracts significantly ($P < 0.05$) improved the nutrient intake, growth performance, and blood profile of broilers, while reducing abdominal fat, which is an indicator of fat deposition. The best growth performance, carcass quality, and abdominal fat reduction were obtained with 2.5% avocado and 2.5% carrot extract, while the best blood profile was observed with 2.5% avocado and 5% carrot extract. The Combined use of avocado and carrot extracts may be recommended to improve performance and blood profile and reduce fat deposition in broilers.

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