The Effect of Giving Tuna Waste Flour on the Growth of Native Chickens Aged 3-10 Weeks

Astiti Ni Made Ayu Gemuh Rasa[1] , *Supastiawan I Gede Ari*[1], *Rukmini Ni Ketut Sri*[1], *Mardewi Ni Ketut*[1], *Sutapa I Gede*[1]

[1]Animal Husbandry Department, Faculty of Agriculture, Science and Technology, Warmadewa University

Abstract. Livestock in Indonesia is currently experiencing rapid development, with native chicken being a significant source of protein. The protein needs of native chickens vary based on their growth stage. For infants aged 1-1.5 months, the protein content is 18-22%. For infants aged 1.5-3 months, the protein content is 16-18%. For infants 3 months old and above, the protein content is 15-16%. Native chickens require less protein than broiler chickens and laying hens (1). Native chickens require high-quality feed to provide optimal nutrition and achieve the best results. The application of fermentation technology in the feedlot industry also highlights that feed has a significant contribution to production costs, accounting for 60-80% (2). Therefore, efficiency in feed use is the primary key to the sustainability and profitability of the livestock business. Feed ingredients that can be used as alternative feed ingredients include fishery slaughterhouse waste, such as tuna waste. The administration of fish waste meal at a level of 9% had a significant effect on feed consumption and chicken body weight gain. The use of fish waste meal did not hurt livestock (3). The purpose of this study was to determine the effect of providing tuna fish waste flour on the growth variables of native chickens aged 3-10 weeks. The experimental design employed was a Completely Randomized Design (CRD), consisting of five treatments and three replications. The treatments were K0 (ratio without tuna fish waste flour), K1 (ratio containing 3% tuna fish waste flour), K2 (ratio containing 6% tuna fish waste flour), K3 (ratio containing 9% tuna fish waste flour), and K4 (ratio containing 12% tuna fish waste flour).

1 Introduction

Indonesia's very rapid population growth requires the availability of sufficient animal protein in terms of both quantity and quality. Based on the established animal protein consumption standards of at least 6 g/capita/day or equivalent to 10.1 kg of meat, 3.5 kg of eggs, and 6.4 kg of milk/capita/year. According to the Central Statistics Agency [1], the production of native chicken meat in each province has increased on average. Poultry farming significantly contributes to national food security by providing animal protein and creating employment opportunities in both rural and urban areas. Nationally, the poultry industry is the primary driver of growth in the livestock sub-sector.

Native chicken is a cross between male kampung chicken and female laying hen (broiler chicken), has faster growth compared to local kampung chicken, where the quality of the meat is much better, denser, tastes more savory, low fat or cholesterol content, high protein content, low mortality rate, and easy to adapt to the environment. Native chicken must pay attention to the nutritional needs of chickens, specifically crude protein (CP) of 14-17%, metabolic energy (EM) of 2600-2700 Kcal/kg, calcium (Ca) of 0.9%, phosphorus (P) of 0.45%, and supplemented with other minerals and vitamins that meet these needs [2]. The protein needs of native chickens are based on their growth stage. At 1-1.5 months, the protein content is 18-22%. At 1.5-3 months, the protein content is 16-18%. For ages 3 months and above, the protein content is 15-16%. Native chicken requires lower protein compared to broiler chickens or laying hens. Supporting the demand for native chicken meat, it is necessary to develop native chicken farming to meet the increasing needs year after year. Native chicken maintenance requires high-quality feed to fulfill its nutritional needs. A well-balanced feed with optimal nutrient content will yield the best results. However, the reality is that the price of commercial feed on the market is costly.

Rezeki et al. [3] in their review of the application of fermentation technology in the feedlot industry also emphasized that feed has a dominant contribution to production costs, accounting for 60-80%. Therefore, efficiency in feed utilization is the primary key to the sustainability and profitability of livestock businesses. To overcome this problem, it is necessary to find alternative feed ingredients that are potential, easily obtainable, and continuously available, with the most important consideration being that the feed has good nutritional content for livestock productivity [4]. Efforts that can be made include replacing some or all of the fish meal in the ration mixture with alternative ingredients. These ingredients must have a nutritional content that is not significantly different from that of fish meal. The crude protein content of fish meal ranges from around 60% to 65%, with a fat content of between 6.5% to 8.09%, and an ash content of around 6.7%. Additionally, the remaining carbohydrates comprise approximately 22.4%, and the gross energy can exceed 3,730 cal/g [5].

One type of fish that is widely found everywhere is the skipjack tuna, a type of sea fish that belongs to the Scombridae family, which is the same as tuna. This fish is widely distributed in tropical waters. They typically live in large groups in open waters near the ocean's surface. Not all parts of the skipjack tuna can be utilized. Of course, there is waste produced. This waste can be used through several processes, including converting it into skipjack tuna waste flour, which can be used as poultry feed, particularly for native chicken, serving as a substitute for fish meal. Skipjack tuna waste consists of 29.70% protein, 18.83% fat, 1.94% carbohydrate, 8.97% water content, 1.07% crude fiber, and 1.83% C content, N 5.83%. Skipjack tuna bone waste that has been made into skipjack tuna flour contains 47.34% protein, 2.62% calcium, and 12.72% fat, with a metabolic energy of 3335.18 kcal/kg [6]. Based on laboratory analysis data at the Faculty of Animal Husbandry, Udayana University, the nutritional content of tuna waste flour is 7.9%, dry matter 92.09%, ash 21.7%, organic matter 78.2%, crude protein 50.9%, crude fiber 1.9%, crude fat 15.6%, TDN 90.07%, BETN 1.9%, gross energy 4,775 kcal/g, EM 3,552 kcal/g.

Hafiludin [7] stated that the high meat content in tuna fish is related to its body shape, specifically a cigar-shaped body with the most significant part located in the stomach, which contains a substantial amount of meat. The composition of white meat (37.18%) is more than that of red meat (12.82%). The nutritional content of tuna fish is protein 21.60-26.30%, fat 1.30-2.10%, water 71-76.76%, minerals 1.20-1.50% and ash 1.45-3.40%.

The use of tuna waste flour as animal feed is a strategic solution that addresses two key issues simultaneously: reducing fish waste and lowering feed costs. In Karangasem Regency, the use of tuna waste remains minimal, while the amount of waste produced from fish slaughterhouse activities is quite substantial. This waste, if processed into flour, can provide an affordable alternative feed for the community, thereby reducing dependence on commercial feed, which tends to be expensive. Additionally, by processing fish waste into flour, the community also contributes to reducing environmental pollution caused by the accumulation of fish scraps. Tuna waste flour contains good nutrients, such as protein and minerals, which can support the growth of livestock, especially poultry and pigs, making it an economical and environmentally friendly choice for farmers. Based on the background that has been explained, the researcher took the title "The Effect of Providing Skipjack Tuna Waste Flour on the Growth of Native Chickens Aged 3 - 10 Weeks".

2 Research methods

2.1 Time and Place of Research

This research was conducted over 10 weeks, from November 12 to December 30, in a cage located on Jalan Sedap Malam, Banjar Kebon Kori Klod, Gang Melati, No. 15, Kesiman Village, East Denpasar, Bali Province.

2.2 Research Design

The design used in this research was a completely randomized design (CRD) with five treatments and three replications. Each replication (experimental unit) consisted of five native chickens, resulting in a total of 75 native chickens used.
The treatments used are:
K0 (Control) = Ration without the addition of tuna fish meal.
K1 = Ration containing 3% tuna fish waste flour.
K2 = Ration containing 6% tuna fish waste flour.
K3 = Ration containing 9% tuna fish waste flour.
K4 = Ration containing 12% tuna fish waste flour

2.3 Research Procedures

2.3.1 How to Make Tuna Fish Waste Flour

Steps for making tuna fish waste flour include washing the tuna fish waste thoroughly to remove dirt and blood. Cut the fish waste into small pieces to speed up and even out the drying process. Dry the fish waste by exposing it to direct sunlight, using an oven, or a dryer. If drying, ensure the drying place is clean and free from pollution. The drying process can take up to 4 days until the fish waste is dry. If using an oven, set the temperature to around 60-70°C. Dry the fish waste for several hours until completely dry. After the fish waste is dry, grind it using a blender or grinder until it becomes a fine powder. If necessary, add a small amount of salt during the grinding process to enhance the flavor and texture of the flour. Sift the ground flour using a sieve or strainer to get a finer flour texture. Waste that is not fine can be ground again until it reaches the desired level of fineness. Weigh the sifted flour and store it in an airtight container. Make sure the storage container is clean and dry to prevent contamination and bacterial growth. Store the flour in a cool and dry place to maintain quality

2.3.2 Randomization of Cage and Chicken

Of the 300 native chickens prepared, they were first weighed to determine the average body weight, which ranged from 214 to 233 g per head. Then, 75 native chickens were selected that were close to the average body weight. After that, the 75 chosen chickens were placed randomly in cages containing 15 squares. Each square was filled with five chickens of homogeneous weight. Before being placed in the treatment cage, each native chicken was given cable ties on its legs in 5 different colors. It aims to make it easier to find out the weight gain of each native chicken.

2.3.3 . Mixing and Rationing of Tuna Fish Waste Flour

Ration mixing is done every week. Before mixing the ration, weigh the ingredients, such as corn, followed by weighing the concentrate, tuna waste flour, and other ingredients based on the quantity computed for a week, multiplied by the number of days in a week and the number of native chickens in each treatment. A bucket or clean plastic container is used for mixing. Larger amounts of the ratio material are uniformly distributed in the bucket or plastic container, followed by smaller amounts. To create a genuinely homogeneous feed mixture, the ration material is then separated into multiple sections, each of which is blended alternately after being evenly stirred and repeated numerous times. The mixed ration is weighed to meet the chicken's daily needs for one week, and the weighed ration is then placed in plastic and given a code or label according to its treatment.

2.3.4 Disease Prevention

To eliminate pests, viruses, bacteria, and fungi, the cage and its equipment are sprayed with disinfectant before the chickens are placed inside. Every day, the drinking water is cleaned, and the native chicken is given Vita Chick through the drinking water when it is first placed in the cage to help avoid stress, maintain endurance, and increase appetite during Newcastle Disease (ND) vaccination. The purpose of the ND vaccination is to prevent the occurrence of disease in poultry. This vaccine is given through eye drops.

2.3.5 Provision of Rations and Drinking Water

Ad libitum rations and drinking water were supplied twice daily, in the morning and the evening. A well that was drilled close to the research cage provided the drinking water. To prevent illness, the drinking water container was cleaned once a week and then filled with fresh water. The remaining rations were weighed once a week.

2.4 Observed Variables

The variables observed in this study are as follows.

1. Initial Body Weight (g/head) refers to the weight recorded when the native chicken is first placed in the cage at the age of 3 weeks.
2. Ration Consumption (g/head) is calculated by weighing the amount of ration given minus the remaining ration during the study.
3. Weight Gain (g/head) is calculated by subtracting the initial weight of the native chicken from the final weight at 10 weeks of age.
4. Final Body Weight (g/head), which was measured at the end of the study, when the chickens were 10 weeks old.

5. *Feed Conversion Ratio* (FCR) is calculated by dividing the amount of ration consumed by the increase in body weight.

2.5 Statistical Analysis

The research data were processed statistically using analysis of variance. If there were significantly different results (P < 0.05) between treatments, then Duncan's smallest real distance test (Steel and Torrie, 1991) was continued.

3 Results and Discussion

The ration used in this study was a self-mixed ration consisting of: tuna fish waste flour, 511 concentrate, rice bran, thousand-cracked corn, coconut oil, and minerals. The drinking water provided was from a drilled well. The composition of the ration ingredients and the nutritional content of the ration for 3-to 10-week-old native chickens are presented in Table 1. The nutritional content of the treatment ration is shown in Table 2.

Table 1. Research Rationale Composition

Type of Material	Treatment				
	K0	K1	K2	K3	K4
Concentrate 511	43	43	43	43	43
Thousand Cracked Corn	28	28	28	28	28
Soybean Meal Flour	14	11	7.5	4.3	1.2
Rice bran	12	12	12.5	13.7	14.6
Tuna Fish Waste Flour	0	3	6	9	12
Coconut oil	1.5	1.5	1.5	1	0.5
Mineral	1.5	1.5	1.5	1	0.7
Total	100	100	100	100	100

Table 2. Nutritional Content of Rations according to Treatment

Nutrients	Treatment				
	K0	K1	K2	K3	K4
Dry Matter (%)	87.03	86.9	86.86	86.60	88.73
Water content (%)	12.97	13.1	13.13	13.39	11.27
Ash Content (%)	7.52	7.31	8.08	8.16	9.19
Organic Matter (%)	92.52	92.68	91.92	91.84	90.81
Crude Protein (%)	24.2	25.39	24.36	25.43	30.84
Crude Fiber (%)	4.66	4.42	6.8	7.54	7.99
Crude Fat (%)	4.69	5.58	7.27	5.83	6.86
TDN (%)	72.17	73.77	70.55	67.22	67.44
BETN (%)	45.78	44.19	40.33	39.64	33.85
GE (Kcal/kg)	3270	3292	3958	3922	4135

The results showed that the use of tuna fish waste flour in treatments K0 to K4 in the ration did not have a significant effect (P > 0.05) on initial body weight, final body weight, weight gain, or ration consumption. However, the results showed that the Feed Conversion Ratio (FCR) value was significantly different (P<0.05) between treatments. The FCR value in treatments K1 to K4 was lower than in K0, indicating that the chickens in these treatments were more efficient in converting feed into body weight. Treatment K3 had the lowest FCR value, indicating that the ration with 9% tuna fish waste flour content provided better feed utilization efficiency than other treatments. The initial body weight, which was not significantly different, indicated that all groups had similar initial conditions before receiving treatment. Final body weight and weight gain also yielded nearly identical results between treatments, with the highest value observed in treatment K3 and the lowest value in treatment K0. The Effect of Giving Tuna Fish Waste Flour on the Growth of Native Chickens Aged 3-10 Weeks can be seen in Table 3.

Table 3. The Effect of Giving Skipjack Tuna Waste Flour on the Growth of Native Chicken Aged 3-10 Weeks

Research Variables	Treatment					SEM (3)
	K0	K1	K2	K3	K4(1)	
Initial Body Weight (g)	221.92^{a}	227.24^{a}	225.51^{a}	225.75^{a}	223.36$^{a(2)}$	1.67
Final Body Weight (g)	986.27^{a}	1166.68^{a}	1139.11^{a}	1185.59^{a}	1158.37^{a}	25.71
Weight Gain (g)	764.35^{a}	939.44^{a}	913.59^{a}	959.84^{a}	935.01^{a}	26.29
Ration consumption (g)	2948.27^{a}	2950.97^{a}	2898.01^{a}	2870.08^{a}	2866.10^{a}	22.48
FCR	3.87^{a}	3.15^{b}	3.20^{b}	3.00^{b}	3.07^{b}	0.09

Information :

1. K0 = Ration without tuna waste flour content.
   K1 = Ration containing 3% tuna fish waste flour.
   K2 = Ration containing 6% tuna fish waste flour.
   K3 = Rations containing 9% tuna fish waste flour.
   K4 = Ration containing 12% tuna fish waste flour
2. Values with the same letter in the same row indicate no significant difference (P>0.05).
3. SEM (Standard Error of Treatment Means).

In this study, the ratios given to all treatments (K0 to K4) had a nearly uniform composition. However, there were differences, especially in the addition of tuna fish waste flour, the proportion of which increased in treatments K0 to K4. Previous research by Suprayogi [8] indicated that the addition of fish meal to feed can impact the quality of chicken growth; however, significant changes will only occur if there is a clear difference in the amount or quality of protein and energy provided in each treatment. The decrease in soybean meal content in treatments K0 to K4 and the increase in tuna fish waste flour can affect the digestibility and palatability of the feed; however, a significant increase in growth does not always follow these changes. This finding aligns with the research by Saputra et al. [9], who discovered that although tuna fish meal is rich in protein, its impact on chicken performance depends on the level of chicken adaptation to the feed content. Therefore, if there is no striking difference in feed composition, chicken growth tends to be uniform.

Factors that affect the final body weight of native chickens include genetics, gender, ration protein, environmental temperature, cage management, and sanitation. That nutritional factors, including protein, vitamins, minerals, and calcium, affect chicken growth. Chickens that consume the same amount of protein have the same growth rate. Changes in the final body weight in treatments K0 to K4 can be attributed to variations in ration consumption and the efficiency of nutrient utilization by native chickens. Unstable feed consumption can lead to fluctuating growth, particularly when there are differences in palatability or feed acceptance among chickens. In addition, explained that varying feed quality can lead to inefficiency in energy and protein utilization, resulting in nonlinear growth patterns that exhibit fluctuations in chicken development. Environmental factors, such as temperature and cage density, can also trigger these fluctuations, as thermal stress and competition for feed can disrupt chicken consumption and metabolic patterns [10]. Thus, the increase and decrease in final body weight in this study were most likely influenced by a combination of factors, including ration consumption, feed quality, metabolism, and environmental conditions during maintenance.

That palatability is one aspect that can influence ration eating. The scent, taste, texture, and color of the feed all contribute to its palatability. The performance characteristics of ingredients, resulting from their physical and chemical states, are known as palatability. Additionally, it has been found that ration quality and amount, age, ration palatability, and processing techniques all affect variations in feed consumption. Factors that affect ration consumption are chicken breed, environmental temperature, production stage, and ration energy. Several internal and external factors also influence rational consumption. Internal factors include age, body size, physiological status, and health conditions of livestock. At the same time, external factors include ration nutrient content, environmental temperature, and maintenance management. In this study, the relatively similar nutrient content between treatments (especially protein and energy) caused consumption levels that were not significantly different. Native chickens consume rations mainly to meet their energy needs. When energy needs have been met, native chickens will stop eating. This explains why the consumption of ration between treatments was not significantly different.

Based on research data, feed consumption in all treatments (K0-K4) showed results that were not significantly different (P>0.05). The feed consumption value ranged from 2866.10-2950.97 g/head, with the highest value in treatment K1 (ration with 3% tuna waste flour content) and the lowest in K4 (ration with 12% tuna waste flour content). These results, which were not significantly different, indicate that the addition of tuna waste flour up to 12% did not affect the palatability of the ration. This is in line with the research of Zahroh et al. [11], which stated that the palatability of the ration is influenced by the shape, smell, taste, texture, and temperature of the feed ingredients given. The tuna waste flour used in this study likely has physical characteristics that are not significantly different from those of other feed ingredients, so it does not affect the level of consumption.

The Feed Conversion Ratio (FCR) is the ratio between the amount of feed consumed and the increase in body weight over a certain time unit. The smaller the feed conversion value, the more efficient the use of rations. In the K3 treatment, the provision of tuna fish waste flour in the ration yielded the best results for ration conversion, at 3.00 g per head. lower than the K1, K2, and K4 treatments. This is according to the opinion of Allama et al. [12], who said that a low Feed Conversion Ratio FCR value indicates that the efficiency of good ration use is good, because the more efficiently the chicken consumes the ration to produce meat. That ration conversion is influenced by genetics, body weight, environmental temperature, health, and the adequacy of ration nutrition; therefore, the smaller the ration conversion, the more that the provision of rations is, but if the ration conversion is large, then there has been waste [13]. The ration conversion value is influenced by the amount of ration consumption and body weight gain [14]. That feed conversion is influenced by the level of feed consumption, digestibility, and use of nutrients, which must be balanced.

The process by which a chicken grows larger throughout its growth phase is known as weight gain. When the final weight (g/head) is less than the initial weight (g/head), weight gain is achieved. According to the results of this study, the highest weight gain was observed in the K3 treatment, at 959.84 g/head, and the lowest result was in the K0 treatment, at 764.35 g/head. The appeal of feed or feed ingredients that can pique the interest of native hens is known as feed palatability. A key element in deciding how much of a ration is ingested is the amount of energy and protein components it contains. Based on the research results, the use of tuna fish waste flour at a 9% level (R3) showed the most optimal results compared to other treatments. However, the difference was not statistically significant (P > 0.05). This can be attributed to better nutrient utilization efficiency at this level, where native chickens can convert rations into weight gain more efficiently. Lower ration consumption, yet still producing high weight gain, indicates that the nutritional quality of the ration at this level is still within the limits that can be digested and utilized optimally by chickens. In addition, the lowest FCR value in this treatment indicates that feed efficiency in supporting chicken growth is better than in other treatments, which can be related to the balance between energy and protein needs in the ration. The use of animal protein sources in rations can increase feed conversion efficiency, thus having a positive impact on livestock growth rates.

The addition of tuna fish waste flour to native chicken feed did not show significant differences because its protein content is quite comparable to that of the control feed, thus allowing protein and amino acid metabolism to proceed effectively without significant increases [15]. Furthermore, the biological factors of the chickens and the composition of the feed normalize the growth results, making any differences statistically insignificant, even though functionally, tuna fish waste flour can still be used as an efficient source of protein. At the optimal level of tuna fish waste flour usage, protein metabolism and digestion processes occur efficiently without disruption. The metabolism of amino acids, digestive enzymes, and energy balance is maintained, resulting in no significant increase in growth efficiency compared to the control.

4 Conclusion

Based on the study's results and discussion, it can be concluded that the provision of treatment in this study showed a significant difference in the FCR variable, as indicated by different notations ($P < 0.05$). Treatments K1, K3, and K4 had better FCR values than K0, with the lowest FCR value in treatment K3 (3.00). However, for other variables such as initial body weight, final body weight, weight gain, and ration consumption, there were no significant differences between treatments ($P>0.05$). Treatment K3 showed the best results in this study, with the highest final body weight of 1185.59 g and a weight gain of 959.84 g. In addition, feed efficiency in this treatment was also better than other treatments, indicated by an FCR value of 3.00, which is the lowest value, indicating a more efficient feed conversion for livestock growth.

References

1. Badan Pusat Statistik. Produksi Daging Ayam Buras menurut Provinsi (Ton), 2021-2023 https://www.bps.go.id/id/statistics-table/2/NDg2IzI=/produksi-daging-ayam-buras-menurut-provinsi.html . (Diakses: 18 Juni 2024)
2. Istna M. Perbaikan Pakan untuk Meningkatkan Produktivitas Ayam Kampung Super di Kecamatan Plantungan Kabupaten Kendal. Jurnal DIANMAS. 7(1), 35 – 40. (2018). http://jurnaldianmas.org/index.php/Dianmas/article/download/86/71
3. Rezeki, T. & Nurbaiti, Yuyun & Ariyadi, Januar & Maulana, Ishaq & Rahayu, Tri. Review: Peningkatan Ketahanan Pakan Industri Feedlot dengan Teknologi Pengolahan Pakan. Journal of Livestock Science and Production. 7. 582-589 (2023). 10.31002/jalspro.v7i2.8101.
4. Nurmi, A., M. A. Santi, N. Harahap, dan M. F. Harahap. Persentase karkas dan mortalitas broiler dan Ayam Kampung yang di beri Limbah Ampas Pati Aren tidak difermentasi dan difermentasi dalam ransum. Jurnal Ilmiah Peternakan Terpadu. 6 (3), 134-139. (2019). DOI:10.23960/jipt.v6i3.p134-139

5. Farida, I., P.N. Samanta, dan H. Maulana. Evaluasi Mutu Nutrisi dan Organoleptik Tepung Ikan yang Berasal dari Bagian Tubuh dan Kepala Ikan Lemuru. Jurnal Peternakan. 21(1), 38–47. (2024). DOI:http://dx.doi.org/10.24014/jupet.v21i1:22683
6. Astuti, P.S., Abdul dan B. Nugraha. Jenis Dan Distribusi Ukuran Ikan Hasil Tangkapan Sampingan (By catch) Rawai Tuna Yang Didaratkan Di Pelabuhan Benoa Bali. Journal Of Maquares. 5 (4), 453 – 460. (2016). DOI: https://doi.org/10.14710/marj.v5i4.14656
7. Hafiludin. Karakteristik Proksimat dan Kandungan Senyawa Kimia Daging Putih dan Daging Merah Ikan Tongkol (Euthynnus affinis), Jurnal KELAUTAN, 4(1), 1907-9931. (2011).https://journal.trunojoyo.ac.id/jurnalkelautan/article/view/885
8. Suprayogi, D. Pengaruh Pemberian Tepung Ikan pada Pakan Ayam Broiler Terhadap Performa Produksi dan Kualitas Daging. Jurnal Ternak Indonesia. 34(3). 120-131. (2020).https://ojs.uho.ac.id/index.php/jipho/article/viewFile/25069/pdf
9. Saputra, M., S., Yulianto, dan S. Firman. Pengaruh Penggunaan Tepung Limbah Ikan Tongkol terhadap Pertumbuhan Ayam Kampung Super. Jurnal Ilmu Peternakan. 22(1), 42-51. (2019)
10. Setiadi, A. Pengaruh jenis pakan terhadap pola konsumsi dan metabolisme pada ayam pedaging. Jurnal Nutrisi Ternak Indonesia. 8(2), 115-123. (2020)
11. Zahroh, F., H. S., Kusuma, dan N. Istnaini. Pengaruh Penggunaan Tepung Limbah Ikan dalam Ransum terhadap Konsumsi Pakan dan Pertambahan Bobot Badan Ayam Pedaging. Jurnal Ternak Tropika. 19(2), 111-119. (2018)
12. Allama, H., O. Sofyan, E. Widodo dan H. S. Prayogi. Pengaruh Penggunaan Tepung Ulat Kandang (Alphitobius diaperinus) dalam Pakan Terhadap Penampilan Produksi Ayam Pedaging. J. Ilmu - Ilmu Peternakan. 22 (3),1-8. (2012). https://jiip.ub.ac.id/index.php/jiip/article/view/116
13. Rodiallah M., Yendraliza Dan S. Siregar. Performa Ayam Broiler Fase Starter Yang Diberi Tepung Keong Mas (Pomacea Spp) Dalam Ransum Standar Komersial. Jurnal Peternakan. 15(1), 15-21 (2018). https://media.neliti.com/media/publications/481131-performans-ayam-broiler-loughmann-mb-202-fa889b3d.pdf
14. Zuidhof, M.J., BL. Scheider, V.L. Carney, D.R. Korver, and F.E. Robinson. Growth, efficiency, and yield of commercial broilers from 1957, 1978, and 2005. Poult. Sci. 93(12), 2970-2982. (2014). https://doi.org/10.3382/ps.2014-04291
15. Baye, A., F. N. Sompie, B. Bagau, M.Regar. 2015. Penggunaan Tepung Limbah Pengalengan Ikan Dalam Ransum Terhadap Performa Broiler. Jurnal Zootek ("Zootek" Journal). 35(1): 96-105. (2015). https://ejournal.unsrat.ac.id/index.php/zootek/article/download/7106/6760