CONTENT OF CALCIUM, PHOSPHORUS AND IRON IN DUCK EGGS WHICH ARE FEED MAGGOT (*Hermetia illucens*)

By
Nando Surbakti[1], Dini Julia Sari Siregar[2]
[1,2]Animal Husbandry Study Program, Faculty of Science and Technology, University of Pembangunan Panca Budi
Email: [2]dinijulia@dosen.pancabudi.ac.id

Article History:
Received: 11-06-2024
Revised: 23-06-2024
Accepted: 05-07-2024

Keywords:
Hba1C, Maggot Fresh, Duck Eggs, Calcium, Phosphorus, Iron (FE)

Abstract: *This research aims to evaluate the effect of adding black soldier fly larvae (Hermetia illucens) to duck feed on the calcium, phosphorus and iron content of the eggs produced. This study used a non-factorial completely randomized design (CRD) with 4 feed treatments and 5 replications. Egg samples were taken from each experimental unit for analysis. The feed treatments given were: (FP0) 100% commercial feed; (FP1) 75% commercial feed + 25% fresh larvae; (FP2) 50% commercial feed + 50% fresh larvae; (FP3) 25% commercial feed + 75% fresh larvae. The results of the research showed that the treatment of adding fresh larvae to duck feed had a significant effect (P<0.05) on the calcium, phosphorus and iron content of the eggs produced. However, the addition of fresh larvae to the feed produces eggs with a lower average crude protein than 100% commercial feed. Significantly, the addition of Hermetia illucens larvae to duck feed increased the calcium, phosphorus and iron content of the eggs produced. FP2 treatment (50% commercial feed + 50% fresh larvae) produced the highest egg calcium, phosphorus and iron content. The results of this research indicate that black soldier fly larvae (Hermetia illucens) can be used as an effective alternative food source to improve the nutritional quality of duck eggs. The addition of fresh larvae to duck feed significantly increases the calcium, phosphorus and iron content of the eggs produced. Thus, black soldier fly larvae can be a good feed substitute to enrich the nutritional profile of duck eggs*

INTRODUCTION

Livestock farming is very important in ensuring that the supply of animal protein is sufficient for human needs. Its role is very vital in meeting people's needs for animal protein (Siregar, 2018). Poultry farming, such as the production of duck eggs and meat, is an important component in the food industry because it plays a role in meeting human protein needs (Alfisyahrin & Siregar, 2024).

Apart from being known as a source of animal protein which is important for the human diet, duck eggs are also an integral part of the rich variety of foods in Indonesia (Ariani et al., 2018). Understanding the high nutritional benefits of duck eggs has encouraged an increase

in the level of consumption of this product in the country (Sundari et al., 2020), especially for those who pay attention to health and nutrition, considering their abundant protein, vitamin and mineral content (Hidayati & Sary, 2019) . However, it should be noted that apart from the type of duck, the feed given to ducks also influences the nutritional quality contained in the duck eggs.

The quality of the feed given to ducks greatly determines the nutritional quality contained in the duck eggs produced (Purwati et al., 2015). This is in accordance with the opinion (Sunarno et al., 2021) that ducks that receive high quality feed will produce eggs with optimal nutritional content, while inadequate feed can produce poor eggs. Thus, studies and research on feed that can increase the nutritional value of duck eggs are a very significant thing to carry out.

Maggot (*Hermetia illucens*) is a type of alternative feed that has become the focus of much research. Maggots or black fly larvae are considered an alternative feed that can increase or improve the nutritional quality of duck eggs (Fitasari et al., 2021). Maggots have the advantages of high protein content, easy cultivation and affordable prices, making them an attractive choice for use as feed to improve the nutritional quality of duck eggs.

Maggots or fly larvae come from the black soldier fly (Hermetia illucens) which are often found in vegetable and fruit remains, and can also be found in palm oil industry waste (Siregar et al., 2023). Maggots are an attractive choice for use as feed to improve the nutritional quality of duck eggs, this is because maggots have a high protein content and are affordable.

According to (Siregar et al., 2022), processing maggots into flour is an economical solution for breeders, especially because of the high price of commercial feed. The addition of maggot that has been made into flour from laying hen manure in the ration of laying quail and mixed with fish meal up to 6% can increase egg production, increase egg weight, increase egg mass, reduce feed consumption and reduce feed conversion (Siregar et al., 2022).

Using maggots as duck feed has several advantages, namely the high protein content can improve the nutritional quality of duck eggs, apart from that, maggots are also rich in essential fatty acids and vitamins that are important for livestock health, and maggots are also environmentally friendly because they can be made from organic waste (Bagaskara et al., 2024). Using maggots as duck feed can not only improve the nutritional quality of duck eggs, but can also help reduce the amount of organic waste and support sustainable agricultural practices. Previous studies have revealed that giving maggots as feed to ducks can improve the nutritional quality of the duck eggs produced. However, more in-depth research is still needed to comprehensively understand the effect of feeding maggots on the nutritional quality of duck eggs. Therefore, research on the impact of feeding maggots on the nutritional quality of duck eggs has significant relevance and needs to be carried out.

Based on the description above, it is very necessary to carry out research on the calcium, phosphorus, iron and sodium content in duck eggs fed maggot (*Hermetia illucens*).

RESEARCH METHODS

This research was conducted at the Panca Budi Development University Laboratory, Building C.

The research period took place from December 2023 to April 2024. The materials

ISSN 2798-3471 (Cetak)
ISSN 2798-3641 (Online)

used included fresh maggots and commercial feed. For nutritional analysis, the materials used are distilled water, H_2SO_4, potassium magnesium sulfate ($MgSO_4$), sodium hydroxide (NaOH), benzoic acid (H_3BO_3), ether, benzene, K_3SO_4, HCl, acetone, and methyl red indicator.

The equipment used includes plastic jars, buckets, knives and scales. For nutritional chemistry testing, the tools used are thermometers, digestion tools, distillation tools, titration tools, and shoxlet tools.

The research method used in the research was a non-factorial Completely Randomized Design (CRD) with 4 treatments and 5 replications. The treatment given is as follows:

FP_0: 100% commercial feed (Concentrate Feed for Laying Ducks).
FP_1: Commercial feed 75% (Concentrate Feed for Laying Ducks) + Maggot fresh 25%
FP_2: Commercial feed 50% (Concentrate Feed for Laying Ducks) + Fresh maggot 50%
FP_3: Commercial feed 25% (Concentrate Feed for Laying Ducks) + Fresh maggot 75%

Research Implementation

Duck Egg Sampling

To chemically analyze the nutritional content of duck eggs, samples were taken randomly according to the specified treatment. The samples that have been collected are then immediately analyzed in the laboratory.

Analytics And Data

Research data analysis was carried out using the analysis of variance (ANOVA) method. If the results of the analysis show a real difference, then a further difference test is carried out by paying attention to the coefficient of diversity of the data obtained.

Research Parameters

1) *Calcium Level Analysis (Ca)*

⇒ *The analytical procedure carried out includes taking 4 mL of egg samples, adding 100 mL of distilled water, adjusting the pH of the solution to 12-13 using 2 M NaOH, adding 50 mg of 0.2% murexide indicator, and titrating using a standard solution of 0.050 M Na2EDTA until changes occur. the color from pink to purple at the end point of the titration.*

$$\text{Calcium Levels} \quad (\text{mg}/100\ \text{ml}) = \frac{M \times V1 \times 40{,}08 \times 100}{V2}$$

Information : *M = Molarity of Na2EDTA (M)*
V1 = Volume of Na2EDTA (mL)
V2 = Sample volume (mL)

2) *Phosphorus Level Analysis (P)*

⇒ *The procedure for making a standard phosphorus solution, namely weighing around 1.5354 g of the dried KH_2PO_4 compound, putting it quantitatively into a 50 mL volumetric flask, adding distilled water as a solvent up to the limit mark, and cooling the solution in the refrigerator.*

⇒ *Egg sample preparation was carried out using the following procedure. First, carefully weigh 10.0 g of the sample into a porcelain cup, then ash it*

by heating over a Bunsen flame to reduce the water content. After that, the sample was placed in the oven for 3 hours. Next, the sample was transferred to an ashing furnace at a temperature of 600°C until carbon free, around 3-4 hours, then cooled. The sample ash was then put into a 250 mL glass beaker, and 40 mL of HCl solution (1:3) and a few drops of HNO3 were added. The mixture is heated in a water bath and then cooled. The dissolved ash was transferred quantitatively into a 10 mL volumetric flask and distilled water was added until it reached the limit mark.

⇒ *The data is in the form of absorbance from the sample, then entered into a linear regression equation between concentration and absorbance, then the phosphorus content is calculated using the formula:*

Formula = y = bx + a

Information : y = absorbance
b = regression coefficient
x = phosphorus concentration
a = regression constant (intercept)

3) Iron Level Analysis (FE)

⇒ *Samples of egg shells in the form of ash were weighed at 1 gram each, put into a test tube, then added with 2 ml of 1 N NaOH solution. The reaction that occurred was observed. (Fe2+ identification) 2.*

⇒ *1 ml of sample solution was put into a test tube then added with 1 ml of NH3 solution. Observe the reaction that occurs. (Fe3+ identification) 3.*

⇒ *1 ml of sample solution was put into a test tube and then 1 N NaOH solution was added. The reaction that occurred was observed. (Fe3+ identification) 4.*

⇒ *1 ml of dragon fruit sample solution was put into a test tube and then added with ammonium disulfide solution. Observe the reaction that occurs.*

⇒ *After measuring the absorbance of the standard solution, a standard solution concentration calibration curve was created. So the iron (Fe) content can be calculated using: The formula is : y = a + bx*
Description: y = absorbance
a, b = regression coefficients
x = substance content

RESULTS AND DISCUSSION

In this study, the feed composition for laying ducks consisted of commercial feed and fresh maggots which were given based on treatment with levels of calcium, phosphorus and iron. Details of feed composition for each treatment can be seen in Table 1.

Table 1. Recapitulation of the average value of giving maggot fresh (Hermetia illucens) to duck feed on the nutritional quality (calcium, phosphorus and iron) of duck eggs.

Treatment	*Parameters*		
	Ca (mg)	P (mg)	Fe (mg)
FP_0	171,7097[a]	201,6264[a]	3,9101[a]

FP_1	175,4988[a]	203,4433[a]	7,49415[a]
FP_2	179,5229[b]	211,3922[b]	12,5432[b]
FP_3	178,3123[a]	206,1547[a]	10,1139[b]

Notes: Different superscripts in the same column indicate significantly different results (p<0.05).

Table 1 presents the results of the analysis of calcium, phosphorus and iron content in duck eggs given commercial feed and fresh maggots with different treatments. The results of statistical analysis showed that there were significant differences (P<0.05) in calcium (Ca) content between all treatments. The average calcium (Ca) content in the FP0, FP1, FP2, and FP3 treatments was 171.7097%, 175.4988%, 179.5229%, and 178.3123%, respectively.

Calcium is an important mineral that plays a role in the formation of egg shells and healthy duck bones. The addition of fresh maggots to duck feed showed the highest increase in egg calcium content, namely in the FP2 treatment with a composition of 50% commercial feed and 50% fresh maggots. This is because maggots have a high calcium content, which can then be absorbed and accumulated in duck eggs. The increase in calcium content in the FP2 treatment was greater than in the FP0, FP1 and FP3 treatments, indicating that the proportion of 50% maggot in the feed was optimal enough for calcium absorption by the ducks and did not require further additions which might not be utilized optimally by the ducks' bodies (Handarini et al., 2023) and deposited in eggs. This increase is consistent with the increase in the proportion of maggots in the feed, indicating that maggots are an effective source of calcium (Armayanti et al., 2024).

Phosphorus is an important mineral in metabolism and the formation of bones and egg shells. This research shows that the phosphorus content increases with the addition of maggot, with the highest content in FP_2. Phosphorus in maggots is quite high and has good bioavailability, which allows phosphorus to be absorbed effectively by ducks and deposited in eggs.

Iron is important for hemoglobin formation and enzymatic function in the body. The increase in iron content in duck eggs was clearly visible with an increase in the proportion of maggots in the feed, with the best results in FP_2. The high iron in maggots increases the intake of this mineral by ducks, which then accumulates in the eggs.

The results of this research provide practical guidance for duck breeders to improve egg quality through feed modification. By adding maggots to feed, especially at a proportion of 50% (FP_2), farmers can increase the calcium, phosphorus and iron content of eggs, which increases the selling value and quality of the product. The use of maggots in this proportion has proven to be optimal without wasting resources.

CONCLUSION

FP_2 treatment (50% commercial feed + 50% fresh maggot) is the best treatment to get the highest results in calcium, phosphorus and iron content in duck eggs.

SUGGESTION

The next research study can be continued and carried out to identify the optimal percentage of use of fresh maggots in duck feed, as well as analyze the impact of long-term use of maggots

on *ducks.*

REFERENCES

[1] Alfisyahrin, L., & Siregar, D. J. S. (2024). EVALUATION OF NUTRITIONAL EARTH WORMS (LUMBRICUS RUBELLUS) AS A SUBSTITUTE FOR FISH MEAL IN BASAL FEEDING FOR POULTRY. *Journal of Innovation Research and Knowledge*, *3*(8), 1691–1698.

[2] Ariani, M., Suryana, A., Suhartini, S. H., & Saliem, H. P. (2018). Keragaan konsumsi pangan hewani berdasarkan wilayah dan pendapatan di tingkat rumah tangga. *Analisis Kebijakan Pertanian*, *16*(2), 147–163.

[3] Armayanti, A. K., Luthfi, N., Nuraliah, S., Khaeruddin, K., Prima, A., Suryani, H. F., Wati, N. E., Ibrahim, I., Indah, A. S., & Ali, N. (2024). *Nutrisi Ternak Dasar: Dinamika Teori dan Perkembangannya*. PT. Sonpedia Publishing Indonesia.

[4] Bagaskara, K. S., Raka, I. G. A. A. P., Salsabillah, F. A., Alfinaini, N. A. D., Rahmawati, D. A., & Putra, M. A. (2024). Sosialisasi Budidaya Maggot sebagai Pengolahan Sampah Organik di Desa Mayang, Jember. *Jurnal PkM (Pengabdian Kepada Masyarakat)*, *7*(1), 16–24.

[5] Fitasari, B. D., Rengganis, B. S., Meidatuzzahra, D., & Fathurrahman, F. (2021). Rantai Pemasaran Hasil Usaha Budidaya Maggot (Belatung) Sebagai Alternatif Pakan Ternak Unggas. *Jurnal Pengabdian Masyarakat: BAKTI KITA*, *2*(2), 1–8.

[6] Handarini, R., Baharun, A., Haq, R. A., Kardaya, D., Malik, B., Rahmi, A., & Wahyuni, D. (2023). EFEKTIFITAS PENAMBAHAN TEPUNG MAGGOT (HERMETIA ILLUCENS) SEBAGAI PENGGANTI TEPUNG IKAN DALAM RANSUM TERHADAP PERSENTASE DAGING NIRTULANG AYAM KAMPUNG UNGGUL BALITNAK (KUB): THE EFFECTIVENESS OF ADDING MAGGOT FLOUR (HERMETIA ILLUCENS) AS A SUBSTITUTE FOR FISH MEAL IN THE RATION ON THE PERCENTAGE OF BONELESS MEAT IN BALITNAK SUPERIOR VILLAGE CHICKEN (KUB). *Jurnal Peternakan Nusantara*, *9*(1), 21–30.

[7] Hidayati, T., & Sary, Y. N. E. (2019). *Pendamping Gizi Pada Balita*. Deepublish.

[8] Purwati, D., Djaelani, M. A., & Yuniwarti, E. Y. W. (2015). Indeks kuning telur (IKT), haugh unit (HU) dan bobot telur pada berbagai itik lokal di Jawa Tengah. *Jurnal Akademika Biologi*, *4*(2), 1–9.

[9] Siregar, D. J. S. (2018). Pemanfaatan tepung bawang putih (allium sativum l) sebagai feedadditif pada pakan terhadap pertumbuhan ayam broiler. *Jurnal Ilmiah Abdi Ilmu*, *10*(2), 1823–1828.

[10] Siregar, D. J. S., Julianti, E., & Suryanto, D. (2023). Pemanfaatan Limbah Organik Terhadap Produksi dan Kandungan Nutrisi dari Larva Lalat (Hermetia illucens). *Prosiding Seminar Nasional Fakultas Pertanian UNS*, *7*(1), 664–671.

[11] Siregar, D. J. S., Warisman, W., Setyaningrum, S., & Amrul, H. M. Z. N. (2022). Pemanfaatan larva lalat black solder fly (Hermetia illucens) dengan berbagai media berbeda sebagai pakan puyuh untuk meningkatkan pendapatan masyarakat. *JPKMI (Jurnal Pengabdian Kepada Masyarakat Indonesia)*, *3*(1), 88–95.

[12] Sunarno, S., Budiraharjo, K., & Solikhin, S. (2021). Analisis Efek Pemeliharaan Sistem Intensif dan Ekstensif terhadap Produktivitas dan Kualitas Telur Itik Tegal. *Jurnal Peternakan Indonesia*, *23*(2), 83–93.

ISSN 2798-3471 (Cetak)
ISSN 2798-3641 (Online)

[13] Sundari, R. S., Kusmayadi, A., Hidayati, R., & Arshad, A. (2020). Meningkatkan kualitas dan preferensi konsumen telur itik dengan cara menurunkan level bau amis telur asin yang diperkaya antioksidan daun jintan (Plectranthus amboinicus L.). *Jurnal Pemikiran Masyarakat Ilmiah Berwawasan Agribisnis*, *6*(2), 853–860.

HALAMAN INI SENGAJA DIKOSONGKAN

ISSN 2798-3471 (Cetak)
ISSN 2798-3641 (Online)