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The effect of indigofera leaf meal on production performance and eggs quality of *Coturnix coturnix japonica*

Pengaruh tepung daun indigofera terhadap performa produksi dan kualitas telur puyuh (Coturnix coturnix japonica)

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ABSTRACT

The research aimed to determine the effect of using indigofera leaf meal on quail eggs performance and physical quality. The research was conducted from March to May 2023 at the Poultry Laboratory of Yogyakarta Magelang Agricultural Development Polytechnic (POLBANGTAN). The research used a completely randomized design (CRD) with 4 treatments and 5 replications, using 200 blaster quails. Treatments included P0 (without Indigofera leaf meal), P1 (7.5% Indigofera leaf meal), P2 (15% Indigofera leaf meal), and P3 (22.5% Indigofera leaf meal). Parameters observed included feed consumption, egg production, egg weight, egg index, shell thickness, albumen index, egg yolk index, haugh units, and egg yolk color score. The research data was analyzed using ANOVA and Kruskal Wallis analysis. A further Duncan Multiple Range Test (DMRT) was carried out if the treatment had a significant difference. Based on the results, the use of Indigofera leaf meal at different levels had no significant effect (P>0.05) on egg production, feed consumption, egg weight, albumen index, egg yolk index, and haugh units. However, it significantly affected (P<0.05) shell thickness, egg index, and yolk color score. The research concluded that feeding Indigofera leaf meal up to 22.5% can be used because it does not affect production performance and improves egg quality.

Kata kunci:
Serat kasar
Kualitas telur
Tepung daun indigofera
Performa
Puyuh

ABSTRAK

Penelitian ini bertujuan untuk mengetahui pengaruh penggunaan tepung daun Indigofera terhadap performa dan kualitas fisik telur puyuh. Penelitian dilakukan pada bulan Maret hingga Mei 2023 di Laboratorium Ternak Unggas, Politeknik Pembangunan Pertanian (POLBANGTAN) Yogyakarta Magelang. Penelitian menggunakan Rancangan Acak Lengkap (RAL) dengan 4 perlakuan dan 5 ulangan, ternak yang digunakan adalah 200 ekor puyuh blaster. Perlakuan meliputi P0 (tanpa tepung daun Indigofera), P1 (tepung daun Indigofera 7,5%), P2 (tepung daun Indigofera 15%), dan P3 (tepung daun Indigofera 22,5%). Parameter yang diamati meliputi konsumsi pakan, produksi telur, bobot telur, indeks telur, tebal kerabang, indeks albumen, indeks yolk, haugh unit, dan skor warna kuning telur. Data penelitian dianalisa menggunakan ANOVA dan Kruskal Wallis. Apabila pelakuan berpengaruh nyata maka dilakukan uji lanjut Duncan Multiple Range Test. Berdasarkan hasil penelitian penggunaan tepung Indigofera dengan level yang berbeda tidak berpengaruh nyata (P>0,05) terhadap produksi telur, konsumsi pakan, bobot telur, indeks albumen, indeks yolk, haugh unit, dan meberikan berpengaruh nyata (P<0,05) terhadap tebal kerabang, indeks telur, dan skor warna. Pemberian pakan dengan tepung Indigofera hingga 22,5% dapat digunakan karena tidak mempengaruhi performa produksi dan meningkatkan kualitas telur.

INTRODUCTION

Feed costs in animal industries reach 60% to 70% of total costs, therefore, feed becomes crucial in animal businesses, especially raising quail (Al Uswah et al., 2019). Feeding is important for the optimal growth and egg production of quails. It is customized based on their life phase. Feed consumption reflects palatability and feed efficiency. Feeding laying quail has a big influence on their production performance and egg quality.

Indigofera is a legume plant, that has high-quality feed ingredients that are cheap and easy to obtain by farmers. Indigofera nutrient content, according to Tambunan (2015) as follows: dry matter 89.47%, crude protein 20.30% to 31.10%, crude fiber 15.13%, energy 3,788 kcal/kg, and tannin 0.6 ppm to 1.4 ppm. Indigofera plants contain high amounts of crude fiber. One of the poultry that can consume forage is quail since it has microbes that can digest crude fiber in their caecum (Saraswati, 2018). Indigofera is a potential feed ingredient to make alternative high-quality rations for quail. The addition of Indigofera to quail rations is first dried and ground. Even though the protein content in the Indigofera leaf meal is high, the crude fiber in this feedstuff is also high. This research aims to determine the effect of feeding high-level crude fiber feed by adding Indigofera leaf meal on the production performance and physical quality of quail eggs in the layer phase.

MATERIAL AND METHOD

Research Location

The research was conducted at the Poultry Laboratory of POLBANGTAN Yogyakarta Magelang, from March 28th to May 26th 2023. There were 200 blasters quail 28 days aged. Testing of the nutrient content of feed ingredients is carried out at the Animal Drug and Animal Feed Testing Laboratory of Dinas Peternakan dan Kesehatan Hewan, Central Java Province.

Research Design

This study used a completely randomized design (CRD) using 4 treatments and 5 replications. The treatment consists of 4 treatments, there are:

P0 : Control feed without Indigofera leaf meal
P1 : Feed with 7.5% Indigofera leaf meal
P2 : Feed with 15% Indigofera leaf meal
P3 : Feed with 22.5% Indigofera leaf meal

Cage Preparation

The cage was prepared through sanitation using limestone and disinfectant. The steps involved cleaning dirt with soap, drying it in the sun, spreading the limestone on the floor, and disinfecting it to maintain cleanliness and prevent pathogens. Once the cage is dry, the quail is ready to be put in. The size of the cages was 50 cm in length, 45 cm in width, 25 cm high, and equipped with lights, feeder box, and drinking equipment. The quails were weighed first to ensure their body weight.

Research Preparation and Feeding Management

Preparation was carried out with a formulation for the standard needs of layer phase quail. The preparation of the control feed is adjusted to the SNI for egg-laying quail feed (quail layer) number 01 3907 2006. The process of mixing the ration was done manually, and then the feed was served in crumble form. Each cage was fed twice a day, in the morning and evening. Drinking water was provided ad libitum during data collection. The composition of the feed is shown in Table 1.

Parameters

Data was collected every day from week 9th of age to week 12th of age with the following parameters:

Feed consumption. Feed consumption is the amount of feed that was consumed by the quail. Consumption was calculated by deducting the weight of the feed given from the remaining feed in the feeder box each day. The calculation using the formula is:

Feed consumption = given feed - remaining feed

Daily egg production. Daily egg production was calculated by dividing the number of eggs that were produced each day in each treatment by the number of live quail.

Daily egg production =

$$\left(\frac{\text{Number of eggs produced per day}}{\text{Number of quail living at that time}}\right) \text{x } 100\%$$

Egg weight. Egg weight was weighed using an analytical digital scale. Eggs that have

Table 1. Composition of rations with the level of addition of indigofera meal

Feed ingredients	Treatments (%)			
	P0	P1	P2	P3
Corn	44.80	43.80	43.90	42.00
CPO	0.00	1.90	3.40	4.10
SBM	19.40	19.10	18.60	19.70
PKC	19.50	10.50	2.00	0.00
DDGS	3.00	2.90	4.90	1.10
Pollard	3.10	3.10	1.10	0.00
MBM	2.00	2.70	2.60	2.70
Lysin	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20
Limestone	7.00	7.30	7.30	6.70
Salt	0.30	0.30	0.30	0.30
Antioxidant	0.20	0.20	0.20	0.20
Toxin binder	0.20	0.20	0.20	0.20
Vitamin	0.10	0.10	0.10	0.10
Indigofera meal	0.00	7.50	15.00	22.50
Total	100	100	100	100
Nutritional Content				
Water content (%)	9.68	9.92	10.25	10.29
Crude Protein (%)	18.04	18.05	18.05	18.06
Fiber (%)	6.80	8.04	9.03	10.89
Extract ether (%)	4.40	3.51	2.76	2.34
Ash (%)	3.48	3.70	3.73	3.92
Calcium (%)	3.49	3.42	3.17	2.90
Phosphore (%)	1.58	1.06	0.54	0.38
Metabolizable energy (kkal/kg)	2,836.65	2,810.00	2,786.73	2,743.04
Lysin (%)	1.00	0.97	0.92	0.91
Metheonin (%)	0.48	0.45	0.43	0.41

been cleaned from any remaining dirt were then weighed.

$$\text{Egg weight} = \frac{\text{Total egg weight (kg)}}{\text{Number of eggs per egg}}$$

Shell thickness. Two eggs samples were taken from each replication Measuring the thickness of the shell was using a vernier caliper by measuring the thick of the shell in the egg blunt, middle and pointed ends of the egg. This measurement was carried out after weighing the shells, then calculating the average for each treatment.

Haugh units (HU). HU were measured using a vernier caliper by measuring the albumen height (mm) and weighing the eggs (g) in each treatment and then calculated using the formula:

$$HU = 100 \log (W\text{-}1.7H^{0.37} + 7.57)$$

Egg white index. According to the National Standardisation Agency (2008), the comparison between the average diameter of the thick egg white and the height of the egg white is known as the egg white index. Egg white index measurements were obtained by measuring the height of the thick egg white and the diameter of the egg white using a vernier caliper. The egg white index value is calculated using the formula:

$$\text{Egg white index} = \frac{H}{(D1+D2)/2}$$

Yolk index. The yolk index is the ratio of the height of the yolk to the diameter of the yolk. The

yolk index was measured using a vernier caliper by measuring the height and diameter of the yolk. The yolk index value can be calculated using the formula:

$$\text{Yolk index} = \frac{H}{(D1+D2)/2}$$

Yolk color. Yolk color was assessed by the Roche Yolk Color Fan which has a color standard from 1 to 12 by comparing the color of each yolk to get a yolk color score. The data of yolk color score were collected for 3 days respectively by comparing the yolk color which was close to the yolk color fan value.

Data Analysis

Data was analyzed using the Oneway Analysis of Variance (Oneway ANOVA) test using the SPSS version 20 application. Treatment was considered significant if the P value <0.05. Duncan's Multiple Range Test (DMRT) was performed to detect differences between treatments, according to the method described by Steel & Torrie, (1986). Data analysis related to the egg yolk color test, a non-parametric statistical test, was analyzed using the Kruskal Wallis test. Treatment was considered significant if the P value was <0.05. If there are significant results in the Kruskal Wallis test, a further test using the Mann-Whitney U test was performed to compare treatment pairs.

RESULT AND DISCUSSION

Quail Productivity

The effect of adding Indigofera meal in the ration at different levels on quail productivity is shown in Table 2.

Based on the ANOVA analysis in Table 2, shows that the addition of Indigofera leaf meal at different levels did not have a significant effect (P>0.05) on feed consumption, egg production, or egg weight. It is probably quail, which are birds that have a good tolerance for digesting feed that contains seemingly high crude fiber content that is contained in Indigofera meal. Tejeda & Kim (2021) stated that fiber can escape from the digestion and absorption processes in the gastrointestinal tract, which enables other nutrients to be digested in the small intestine. Furthermore, Singh & Kim (2021) claim that fiber would be utilized by microbes that exist in the lower gut. In addition, Jha & Mishra (2021) claim that increasing fiber content in the diet would lead to increasing the length and weight of cecum.

The nutrient content of each treatment was relatively the same along with increasing levels of Indigofera leaf meal, except for crude fiber content for P0 – P4 which increased respectively (6.8% - 10.89%). Sarajar et al., (2016) stated that providing crude fiber up to 5.44% did not affect feed consumption because the treatment diet contained energy that met the quail's requirements. Furthermore, giving a higher crude fiber content in the ration up to 9% by increasing Indigofera leaf meal proportion to 20% does not affect the daily egg production of Arabian chickens (Pagala et al., 2018). The non-significant data of feed consumption and egg production among treatments that have different fiber content shows that quails can be fed which contains crude fiber up to 10%. Fiber is considered a polymer of carbohydrates derived from plants which can escape from degradation in the poultry's small intestine (Sekh & Karki, 2022). In poultry, dietary fiber might directly contribute to providing nutritive value as an energy source and indirectly could improve the digestion and metabolic process (De Vries, 2015). Since the animal's need was fulfilled from the ransom, egg production was not affected by the different levels of crude fiber.

The egg weight of this research was higher

Table 2. Egg productivity in quail with different levels of Indigofera meal

Treatments	Parameter		
	Feed consumption (g/head/day)	Eggs production (%)	Eggs weigh (gr)
P0	25.29 ± 1.39^{ns}	68.72 ± 3.58^{ns}	10.47 ± 0.32^{ns}
P1	24.95 ± 2.37^{ns}	64.84 ± 6.44^{ns}	10.25 ± 0.28^{ns}
P2	26.14 ± 1.19^{ns}	65.56 ± 9.55^{ns}	10.32 ± 0.22^{ns}
P3	25.23 ± 1.99^{ns}	62.48 ± 6.85^{ns}	10.22 ± 0.39^{ns}

Note: ^{ns} non-significant (P>0.05)

than the research conducted by Satria et al. (2021) who served feed with a crude fiber content of 5% and produced an average egg weight of 8.08 to 8.95 g/piece. The weight of quail eggs fed with 6% crude fiber content in the ration for quail aged 9 to 12 weeks was 9.58 to 9.73 g/piece (Zahra et al., 2012). The weight in this study was lower than the previous study that was conducted by Wahyuningrum et al., (2020) who gave Moringa leaves solution in the quail's drinking water which can produce egg weights between 10.98 and 11.47 grams. Kowalska et al. (2021) stated that egg weight increases its age. At the same age, the weight of the egg is the same. Moreover, egg weight is affected by dietary energy level, the lower the energy value, the lower the egg weight (Mikulski et al., 2020). In this study, however, the energy values were the same, so the egg weight was the same as well.

Egg Quality

The physical quality of quail eggs with different levels of Indigofera leaf meal in the ration is shown in Table 3.

The addition of Indigofera leaf meal did not have a significant effect (P>0.05) on the HU, egg white index, and yolk index. Feeding the birds with similar nutritional value would not influence these physical parameters. The average HU value is relatively the same, ranging from 59.13 – 60.29, this result is by Lestari & Tana (2016) who state that HU values ranged from 59 to 62 in quail eggs exposed to monochromatic light. The results of this study are lower than the research conducted by Amin et al. (2015) who found that adding Turmeric extract in drinking water produced HU values of 78.90 to 86.50. The egg white index and yolk index were higher than the study that was conducted by Badri et al. (2022) who administered Indigofera leaf meal up to a level of 12.5% in quail rations to produce an albumen index with albumen index values ranging from 0.08 to 0.09 and yolk index scores ranged from 0.42 to 0.43.

The addition of Indigofera leaf meal had a significant effect (P<0.05) on eggshell thickness and yolk color. The increase in shell thickness is in line with the increase in the use of indigofera leaf meal in the ration. The thickest eggshells were in treatment P2 compared to all treatments. P2 is 33.33% higher than PO, 15.79% compared to P1 and 15.79% compared to P3. This might be caused by the micro minerals content such as calcium, magnesium, and phosphorus which are contained in the Indigofera leaf meal. Indigofera leaves are rich in minerals such as calcium, phosphorus, potassium, sodium, magnesium, manganese, zinc, copper, iron, and chromium (Ernawati et al., 2021). Gafar et al. (2011) found that the mineral composition of Indigofera leaves in mg/100g dry matter are potassium 15.55, calcium 11.49, iron 20.95, magnesium 10.89, sodium 0.33, phosphorus 0.39, copper 0.02, and zinc 0.11. The quality of eggshells depends on the bird's ability to absorb calcium in the feed (Abbas et al., 2021). This small amount of micro minerals that come from Indigofera leaf meal might influence the ability of birds to deposit the minerals in the eggs. The composition of eggshells consists of 98.43% calcium, 0.84% magnesium, and 0.75% phosphorus (Yuwanta, 2010). Moreover, Sudrajat et al. (2014) stated that giving Indigofera leaf meals in the diet of Arabian chickens affected eggshell weight and yolk color.

The increases in yolk color value were higher and in line with the increasing levels of Indigofera leaf meal addition in the ration. The highest value occurred in treatment P3 compared to all treatments. P3 is 63.64% higher than PO, 24.14% compared to P1 and 5.26% compared to

Table 3. Physical quality of quail's eggs with different levels of Indigofera leaf meal addition

Treatments	Parameters				
	Shell thickness (mm)	Haugh unit	Egg white Index	Yolk index	Yolk color
P0	0.198 ± 0.019^{b}	59.13 ± 0.44^{ns}	0.107 ± 0.020^{ns}	0.414 ± 0.038^{ns}	4.40 ± 0.55^{a}
P1	0.228 ± 0.026^{ab}	60.29 ± 1.36^{ns}	0.125 ± 0.008^{ns}	0.414 ± 0.022^{ns}	5.80 ± 0.84^{b}
P2	0.264 ± 0.034^{a}	59.43 ± 1.67^{ns}	0.115 ± 0.016^{ns}	0.430 ± 0.045^{ns}	6.40 ± 0.89^{bc}
P3	0.228 ± 0.022^{ab}	59.27 ± 2.19^{ns}	0.121 ± 0.019^{ns}	0.450 ± 0.059^{ns}	7.20 ± 0.84^{bc}

Note: ns non-significant (P>0.05), ^{a,b} different superscripts in the same column indicate significant differences (P<0.05).

P3. This is due to the dye content, beta-carotene content, and vitamin A found in Indigofera leaves. The xanthophyll and carotenoid content in Indigofera leaves functions as a coloring agent for egg yolks found in corn and as a source of antioxidants in the ration (Wahyuningrum et al., 2020). Apart from that, it is also suspected that β-carotene and vitamin A contained in the ration affect the color of the eggs produced. The high content of β-carotene and vitamin A in Indigofera can increase the yolk color by up to 55.88% (Palupi et al., 2015). The color value of quail yolks fed Indigofera meal up to 12.5% has a significant influence on yolk color because Indigofera leaves are rich in β-carotene and xanthophyll which influence egg yolk color (Badri et al., 2022).

The yolk color value produced was higher than Laksmiwati & Siti (2012) who explained that yolk color score in rations that were supplemented with calliandra leaves produced a color score of 6.93 to 12.83 and the results of research conducted by Badri et al. (2022) found that the use of Indigofera leaf meal up to 12.5% can increase the color of yolk with a value range of 5.83 to 6.94. The use of fresh Indigofera up to 10% has a positive effect on improving the yolk color index (Akbarillah et al., 2010). Giving feed containing Indigofera leaf meal up to a level of 20% to Arabian chickens has a significant effect on the yolk color value of 7.38 (Sudrajat et al., 2014).

CONCLUSION

Based on the results of the research, it can be concluded that feeding quail with 22.5% Indigofera leaf meal increases fiber content in the diet by up to 10% and can be adopted because it improves egg quality.

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REFERENCES

Abbas, A., Paly, M. B., & Rifaid, R. (2021). Karakteristik Telur Berdasarkan Umur Ayam dan Ransum yang Diberikan: The Eggs' Properties Based on Layers' Age and Feed Types. *Jurnal Ilmu Peternakan Dan Veteriner Tropis (Journal of Tropical Animal and Veterinary Science)*, *11*(1), 67-74. https://doi.org/10.46549/jipvet.v11i1.145

Akbarillah, T., Kususiyah, K., & Hidayat, H. (2010). Pengaruh penggunaan daun indigofera segar sebagai suplemen pakan terhadap produksi dan warna yolk itik. *Jurnal Sain Peternakan Indonesia*, *5*(1), 27–33.

Al Uswah, S. F., Setiawan, B. D., & Ratnawati, D. E. (2019). Optimasi Komposisi Pakan Ternak Ayam Petelur Menggunakan Algoritme Genetika. *Jurnal Pengembangan Teknologi Informasi Dan Ilmu Komputer*, *3*(1), 426–433.

Amin, N. S., Anggraeni, A., & Dihansih, E. (2015). Pengaruh penambahan larutan ekstrak kunyit (curcuma domestica) dalam air minum terhadap kualitas telur burung puyuh. *JurnalPeternakan Nusantara*.

Badri, M., Warnoto, W., & Kaharuddin, D. (2022). Pengaruh Penggunaan Tepung Daun Indigofera dalam Ransum terhadap Kualitas Telur Puyuh. *Bulletin of Tropical Animal Science*, *3*(1), 75–80.

Steel, R. G., & Torrie, J. H. (1986). *Principles and procedures of statistics: a biometrical approach*. McGraw-Hill New York, NY, USA.

De Vries, S. (2015). Fiber in poultry nutrition: Bonus or burden. *20th European Symposium on Poultry Nutrition*, 38.

Ernawati, A., Abdullah, L., & Permana, I. G. (2021). Kandungan dan Serapan Mineral Pucuk Indigofera zollingeriana dari Tanaman dengan Kerapatan Tanam Berbeda. *Jurnal Ilmu Nutrisi Dan Teknologi Pakan*, *19*(2), 49–58.

Gafar, M. K., Itodo, A. U., Atiku, F. A., Hassan, A. M., & Peni, I. J. (2011). Proximate and mineral composition of the leaves of hairy indigo (Indigofera astragalina). *Pakistan Journal of Nutrition*, *10*(2), 168–175.

J. Tejeda, O., & K. Kim, W. (2021). Role of dietary fiber in poultry nutrition. *Animals*, *11*(2), 461.

Jha, R., & Mishra, P. (2021). Dietary fiber in poultry nutrition and their effects on nutrient utilization, performance, gut health, and on the environment: a review. *Journal of Animal Science and Biotechnology*, *12*, 1–16.

Kowalska, E., Kucharska-Gaca, J., Kuźniacka, J., Lewko, L., Gornowicz, E., Biesek, J., & Adamski, M. (2021). Egg quality depending on the diet with different sources of protein and age of the hens. *Scientific Reports*, *11*(1), 2638.

Laksmiwati, N. M., & Siti, N. W. (2012). Pemanfaatan

daun kaliandra (Calliandra calothyrsus) sebagai sumber protein pada pakan itik. *Majalah Ilmiah Peternakan*, *15*(1), 164232.

Lestari, W. T., & Tana, S. (2016). Indeks kuning telur dan nilai haugh unit telur puyuh (Coturnix coturnix japonica L.) hasil pemeliharaan dengan penambahan cahaya monokromatik. *Buletin Anatomi Dan Fisiologi Dh Sellula*, *24*(1), 42–49.

Mikulski, D., Jankowski, J., Mikulska, M., & Demey, V. (2020). Effects of dietary probiotic (Pediococcus acidilactici) supplementation on productive performance, egg quality, and body composition in laying hens fed diets varying in energy density. *Poultry Science*, *99*(4), 2275–2285.

Nasional, B. S. (2008). SNI 3926: 2008 Telur Ayam Konsumsi. *BSN, Jakarta*, *24*.

Pagala, M. A., Bain, A., & Surajat, A. (2018). pengaruh penambahan tepung daun Indigofera zollingeriana dalam ransum terhadap produksi dan berat telur ayam arab. *Jitro*, *5*(1), 51–61.

Palupi, R., Abdullah, L., & Astuti, D. A. (2015). *Potential and utilization of Indigofera sp shoot leaf meal as soybean meal substitution in laying hen diets*.

Sarajar, C. L. K., Montong, M. E. R., & Najoan, M. (2016). Performans Burung Puyuh (Coturnix–coturnix japonica) yang diberikan Tepung Keong Sawah (Pila ampullacea) Sebagai Pengganti Tepung Ikan dalam Ransum. *Zootec*, *37*(1), 62–69.

Satria, W., Harahap, A. E., & Adelina, T. (2021). Kualitas telur puyuh yang diberikan ransum dengan penambahan silase tepung daun ubi kayu. *Jurnal Sain Peternakan Indonesia*, *16*(1), 26–33.

Sekh, N., & Karki, D. (2022). Dietary Fiber in Poultry Nutrition in the Light of Past, Present, and Future Research Perspective: A Review. *Open Journal of Animal Sciences*, *12*(4), 662–687.

Singh, A. K., & Kim, W. K. (2021). Effects of dietary fiber on nutrients utilization and gut health of poultry: a review of challenges and opportunities. *Animals*, *11*(1), 181.

Sudrajat, D., Kardaya, D., Dihansih, E., & SFS, P. (2014). Performa produksi telur burung puyuh yang diberi ransum mengandung kromium organik. *Jurnal Ilmu Ternak Dan Veteriner*.

Tambunan, M. H. (2015). Pengaruh pemberian tepung daun indigofera sp terhadap konsumsi, pertambahan bobot badan dan efisiensi ransum kelinci peranakan new zealand white. *Students E-Journal*, *4*(1).

Tyas Rini Saraswati, S. (2018). Pakan Organik dan Metabolisme pada Puyuh. In *Semarang: Undip press*. Leskonfi.

Wahyuningrum, M. A., Bakrie, B., & Fahroji, H. (2020). Bobot produksi telur burung puyuh (Coturnix-coturnix japonica) dengan pemberian larutan daun kelor. *Jurnal Ilmiah Respati*, *11*(1), 24–32.

Yuwanta, T. (2010). *Telur dan kualitas telur*. Gadjah Mada University Press, Yogyakarta.

Zahra, A. A., Sunarti, D., & Suprijatna, E. (2012). Pengaruh pemberian pakan bebas pilih (Free choice feeding) terhadap performans produksi telur burung puyuh (Coturnix coturnix japonica). *Animal Agriculture Journal*, *1*(1), 1–11.