International Journal of Environmental & Agriculture Research (IJOEAR)
ISSN: [2454-1850]
[Vol-12, Issue-4, April- 2026]
Website: www.ijoear.com
Journal DOI: 10.25125/agriculture-journal

The Effect of Papaya Fruit Peel Extract (*Carica papaya* L.) on The Percentage of External Offal in Broiler Chickens

Sebayang, N. D.[1]; G. A. M. K. Dewi[2]; M. Wirapartha[3]; dan N. P. M. Suartiningsih[4*]

Faculty of Animal Husbandry, Udayana University, Indonesia
*Corresponding Author

Received:- 07 April 2026/ Revised:- 16 April 2026/ Accepted:- 21 April 2026/ Published: 30-04-2026

Abstract— *This study aims to determine the effect of papaya peel extract (Carica papaya L.) administered through drinking water on the percentage of external offal in 35-day-old broiler chickens. The study was conducted at the Sesetan Farm, Faculty of Animal Science, Udayana University in February 2025. The study involved 80 broilers that were given papaya peel extract in drinking water at different concentrations, namely 4%, 6% and 8%. The study was designed using a completely randomized design (CRD) with 4 treatments and 5 replications: P0 as the control (drinking water without papaya peel extract), P1 (drinking water with 4% papaya peel extract), P2 (drinking water with 6% papaya peel extract), and P3 (drinking water with 8% papaya peel extract). The variables observed were the percentage of external offal (head, neck, feet, blood, and feathers). The results showed that the administration of papaya peel extract at concentrations of 4%, 6% and 8% had no significant difference (P>0.05) on external offal. Therefore, this study concluded that the administration of papaya peel extract at concentrations of 4%, 6% and 8% in drinking water produced similar results on the percentage of external offal (head, neck, feet, blood and feathers) in 35-day-old broiler chickens.*

Keywords— Broiler chickens, External offal, Papaya peel extract.

I. INTRODUCTION

The growth in the population and the improvement in the standard of living of the Indonesian people have led to an increase in food demand, especially animal protein. Based on data from the Central Statistics Agency (BPS), the population of Indonesia continues to increase year by year. In 2020, the Population Census recorded a population of 270.20 million people. Population projections indicate an increase to 275.77 million people in 2022, 278.70 million people in 2023, and 281.60 million people in 2024. The need for animal protein can be met by one type of animal meat, namely broiler chicken. In 2013, per capita consumption was recorded at 3.65 kg per year and increased to 5.68 kg per year in 2017. In total, national consumption of broiler chicken during the 2017–2021 period reached an average of 1.62 million tons per year, placing Indonesia as the sixteenth largest consumer of broiler chicken in the world. This increase in consumption reflects the important role of broiler chicken as an affordable and popular source of animal protein among the Indonesian population.

Broiler chickens are the result of crossbreeding various chicken breeds with high meat production capabilities, making them one of the main commodities. Along with the growth in population, the production of broiler chicken meat in Indonesia has also shown an increase. Data on broiler chicken meat production per province from the Central Bureau of Statistics (BPS) in 2024 shows variations in production across different regions, with broiler chicken meat production in Bali reaching 93,596.37 tons. Denpasar City produced 8,268 tons of poultry meat in 2022. This increase in broiler chicken meat production reflects efforts to meet the rising demand in line with the growing population and the need for animal protein consumption in Bali. According to the Central Bureau of Statistics (BPS) data in 2024, the population of broiler chickens in Indonesia reached 3.11 billion, an increase of 6.43% compared to the previous year, which recorded 2.93 billion.

Since 1946, antibiotics have been used as additives in livestock feed in Indonesia with the aim of improving digestibility, growth, and the health of livestock. However, the use of Antibiotic Growth Promoters (AGP) has been banned in Indonesia since January 1, 2018, in accordance with the Minister of Agriculture Regulation Number 14 of 2017 concerning the Classification of Veterinary Drugs (Dwi Cahyono and Nurul, 2022). One of the natural feed additive ingredients is papaya fruit peel extract. Papaya fruit peel is a byproduct of the papaya fruit that has almost the same nutritional content as the fruit itself. Papaya fruit peel contains antibacterial compounds such as alkaloids, tannins, steroids, saponins, and flavonoids. Papaya fruit peel also has active compounds such as papain, vitamin C, vitamin A, magnesium, copper, pantothenic acid, B complex vitamins, beta-carotene, lutein, zeaxanthin, vitamin E, calcium, potassium, vitamin K, and lycopene (Armando, 2020).

Prabayanti et al. (2022) stated that the administration of garlic skin extract at 1%, 2%, and 3% in drinking water did not affect the percentage of external offal (head, neck, feet, blood, and feathers) of 4-week-old broilers. Additionally, according to Triwibowo et al. (2021), the addition of papaya leaf juice in drinking water up to a level of 1.5% did not have a significant effect ($P>0.05$) on feed consumption, drinking water consumption, body weight gain, and feed conversion. Research by Wiriani (2023) reported that the administration of papaya seed extract (Carica papaya L.) through drinking water at levels of 1%, 2%, and 3% yielded similar results regarding the percentage of external offal in 4-week-old broilers. Based on this background, this study was conducted to determine the effect of administering drinking water with added papaya peel extract (Carica papaya L.) on the percentage of external offal in 5-week-old broilers.

II. MATERIALS AND METHODS

2.1 Place and Time of the Research

This research was conducted at the Faculty of Animal Husbandry, located on Jalan Raya Sesetan Gang Markisa, Denpasar, Bali. The research lasted for 2 months, from preparation to data processing.

2.2 Broiler Chickens

The broiler chickens used in this study did not differentiate between specific sexes (unsexed) and the broilers used were 2 days old. A total of 100 Day Old Chickens (DOC) were obtained, from which 80 were selected based on weight uniformity with a standard deviation of ±5% of the mean weight.

2.3 Cages and Equipment

This study uses colony-type cages made of iron, measuring 75 cm in length, 75 cm in width, and 50 cm in height. The colony cages are placed inside a building measuring 16 meters x 6 meters, with an asbestos roof and a concrete floor. A total of 20 units of cages were used in this study, with each cage housing 4 livestock. Each cage is equipped with a plastic feeder and a special drinking place for poultry. This research also uses various additional equipment, such as buckets to mix papaya peel extract with water, measuring cups to measure the amount of drinking water, blenders to make papaya peel extract, strainers to separate the pulp from the extract, and stationery to record data during the research.

2.4 Ration and Drinking Water

This study used the commercial ration CP 511B from PT Charoen Pokhpand and papaya fruit peels. The provision of feed and drinking water was given ad libitum and the leftovers were measured the next day. The drinking water used is sourced from a well. The nutritional content of the commercial feed used can be seen in Table 1.

TABLE 1
NUTRITIONAL CONTENT OF CP 511

Nutrient	Composition (%)	Standard Requirements for Broiler Starters (%)	Standard Requirements for Broiler Finisher (%)
Water	13	Max. 14.0	Max. 14.0
Proteins	21	Max. 19.0	Min. 18.0
Fat	4	Max. 7.4	Max. 8.0
Fiber	4	Max. 6.0	Max. 6.0
Ash	6.5	Max. 8.0	Max. 8.0
Calcium	0.9	0.9 – 1.20	0.9 – 1.20
Phosphorus	0.7	0.6 – 1.00	0.6 – 1.00

Information:

- PT. Charoen Phokphand Indonesia
- Standard Requirements for Broiler Starters according to SNI 01-3930-2006
- Standard Requirements for Broiler Finisher according to SNI 01-3930-2006

2.5 Research Design

In this study, the design that was used is a Completely Randomized Design (CRD) with 4 treatments and 5 replications, each replication consisting of 4 broiler chickens. The treatment involves administering papaya peel extract through drinking water with the following groups:

- P0: Drinking water without papaya peel extract (control)
- P1: Drinking water with 4% papaya peel extract
- P2: Drinking water with 6% papaya peel extract
- P3: Drinking water with 8% papaya peel extract

2.6 Randomization of Broiler Chickens

In this study, 100 chickens were used, with a weight range of approximately 5% standard deviation. The randomization of the chickens was carried out to select 80 DOC from 100 DOC according to the weight with a standard deviation of ±5%. They were then divided into 4 treatments with 5 replications and 20 randomly assigned cages. Each cage was filled with 4 chickens.

2.7 Making Papaya Peel Extract

The making of papaya peel extract was done by collecting the papaya peels that had been separated from the flesh. After separation, the papaya peels were cut into small pieces to make it easier to put them into the blender. Once cut, they were put into the blender and mixed with water using a 1:1 ratio, meaning 1 kg of papaya peel equals 1 liter of water. After blending, the mixture was strained and given to the livestock according to the treatment.

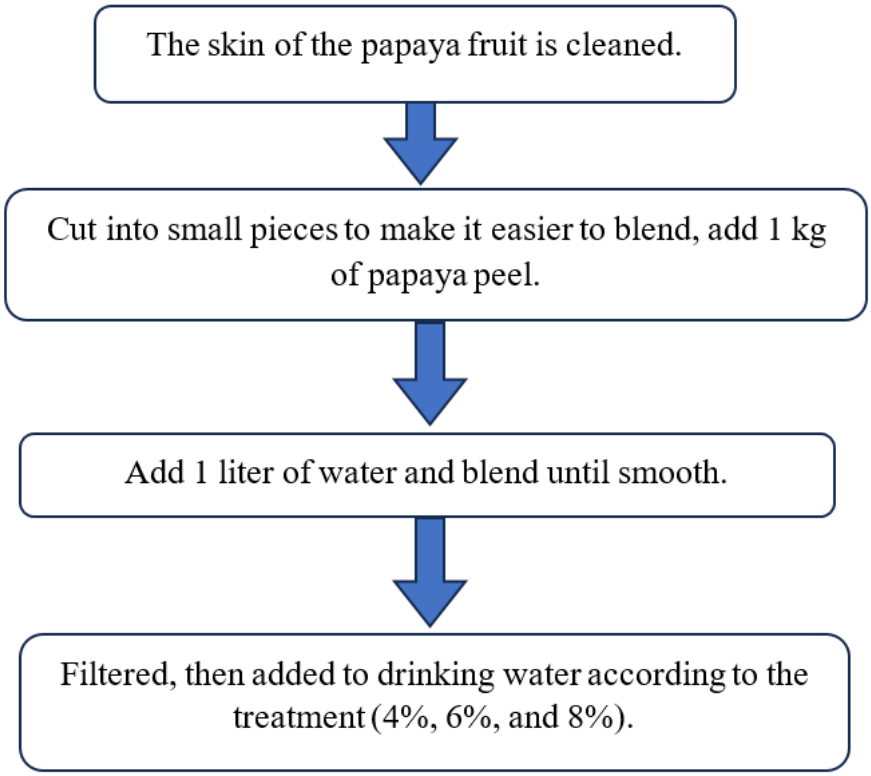

FIGURE 1: Method of making papaya peel extract

2.8 Administration of Papaya Peel Extract

Administration of drinking water:

- P0: Drinking water without papaya peel extract
- P1: Drinking water with 4% papaya peel extract (960 ml water + 40 ml extract)
- P2: Drinking water with 6% papaya peel extract (940 ml water + 60 ml extract)
- P3: Drinking water with 8% papaya peel extract (920 ml water + 80 ml extract)

In this study, the provision of drinking water was done ad libitum, meaning the water was available throughout the day and the remainder was measured the next day.

2.9 Research Preparation

One week before the research began, the cages and equipment were prepared, and the cage area was sanitized using an antiseptic diluted at a ratio of 1:5 (1 ml of antiseptic added to 5 liters of water) as a disinfectant. On the first day, the DOC was weighed to determine the initial body weight and marked with paint on the broiler's wing to facilitate the recording process.

2.10 Broiler Chicken Slaughtering

Chickens were slaughtered to obtain by-products such as heads, necks, feet, blood, and feathers. The number of chickens slaughtered was 4 chickens from each poultry unit that had been given drinking water with papaya peel extract. However, before slaughter, the chickens were fasted for 12 hours but were still given drinking water. The slaughtering process was carried out according to the USDA (United States Department of Agriculture, 1997) and Soeparno (2009) method, which states that the jugular vein and carotid artery located between the first neck vertebra should be cut. The blood that flows out was collected and weighed to determine its weight. After the chicken was confirmed dead, its body was submerged in warm water at a temperature of 50°-65°C for 30-60 seconds, followed by feather plucking. The next step involved cutting off the external offal of the chicken that had been separated from the carcass, followed by weighing to determine its weight.

2.11 Observed Variables

The observed variables in the research were as follows:

- **Head:** The head weight was calculated by weighing the chicken's head that had been separated from the neck after slaughter. The separation of the head was done by cutting at the joint (atlanto-occipitalis), which is the meeting point between the atlas bone (Os vertebrae cervicalis I) and the back of the skull.

$$\text{Percentage of head} = \frac{Head\ weight}{Cut-off\ weight} \times 100\% \quad (1)$$

- **Neck:** The weight of the neck was obtained by weighing the chicken's neck that had been separated from the head. The cutting was done at the joint between the last neck bone (Os vertebrae cervicalis) and the first back bone (Os vertebrae thoracalis).

$$\text{Percentage of neck} = \frac{neck\ weight}{Cut-off\ weight} \times 100\% \quad (2)$$

- **Feet:** The weight of the feet was calculated by weighing the chicken feet that had been separated from the carcass. The cutting was done at the junction between the tarsal bone (Os tarsal) and the tibia bone (Os tibia).

$$\text{Percentage of feet} = \frac{Feet\ weight}{Cut-off\ weight} \times 100\% \quad (3)$$

- **Blood:** The weight of the blood was obtained by weighing the collected blood of the chicken after slaughter.

$$\text{Percentage of blood} = \frac{Blood\ weight}{Cut-off\ weight} \times 100\% \quad (3)$$

- **Feathers:** The weight of the feathers was calculated by weighing the total body weight of the chicken without feathers, then subtracting the weight of the blood.

$$\text{Percentage of feather} = \frac{Feather\ weight}{Cut-off\ weight} \times 100\% \quad (3)$$

2.12 Data Analysis

The data were analyzed using analysis of variance; if there was a significant difference (P<0.05), it would be followed by Duncan's Multiple Range Test (Steel and Torrie, 1993).

III. RESULTS AND DISCUSSION

The results of the study on the effect of administering papaya fruit peel extract (Carica papaya L.) on the percentage of external offal in broiler chickens can be seen in Table 2.

TABLE 2
RESULTS OF THE ANALYSIS OF THE EFFECT OF ADMINISTERING PAPAYA FRUIT PEEL EXTRACT (CARICA PAPAYA L.) ON THE PERCENTAGE OF EXTERNAL OFFAL IN BROILER CHICKENS AT DIFFERENT LEVELS

Variable	P0	P1	P2	P3	SEM[1])
Head (%)	2.39a	2.46a	2.13a	2.24a	0.09
Neck (%)	4.18a	3.68a	3.91a	3.47a	0.45
Feet (%)	3.85a	4.31a	4.01a	4.26a	0.19
Blood (%)	5.65a	3.37a	4.58a	4.36a	1.34
Feathers (%)	8.76a	5.34a	5.44a	6.11a	0.99

Explanation:

P0: Drinking water without papaya peel extract (control)

P1: Drinking water with 4% papaya peel extract

P2: Drinking water with 6% papaya peel extract

P3: Drinking water with 8% papaya peel extract

[1]) SEM = Standard Error of the Treatment Means

Values with the same letter in the same row indicate no significant difference (P>0.05)

3.1 Percentage of Head

The average head percentage based on the research results on broiler chickens that were not given papaya fruit peel extract (P0) as a control was 2.39% (Table 2). Broiler chickens that received treatment P1 had a head percentage of 2.46%, which was higher compared to treatment P0 but statistically not significantly different (P>0.05). In treatments P2 and P3, the head percentages were 10.88% and 6.28% lower compared to treatment P0, respectively, but statistically not significantly different (P>0.05).

3.2 Percentage of Neck

The average neck percentage based on the research results on broiler chickens that were not given papaya fruit peel extract (P0) as a control was 4.18% (Table 2). Broiler chickens that received treatments P1, P2, and P3 had neck percentages of 11.96%, 6.46%, and 16.99% lower compared to treatment P0, respectively, and were statistically not significantly different (P>0.05).

3.3 Percentage of Feet

The average percentage of feet based on the research results on broiler chickens that were not given papaya fruit peel extract (P0) as a control was 3.85% (Table 2). Broiler chickens that received treatments P1, P2, and P3 had percentages of 11.95%, 4.16%, and 10.65% higher compared to treatment P0, respectively, and were statistically not significantly different (P>0.05).

3.4 Percentage of Blood

The average blood percentage based on the research results on broiler chickens that were not given papaya fruit peel extract (P0) as a control was 5.65% (Table 2). The blood percentage of broiler chickens receiving treatments P1, P2, and P3 were

40.35%, 18.94%, and 22.83% lower, respectively, compared to treatment P0 and were statistically not significantly different (P>0.05).

3.5 Percentage of Feathers

The average feather percentage based on the research results on broiler chickens that were not given papaya fruit peel extract (P0) as a control was 8.76% (Table 2). The feather percentage of broiler chickens receiving treatments P1, P2, and P3 were 39.04%, 37.90%, and 30.25% lower, respectively, compared to treatment P0 and were statistically not significantly different (P>0.05).

IV. DISCUSSION

Statistically, Table 2 shows that the percentage of head, neck, feet, blood, and feathers with the administration of drinking water containing papaya peel extract at levels of 4%, 6%, and 8% showed no significant difference (P>0.05). This is because the head, neck, and feet of broiler chickens are mostly composed of bone tissue, whose growth is more influenced by age and genetic factors rather than the effect of feed additives. Irham (2012) in Suryanti et al. (2019) states that the rate of bone growth does not depend on the influence of feed but rather on the age of the livestock. Furthermore, Wulandari (2014) reported that the process of bone calcification and skeletal formation (skeletogenesis) begins during the embryonic phase, long before the chicks hatch, so the subsequent growth phase has a relatively limited influence of feed additive supplementation on the percentage of the head, neck, and feet.

The head has an important role as the center of the nervous and sensory systems. The head of broiler chickens grows from the embryonic stage inside the egg through intramembranous ossification, accompanied by the development of the brain, eyes, and beak. Wahju (2004) also stated that bones form early in growth, so the influence of additional nutrition during the starter phase is relatively limited on the growth of head size structures. The administration of 4%, 6%, and 8% has not yet been able to influence the growth or percentage of the head in broiler chickens. This is in line with the research by Raillah et al. (2021), which states that the insignificant increase in head weight is related to the final weight of broiler chickens, which also does not show a significant difference, resulting in larger body organs and greater body weight.

Suryantiyanti et al. (2019) added that the weight of livestock organs generally corresponds with the final body weight produced. Additionally, the insignificance of this study can also be attributed to the homogeneity in the research, such as genetics, livestock age, management practices, and the feed used, which are the same, resulting in no significant differences between treatments. Jihad's research (2025) reported that herbal supplements generally have a greater impact on internal parameters such as the digestive system or immune system than on external parameters like head size.

The neck of broiler chickens begins to develop from the embryo through the process of ossification of the cervical vertebrae, which are composed of calcium, phosphorus, and collagen. The main nutrients that play a role in supporting neck growth include protein (especially essential amino acids like arginine), calcium, phosphorus, vitamin D3, and iron, which function in the formation and strengthening of bone and muscle tissue (Pratiwi and Firmawati, 2019). Based on the average results in Table 2, the addition of papaya peel extract through drinking water at levels of 4%, 6%, and 8% did not have a significant effect on the percentage of broiler chicken necks (P>0.05). This indicates that the neck is an external part of the body whose muscle tissue growth is relatively stable and unresponsive to variations in feed or phytochemical supplementation. The absence of significant differences observed can be attributed to the homogeneity in the study, such as the age of broiler chickens, genetic factors, management practices, and the uniform provision of feed and drinking water.

Chicken feet function as the main support of the body and play an important role in supporting body weight during the growth phase of broiler chickens. Based on the average results in Table 2, the administration of papaya fruit peel extract through drinking water at levels of 4%, 6%, and 8% showed no statistically significant difference in the percentage of broiler chicken feet (P>0.05). This indicates that the treatment has not yet been able to provide a significant effect on the growth of the feet parts. Bones are formed from the early stages of growth, so after passing the starter phase, the influence of additional nutrition on bone growth is relatively small (Wahju, 2004). The growth of the feet begins with the process of transforming cartilage tissue into hard bone through endochondral ossification, a process that highly depends on the adequacy of calcium, phosphorus, and vitamins that play a role in maintaining the density and strength of the feet bones (David et al., 2023).

Blood is the main component of the circulatory system that serves as a transport medium for various substances important to the body, such as oxygen, nutrients, hormones, and metabolic waste (Soeparno et al., 2011). The volume and composition of broiler chicken blood are influenced by several factors, including age, physiological condition, nutritional status, and

hormonal balance. Based on the research results, the administration of papaya peel extract through drinking water at levels of 4%, 6%, and 8% has not met the nutritional needs of broilers required to stimulate blood formation, thus showing no significant changes. Statistically, although the blood percentage in treatments P1, P2, and P3 tended to be lower compared to P0, the differences were not significant (P>0.05). This indicates that the administration of papaya fruit peel extract does not have a significant effect on the blood volume of broiler chickens. Physiologically, blood formation is closely related to the process of hematopoiesis, where red blood cells (erythrocytes) begin to form during the embryonic phase in the liver, then shift to the bone marrow as the main production center after hatching (Guedes et al., 2014).

Feathers are the outer part of broiler chickens that continue to grow, but as the livestock ages, the growth rate of the feathers tends to reach a fixed or constant point (Utari et al., 2025). The formation and growth of feathers in broiler chickens are greatly influenced by the adequacy of energy, protein, and minerals obtained from feed and drinking water (Chen et al., 2020). Based on the average results in Table 2, the administration of papaya peel extract through drinking water showed no significant difference in the percentage of broiler chicken feathers (P>0.05). The absence of significant differences between treatments can be attributed to the homogeneity of research conditions such as the age of the livestock, environment, management practices, and relatively similar feed, resulting in uniform feather growth across all treatments. In addition to nutritional factors, the growth and molting of broiler feathers are also influenced by environmental factors, especially temperature, which plays a role in regulating metabolism and feather molting (Achmad et al., 2018). Radhitya (2014) reported that the difference in the weight of broiler feathers in diets with different protein levels did not show significant results when the protein requirements were adequately met. This is in line with the research findings of Widelitz (2019), which reported that all treatments received the same feed additive, so there was no difference in feather growth response between treatments. The main functions of feathers include maintaining body temperature, protecting the body from injury, and forming a protective layer through the growth of feathers from the epidermal follicles outward to the surface of the body.

V. CONCLUSION

Based on the research results, it can be concluded that the administration of 4%, 6%, and 8% papaya fruit peel extract in drinking water does not affect the percentage of external offal (head, feet, neck, blood, and feathers) in broiler chickens aged 35 days. Future studies should investigate higher concentrations of papaya peel extract or explore its effects on internal organ development, growth performance, or meat quality.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the support of the Dean, Head of Research and Community Service, supervising lecturers and staff of the Animal Feed Nutrition Chemistry and Poultry Science Laboratories, Faculty of Animal Husbandry, Udayana University, Bali, Indonesia, for funding and laboratory facilities.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this research. The materials used in this study, including papaya fruit peel extract, were prepared independently by the researchers and were not influenced by any commercial or financial interests.

REFERENCES

[1] Achmad, G. A., Darwati, S., & Sumantri, C. (2018). [Title missing]. *Jurnal Ilmu dan Teknologi Peternakan Tropis, 6*(1), 38–47.

[2] Armando Paat, C. S. (2020). Pemanfaatan tepung kulit buah pepaya (*Carica papaya* L.) dalam ransum. *[Journal Name], 40*(2), 418–427.

[3] Badan Pusat Statistik. (2022). *Produksi tanaman buah-buahan di Indonesia tahun 2021–2022*.

[4] Badan Pusat Statistik. (2023). *Rata-rata harian konsumsi protein per kapita dan konsumsi kalori per kapita tahun 1990–2024*.

[5] Badan Pusat Statistik. (2023). *Rata-rata konsumsi per kapita seminggu beberapa macam bahan makanan penting, 2007–2023*.

[6] Badan Pusat Statistik. (2024). *Jumlah penduduk pertengahan tahun (Ribu Jiwa), 2022–2024*.

[7] Badan Pusat Statistik. (2024). *Produksi daging ayam ras pedaging menurut provinsi (Ton), 2024*.

[8] Badan Pusat Statistik. (2021). *Jumlah ayam pedaging di Indonesia*. https://dataindonesia.id/sektor-riil/detail/jumlah-ayam-pedaging-di-indonesia-capai-311-miliar-pada-2021

[9] Chen, M., Xie, W., Jiang, S., Wang, X., Yan, H., & Gao, C. (2020). Molecular signaling and nutritional regulation in the context of poultry feather growth and regeneration. *Frontiers in Physiology, 11*, Article 1609, 1–14.

[10] David, L. S., Anwar, M. N., Abdollahi, M. R., Bedford, M. R., & Ravindran, V. (2023). Calcium nutrition of broilers: Current perspectives and challenges. *Animals*.

[11] Dwi Cahyono, P., & Nurul, H. (2022). Efektifitas probiotik sebagai pengganti antiprobotik growth promotor (AGP) pada unggas. *Jurnal Penelitian, Fakultas Peternakan, Universitas Islam Malang*.

[12] Guedes, P. T., Oliveira, B. C. E. P. D., Manso, P. P. A., Caputo, L. F. G., Cotta-Pereira, G., & Pelajo-Machado, M. (2014). Histological analyses demonstrate the temporary contribution of yolk sac, liver, and bone marrow to hematopoiesis during chicken development. *PLoS ONE, 9*(3), 1–15.

[13] Irham, M. (2012). *Pengaruh penggunaan enceng gondok (Eichornia crassipes) fermentasi dalam ransum terhadap persentase karkas, nonkarkas dan lemak abdominal itik lokal jantan umur delapan minggu* [Skripsi, Universitas Sebelas Maret Surakarta].

[14] Jihad, A. (2025). *Pengaruh ekstrak daun kelor terfermentasi melalui air minum terhadap persentase offal eksternal broiler* [Skripsi, Universitas Udayana].

[15] Prabayanti, I. A. S. T., Dewi, G. A. M. K., & Wijana, I. W. (2022). Pengaruh ekstrak kulit bawang putih (*Allium sativum*) pada air minum terhadap persentase eksternal offal broiler umur 4 minggu. *Peternakan Tropika, 2*(1).

[16] Pratiwi, H., & Firmawati, A. (2019). *Embriologi hewan*. Universitas Brawijaya Press.

[17] Radhitya, A. (2014). Pengaruh pemberian tingkat protein ransum pada fase grower terhadap pertumbuhan puyuh (*Coturnix coturnix japonica*). *Students e Journal, Universitas Padjadjaran*.

[18] Raillah, H. S., Dewi, G. A. M. K., & Wirapartha, M. (2021). Pemberian tepung kulit kerang dalam ransum terhadap persentase offal eksternal ayam Isa Brown umur 100 minggu. *Jurnal Peternakan Tropika, 9*.

[19] Soeparno. (2009). *Ilmu teknologi daging*. Gadjah Mada University Press.

[20] Suryanti, N. L. A., Dewi, G. A. M. K., & Dewantari, M. (2019). The effect of use of red dragon skin (*Hylocereus polyrhizus*) fermented in the break of external offal broiler. *Jurnal Peternakan Tropika, 7*.

[21] Tribowo, A., Wati, N. E., & Suhadi, M. (2021). Pengaruh penambahan air perasan daun buah pepaya (*Carica papaya* L.) dalam air minum terhadap performa ayam broiler. *Jurnal Wahana Peternakan, 5*(1), 32–40.

[22] Utari, G. A. D. D., Ariana, I. N. T., & Mahardika, I. G. (2025). Kualitas fisik daging itik Bali jantan yang diberi pakan konsentrat protein limbah peternakan ayam (KPLA). *Peternakan Tropika, 13*(2), 249–261.

[23] Wahju, J. (2004). *Ilmu nutrisi ternak unggas* (5th ed.). Gadjah Mada University Press.

[24] Wahju, J. (2004). *Ilmu nutrisi ternak unggas* (5th ed.). Gadjah Mada University Press.

[25] Widelitz, R. B. (2019). Morpho regulation in diverse chicken feather formation. *Developmental Dynamics, 248*(8), 666–676. https://onlinelibrary.wiley.com/doi/10.1111/dgd.12584

[26] Wiriani. (2023). *Pengaruh pemberian ekstrak biji pepaya (Carica papaya L.) melalui air minum terhadap persentase eksternal offal broiler umur 4 minggu* [Skripsi, Universitas Udayana].

[27] Wulandari, R. (2014). *Struktur dan perkembangan rangka embrio ayam (Gallus gallus domesticus)* [Skripsi, Universitas Gadjah Mada]. https://etd.repository.ugm.ac.id/home/detail_pencarian/73657?utm_source.