e-ISSN 2579-9479
p-ISSN 2828-4348
Accredited by a Directorate General of Higher Education, Research and Technology No. 79/E/KPT/2023

Jurnal Ilmu Peternakan Terapan
October 2024, 8 (1): 1-7
DOI: https://doi.org/10.25047/jipt.v8i1.4280
Available online at https://publikasi.polije.ac.id/index.php/jipt

The quality of duck eggs at different lengths of storage by the addition of Tilapia fish oil and noni fruit extract to the feed

Kualitas telur itik pada lama penyimpanan yang berbeda dengan penambahan minyak ikan mujair dan ekstrak buah mengkudu pada pakan

Muhammad Ilham El-Azka, Rosa Tri Hertamawati*, Mira Andriani, Agus Hadi Prayitno, Niati Ningsih, Choirdina Firdausi Nuzula, Hellen Aprilia Mayasinta, Wanda Hanum Meylani, Fadillah Marsudi

Poultry Agribusiness Study Program, Department of Animal Science, Politeknik Negeri Jember, Jl. Mastrip PO BOX 164, Jember, Jawa Timur, Indonesia, 68101
*Corresponding author: rosa_trihertamawati@polije.ac.id

ARTICLE INFO

Received:
18 September 2023
Accepted:
28 May 2024
Published:
3 October 2024

Keywords:
Noni fruit extract
Ducks
Internal quality of eggs
Shelf life
Tilapia fish oil

ABSTRACT

This study aimed to determine the effect of the addition of tilapia oil and noni fruit extract to duck feed on egg quality at different storage times. A total of 80 duck eggs were used as research material using the factorial complete randomized design (CRD) method. In this study, there were two types of treatments: factor A was the diet, which included adding tilapia fish oil and noni fruit extract. The treatments were A1 (no added fish oil or noni fruit extract), A2 (0.5 percent fish oil and 0.75 percent noni fruit extract), A3 (0.75% fish oil and 0.75% noni fruit extract), and A4 (1% fish oil and 1% noni fruit extract). Factor B was the length of time the eggs were stored, with B1 (no storage), B2 (storage for 7 days), B3 (storage for 14 days), and B4 (stored for 21 days). The results showed that the Haugh unit value, the egg white index value, and the percentage of egg weight shrinkage in the storage treatment were significantly different at each length of storage time; the yolk index value and the yolk pH value were significantly different at day 14 and day 21 storage; and the egg white pH value at day 0 storage was significantly different from days 7, 14, and 21 storages. This study concludes there was no interaction between the two treatment factors and the egg quality at different storage times.

Kata kunci:
Ekstrak buah mengkudu
Itik
Kualitas internal telur
Lama penyimpanan
Minyak ikan mujair

ABSTRAK

Penelitian ini bertujuan untuk mengetahui pengaruh penambahan minyak ikan mujair dan ekstrak buah mengkudu pada pakan itik terhadap kualitas telur dengan lama penyimpanan yang berbeda. Sebanyak 80 butir digunakan sebagai bahan penelitian dengan menggunakan metode Rancangan Acak Lengkap (RAL) faktorial. Terdapat 2 faktor perlakuan pada penelitian ini, faktor pertama adalah penambahan minyak ikan mujair dan ekstrak mengkudu (A) yang terdiri dari A1: sebagai kontrol tanpa penambahan minyak ikan mujair dan ekstrak mengkudu; A2: penambahan minyak ikan mujair 0,5% dan ekstrak mengkudu 0,5%; A3: penambahan minyak ikan mujair 0,75% dan ekstrak mengkudu 0,75%; dan A4: penambahan minyak ikan mujair dan ekstrak mengkudu 1% serta faktor kedua berupa lama penyimpanan telur (B) terdiri dari B1: penyimpanan 0 hari; B2: penyimpanan 7 hari; B3: penyimpanan 14 hari; dan B4: penyimpanan 21 hari. Hasil penelitian menunjukkan nilai haugh unit, nilai indeks putih telur dan persentase penyusutan bobot telur pada perlakuan penyimpanan terdapat perbedaan nyata di setiap lama waktu penyimpanan, sedangkan nilai indeks kuning telur dan pH kuning telur berbeda nyata pada penyimpanan hari ke-14 dan hari ke-21, nilai pH putih telur pada penyimpanan hari ke-0 berbeda nyata dengan penyimpanan hari ke-7, hari ke-14 dan hari ke-21. Kesimpulan dari penelitian ini menunjukkan tidak terdapat interaksi antara dua faktor perlakuan terhadap kualitas telur pada lama penyimpanan yang berbeda.

INTRODUCTION

Eggs are a source of animal protein that has a good taste, easy to digest, has high nutrient content, and is relatively cheap in price. Widarta (2018) reported that eggs are rich in minerals such as manganese, magnesium, potassium, iodine, sulfur, calcium, and potassium. According to Warmana, Dewi, & Wijana (2019) duck eggs are one of the food products that is rich in nutrient content, so it can fulfill the nutritional adequacy value of the community. Based on the data from BPS (2023) duck egg production in Indonesia in 2022 increased by 3.017%, after previously in 2021 there was a decline due to the COVID-19 pandemic. In line with the increase in egg production, the consumption of duck eggs has also increased, but the quality of duck eggs is easily declining and damaged when stored at room temperature for 14 days. The decline in egg quality is caused by broken or cracked shells that are unable to withstand the contamination that occurs. Egg storage time causes a decrease in egg weight, the HU value, and an increase in egg pH (Bilyaro, Lestari, & Endayani, 2021). On the other research shows that the presence of antioxidant factors can act to inhibit a decrease in egg quality because eggs contain (mostly egg yolk) long-chain unsaturated fatty acids (polyunsaturated fatty acids), the most abundant of which is linoleic acid (C18:2n-6), which easily undergoes peroxidation and therefore requires antioxidants (Abd El-Hack, Salem, Khafaga, Soliman, & El-Saadony, 2023). According to Lestari, Muflichatun Mardiati, & Anwar Djaelani (2018), the decline in egg quality is caused by the process of oxidation or gas exchange that occurs in the egg. It is necessary to look for the right antioxidant ingredients to inhibit the decline in egg quality. Through modification or enrichment treatment of consumption or feeding manipulation, to produce the high antioxidant on eggs and the quality eggs.

Tilapia oil contains selenium (Se), which plays an important role in maintaining poultry health and can maintain egg quality by destroying free radicals using the enzyme component *glutathione* peroxidase (Safitri, Rosidi, & Hidayat, 2022). According to Harifuddin, Wadi, Jaya, & Risal (2015) the protein content contained in tilapia oil is 18.7%. There are two types of selenium, namely organic consisting of selenomethionine and *selenocysteine,* and inorganic consisting of *selenite* and selenide (Maulana, Sari, Partina, & Azizah, 2020). Based on research conducted by Angkow, Leke, Pudjihastuti, & Tangkau (2017) the use of fish oil in a mixture of laying hen rations with a percentage of 1–4 can affect egg quality improvement. Based on this description, it is expected that the addition of tilapia fish oil can maintain egg quality and maximize the mechanism of Se compounds, besides additional ingredients such as noni fruit extract containing flavonoid compounds that are also needed.

The content of noni fruit (flavonoids, glycosides, and vitamin C) has antibacterial and antioxidant effects, which can help prevent fat oxidation and maintain the quality of duck eggs (Abi, Lisnahan, & Purwantiningsih, 2021). According to Lung & Destiani (2018), antioxidants are compounds that can slow down and prevent the process of *lipid* oxidation due to free radicals, so flavonoid compounds are needed to maintain quality and prevent damage to duck eggs. All compounds contained in noni fruit extracts work together to maintain the quality of duck eggs.

This study aims to examine the combination effect of tilapia oil containing selenium and noni fruit extract containing flavonoids as antimicrobial agents on egg quality during the storage period, and hopefully, with this discovery, new methods can be developed to maintain egg quality.

MATERIALS AND METHODS

The material used in this study was 80 fresh duck eggs obtained from two hundred 32-week-ducks fed with a mixture of tilapia oil and noni fruit extract. This study is designed with Factorial Completely Randomized Design (CRD) 4x4 research consisting of factor A and factor B. Factor A is dietary treatment with a mixture of tilapia oil and noni fruit extract, consisting of A1: as control without addition; A2: addition of each ingredient at 0.5%; A3: addition of each ingredient at 0.75%; and A4: addition of each ingredient at 1%. Factor B is the storage length of eggs, consisting of B1: 0-day storage, B2: 7-day storage, B3: 14-day storage, and B4: 21-day storage.

Research Procedure

This research procedure consists of 3 stages: making tilapia oil and noni fruit extract, rearing, and testing egg quality. The first stage is: 1) Making tilapia oil by first cutting tilapia into smaller parts, and steaming using a water

bath at 90°C for 70 minutes. The steamed tilapia fish will release oil and water which were then filtered using a filter cloth to separate the liquid and solid materials, then the liquid material was put into a centrifuge tube with a volume of 40 ml and put into an ASS machine for 10 minutes at a speed of 10,000 rpm. The oil that has been separated from the liquid material and the yield is taken using a micropipette (Febrianto & Sudarno, 2020), 2) The preparation of noni fruit extract was carried out by slicing the noni fruit into thin slices, then dried using a *dehydrator* at 60°C for 6 hours and macerated with a ratio of 200 g of noni fruit flour and 650 ml of 70% ethanol in a *shaker incubator for* 48 hours. The results of maceration were filtered using filter paper and the separation between solvent and solute was carried out using a *rotary evaporator* for 6 hours at 60°C (Azizah, Singgih, Setiyatwan, Widjastuti, & Asmara, 2020), and 3) Raising Mojosari ducks by giving a mixture of tilapia fish oil feed and noni fruit extract, egg collection and B factor treatment and measuring egg samples according to observation variables.

Variables Observed

The variables observed in this study are:

1. The Haugh Unit value is obtained from the calculation using the formula (Yuwanta, 2010):

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

(H=height albumen (mm), W= egg weight (g))

2. The albumen Index value is obtained by measuring the height of the albumen and the diameter of the length and width of the albumen calculated by the formula (Fibrianti, Suada, & Rudyanto, 2012):

$$\text{The Albumen Index value} = \frac{\text{height of the albumen (mm)}}{\text{diameter of the albumen (mm)}}$$

3. The egg yolk index value is obtained by measuring the height of the yolk with the length and width diameters using vernier calipers then calculated by the formula (Swacita & Cipta, 2011)

$$\text{The Egg Yolk Index value} = \frac{\text{height of the yolk (mm)}}{\text{diameters of the yolk (mm)}}$$

4. The pH value of the egg yolk is obtained by measuring the acidity of the egg yolk using a pH meter.
5. The pH value of albumen was obtained using a pH meter to measure its acidity.
6. The percentage of egg weight shrinkage is obtained by weighing the eggs using a digital balance (Ohaus) before storage and after storage and then calculated using the formula (Yuwanta, 2010):

$$\text{Percentage} = \frac{\text{weighing before (g)-weighing after storage (g)}}{\text{weighing before (g)}} \text{ x } 100\%$$

Data Analysis

The data obtained were analyzed using SPSS software (version 25). Based on the design used, if there were significant differences, further tests were carried out using Duncan's Multiple Range Test (DMRT) (Harsojuwono, Arnata, & Puspawati, 2011).

RESULTS AND DISCUSSION

Haugh Unit Value

The results of the analysis shown in Table 1 indicate that storage time had a significant effect ($P<0.05$), but dietary treatment had no significant impact ($P>0.05$), and the interaction between factors A and B also had no significant effect ($P>0.05$) on the *Haugh unit*. Albumen quality affects egg freshness and *Haugh unit*, if the albumen is diluted, the *Haugh unit* will be lower. This is due to the ovomucin content in albumen which is related to the viscosity of albumen is damaged so that the water from the albumen is oxidized and causes the albumen to dilute. In this study, it is known that the addition of tilapia oil and noni fruit extract to the feed has not been able to prevent the process of albumen dilution perfectly so damage to ovomucin occurs quickly. This statement follows the results of research conducted by Purwati, Djaelani, & Yuniwarti (2015) that ovomucin content in albumen affects the HU value. External factors such as length of storage time, *strain*, and storage temperature can also affect the *Haugh unit* value of duck eggs as stated by Bondoc, Santiago, Bustos, Ebron, & Ramos (2021) that differences in the heritability value of a trait are caused by differences in the number of observations, livestock breeds, time,

Table 1. Haugh unit value analysis results of duck eggs

Dietary treatment	Storage time (day)				Average
	0	7	14	21	
Control	77.652±2.81	75.038±3.31	71.106±4.15	59.084±9.35	70.720±8.90
FO 0.5% and NE 0.5%	77.574±4.14	71.350±4.17	68.746±5.49	56.380±4.84	68.513±9.00
FO 0.75% and NE 0.75%	76.774±4.33	73.650±3.91	69.140±6.44	50.922±5.14	67.622±11.2
FO 1% and NE 1%	77.988±3.29	73.508±4.42	66.158±4.42	49.832±8.34	66.872±12.2
Average	77.497±3.42a	73.386±3.89b	68.787±6.05c	54.054±7.18d	

Note: a, b, c, d means different superscripts indicated statistically different (p>0.05). FO = fish oil. NE = noni extract.

Table 2. Results of duck albumen value analysis

Dietary treatment	Storage time (day)				Average
	0	7	14	21	
Control	0.090±0.01	0.076±0.01	0.072±0.01	0.043±0.00	0.070±0.02
FO 0.5% and NE 0.5%	0.089±0.00	0.072±0.01	0.058±0.01	0.051±0.10	0.068±0.02
FO 0.75% and NE 0.75%	0.084±0.01	0.078±0.00	0.059±0.01	0.044±0.01	0.066±0.02
FO 1% and NE 1%	0.090±0.01	0.074±0.01	0.068±0.02	0.047±0.01	0.070±0.02
Average	0.088±0.01d	0.075±0.01c	0.064± 0.01b	0.046±0.01a	

Note: d, c, b, a means different superscripts indicated statistically different (p>0,05). FO = fish oil, NE = noni extract.

environment and estimation methods used. Bondoc et al. (2021) have research in Mallard ducks showed that *Haugh unit* values of more than 72 are categorized as AA quality eggs, 60 to 72 are categorized as A quality eggs, 31 to 60 are categorized as B quality eggs and *Haugh unit* values of less than 31 are categorized as C quality eggs.

Albumen Index Value

The results of the analysis in Table 2 show that storage time (B) had a significant effect (P<0.05), but dietary treatment factor (A) had no significant effect (P>0.05), and the interaction between factor A and B also had no significant effect (P>0.05) on the index value of albumen. The results showed that the increasing shelf life resulted in a decrease in the viscosity of albumen. The longer the storage, the higher the thick albumen layer will decrease (Andriani, Djaelani, & Saraswati, 2015). Djaelani, Novika, & Azizah (2019) said the longer the storage time, the pores of the shell will be larger and result in damage to the mucosal layer so that water, gas, and bacteria from the outside will more easily enter the egg and quality deterioration will occur quickly. Fresh eggs have an albumen index value of 0.05 to 0.17 (Winarno & Koswara, 2002).

Egg Yolk Index Value

The results of the analysis in Table 3 show that factor B had a significant effect (P<0.05), but factor A had no significant effect (P>0.05), and the interaction between factors A and B also had no significant effect (P>0.05) on the yolk index value. According to Abd El-Hack et al. (2023) selenium content can stimulate the production of vitamin E, which functions as an antioxidant but has not been able to prevent oxidation. According to the statement of Nemati et al. (2020) vitamin E is the main antioxidant found in egg yolk fat, which functions to break the chain of fat peroxidation.

Egg Yolk pH Value

The results of the analysis shown in Table 4 indicate that factor B had a significant effect (P<0.05), but factor A had no significant effect (P>0.05), and the interaction between factors A and B also had no significant effect (P>0.05) on the pH value of egg yolk. The oxidation process that occurs during storage causes the ovomucin content to decrease in quality, which results in a thinner yolk viscosity (Sihombing, Kurtini, & Nova, 2014). According to Warmana et al. (2019) temperature can affect the pH value of egg yolks, the higher the temperature during storage will increase the release of CO_2 and the pH value of the

Table 3. Analysis result of duck egg yolk value

Dietary treatment	Storage time (day)				Average
	0	7	14	21	
Control	0.393±0.07	0.393±0.04	0.379±0.06	0.275±0.07	0.360±0.07
FO 0.5% and NE 0.5%	0.448±0.08	0.353±0.06	0.311±0.15	0.214±0.09	0.332±0.13
FO 0.75% and NE 0.75%	0.409±0.12	0.396±0.12	0.258±0.13	0.342±0.09	0.351±0.12
FO 1% and NE 1%	0.345±0.09	0.4150.03	0.353±0.06	0.287±0.09	0.350±0.08
Average	0.399±0.09a	0.389±0.06a	0.325± 0.11b	0.280±0.09b	

Note: a, b means values on the same row with different superscripts are significantly different (p<0,05). FO = fish oil, NE = noni extract.

Table 4. Results of duck egg yolk pH value analysis

Dietary treatment	Storage time (day)				Average
	0	7	14	21	
Control E	5.790±0.19	6.028±0.14	6.342±0.20	6.644±1.02	6.201±0.59
FO 0.5% and NE 0.5%	6.014±0.36	6.032±0.25	6.318±0.44	6.668±0.91	6.258±0.57
FO 0.75% and NE 0.75%	5.760±0.05	5.948±0.19	6.690±1.00	7.898±1.17	6.574±1.12
FO 1% and NE 1%	6.098±0.69	6.234±0.38	6.916±1.22	6.728±1.02	6.494±0.88
Average	5.915±0.39a	6.060±0.26a	6.566±0.80b	6.984±1.09b	

Note: a, b means values on the same row with different superscripts are significantly different (p<0,05). FO = fish oil, NE = noni extract.

egg yolk will also increase. Thus, the pH of the egg yolk will be more alkaline during storage.

Albumen pH Value

The results of the analysis in Table 5 show that storage time has a significant effect (P<0.05), but factor dietary treatment has no significant effect (P>0.05), and the results of the interaction of the two factors also have no significant effect (P>0.05) on the pH value of albumen. These results indicate that the use of tilapia oil and phytobiotics noni fruit extract up to 1% level through feed media has not been able to affect the pH of duck albumens treated during the storage period. The addition of tilapia oil and noni fruit extract has not been able to inhibit the process of CO_2 gas release, which causes albumens to become thinner. Length of storage and ambient temperature are also factors that can affect the pH of duck eggs. The longer the duck egg is stored, the more the egg will lose CO2 gas (Nuraeni, Djaelani, Sunarno, & Kasiyati, 2019).

Percentage of Weight Shrinkage

The results of the analysis in Table 6 show that factor B had a significant effect (P<0.05), but factor A had no significant effect (P>0.05), and the interaction between factors A and B also had no significant effect (P>0.05) on the percentage of egg weight shrinkage. Egg weight loss occurs continuously during storage time due to gas release or oxidation processes (Siregar, Hintono, & Mulyani, 2012). According to Abdullah, Haryuni, Lidyawati, & Lestariningsih (2022) shrinkage of egg weight is closely related to the decline in egg quality, and egg weight can be maintained during storage if the shell is thick. The process of evaporation of water from the albumen through the pores causes a decrease in egg weight and the activity of microorganisms (Abi et al., 2021). Sihombing et al. (2014) stated that egg weight shrinkage is a change that can be observed directly during the storage process.

CONCLUSIONS

This study concludes that there was no interaction between the two treatment factors: the addition of tilapia oil and noni fruit extract to feed and storage time to the egg quality, and the storage lengths decreasing the quality of duck eggs.

ACKNOWLEDGMENTS

The researchers would like to thank the Ministry of Education, Culture, Research,

Table 5. Results of duck albumen pH value analysis

Dietary treatment	Storage time (day)				Average
	0	7	14	21	
Control	7.998±0.12	8.800±0.32	8.800±0.32	8.786±0.57	8.596±0.49
FO 0.5% and NE 0.5%	7.840±0.19	8.928±0.08	8.866±0.19	8.994±0.26	8.657±0.52
FO 0.75% and NE 0.75%	7.868±0.19	8.868±0.45	8.704±0.88	8.832±0.31	8.568±0.31
FO 1% and NE 1%	8.122±0.15	8.952±0.13	8.668±0.60	8.430±0.77	8.543±0.55
Average	7.957±0.19a	8.887±0.27b	8.759±0.53b	8.760±0.54b	

Note: a, b means different superscripts indicated statistically not different (p>0,05). FO = fish oil, NE = noni extract.

Table 6. Results of the analysis of duck egg weight shrinkage (%)

Dietary treatment	Storage time (day)				Average
	0	7	14	21	
Control	0.00±0.00	0.273±0.01	0.376±0.02	0.489±0.01	0.284±0.01
FO 0.5% and NE 0.5%	0.00±0.00	0.273±0.03	0.374±0.02	0.462±0.01	0.277±0.01
FO 0.75% and NE 0.75%	0.00±0.00	0.284±0.02	0.378±0.02	0.471±0.01	0.283±0.02
FO 1% and NE 1%	0.00±0.00	0.277±0.01	0.376±0.02	0.453±0.03	0.277±0.02
Average	0.00±0.00a	0.277±0.01b	0.376±0.02c	0.469±0.01d	

Note: a, b, c, d means values on the same row with different superscripts are significantly different (p<0,05). FO = fish oil, NE = noni extract.

and Technology of the Republic of Indonesia, Directorate General of Vocational Education, for funding this research through the Student Creativity Program for Exact Research (PKM-RE), specifically for Vocational Higher Education in 2022.

REFERENCES

Abd El-Hack, M. E., Salem, H. M., Khafaga, A. F., Soliman, S. M., & El-Saadony, M. T. (2023). Impacts of polyphenols on laying hens' productivity and egg quality: A review. *Journal of Animal Physiology and Animal Nutrition*, *107*(3), 928–947. https://doi.org/10.1111/jpn.13758

Abdullah, F., Haryuni, N., Lidyawati, A., & Lestariningsih. (2022). Pengaruh Suhu dan Waktu Pemanasan Terhadap Kualitas Interior Telur Ayam Hasil Persilangan Ayam Kedu dan Bangkok. *JSNu : Journal of Science Nusantara*, *2*(1), 33–37.

Abi, N., Lisnahan, C. V., & Purwantiningsih, T. I. (2021). Pengaruh Ekstrak Buah Mengkudu Terhadap Kualitas Internal, Indeks Busa dan Nilai Haugh Unit Telur Ayam Ras. *Journal of Tropical Animal Science and Technology*, *3*(1), 45–54. https://doi.org/10.32938/jtast.v3i1.83

Andriani, T., Djaelani, M. A., & Saraswati, T. R. (2015). Kadar proksimat telur itik pengging, itik tegal, itik magelang di Balai Pembibitan dan Budidaya Ternak Non Ruminansia (BPBTNR), Ambarawa. *Jurnal Biologi*, *4*(3), 8–15.

Angkow, M., Leke, J., Pudjihastuti, E., & Tangkau, L. (2017). Kualitas internal telur ayam MB 402 yang diberi ransum mengandung minyak limbah ikan cakalang (Katsuwonus Pelamis L). *Zootec*, *37*(2), 232–241.

Azizah, T. R. N., Singgih, D. P., Setiyatwan, H., Widjastuti, T., & Asmara, I. Y. (2020). Peningkatan pemanfaatan ransum pada ayam sentul yang diberi ekstrak buah mengkudu (Morinda citrifolia) dengan suplementasi tembaga dan seng. *Jurnal Nutrisi Ternak Tropis Dan Ilmu Pakan*, *2*(1), 25–34. https://doi.org/10.24198/jnttip.v2i1.26667

Bilyaro, W., Lestari, D., & Endayani, A. S. (2021). Identifikasi kualitas internal telur dan faktor penurunan kualitas selama penyimpanan. *Journal of Agriculture and Animal Science*, *1*(2), 55–62. https://doi.org/10.30809/

phe.1.2017.21

Bondoc, O. L., Santiago, R. C., Bustos, A. R., Ebron, A. O., & Ramos, A. R. (2021). Evaluation of egg characteristics using the size classification and grading system for mallard duck eggs. *Philippine Journal of Veterinary & Animal Sciences*, *47*(2), 16–31.

BPS. (2023). *Statistik Indonesia 2023*. Jakarta: Badan Pusat Statistik Indonesia.

Djaelani, M., Novika, Z., & Azizah, N. (2019). Pengaruh Pencucian, Pembungkusan dan Penyimpanan suhu rendah Terhadap Kualitas Telur Ayam Ras (Gallus L.). *Buletin Anatomi Dan Fisiologi*, *4*(1), 29–34.

Febrianto, R., & Sudarno, S. (2020). Proses Produksi Minyak Ikan dari Limbah Ikan Patin (Pangasius pangasius) di Balai Besar Pengujian Penerapan Hasil Perikanan (BBP2HP) Jakarta Timur. *Journal of Marine and Coastal Science*, *9*(2), 65–69. https://doi.org/10.20473/jmcs.v9i2.20251

Fibrianti, S., Suada, I., & Rudyanto, M. (2012). Kualitas telur ayam konsumsi yang dibersihkan dan tanpa dibersihkan selama penyimpanan suhu kamar. *Indonesia Medicus Veterinus*, *1*(3), 408–416.

Harifuddin, Wadi, A., Jaya, A. A., & Risal, M. (2015). Daya Dukung Ikan Mujair Produksi Tambak Sebagai Bahan Sumber Protein Hewani Pakan Ternak Itik. *Jurnal Agrokompleks*, *14*, 35–38.

Harsojuwono, B. A., Arnata, I. W., & Puspawati, G. A. K. D. (2011). *Rancangan Percobaan : Teori, Aplikasi SPSS dan Excel*. Malang: Lintas Kata Publishing.

Lestari, L., Muflichatun Mardiati, S., & Anwar Djaelani, M. (2018). Kadar protein, indeks putih telur, dan nilai haugh unit telur itik setelah perendaman ekstrak daun salam (Syzygium polyanthum) dengan waktu penyimpanan yang Berbeda pada Suhu 4°C. *Buletin Anatomi Dan Fisiologi*, *3*(1), 39–45.

Lung, J. K. S., & Destiani, D. P. (2018). Uji aktivitas antioksidan vitamin A, C, E dengan metode DPPH. *Farmaka*, *15*(1), 53–61. https://doi.org/10.24198/jf.v15i1.12805

Maulana, I. T., Sari, R. W., Partina, R. S., & Azizah, I. N. (2020). Telaah Kandungan Asam Lemak Esensial dalam Empat Jenis Minyak Ikan Konsumsi di Jawa Barat. *Jurnal Ilmiah Farmasi Farmasyifa*, *3*(2), 92–101.

Nemati, Z., Ahmadian, H., Besharati, M., Lesson, S., Alirezalu, K., Domínguez, R., & Lorenzo, J. M. (2020). Assessment of Dietary Selenium and Vitamin E on Laying Performance and Quality Parameters of Fresh and Stored Eggs in Japanese Quails. *Foods*, *9*(9), 1–13. https://doi.org/10.3390/foods9091324

Nuraeni, S., Djaelani, M., Sunarno, & Kasiyati. (2019). Nilai Haugh Unit (HU), Indeks Kuning Telur (IKT) dan Ph Telur Itik Pengging Setelah Pemberian Tepung Daun Kelor (Moringa oleifera Lam.). *Buletin Anatomi Dan Fisiologi*, *4*(2), 107–115.

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 Biologi*, *4*(2), 1–9.

Safitri, N. R., Rosidi, & Hidayat, N. (2022). Pengaruh suplementasi selenium yeast terhadap bobot albumen, bobot yolk, rasio yolk dan albumen ayam niaga petelur. *ANGON: Journal of Animal Science and Technology*, *4*(2), 152–160.

Sihombing, R., Kurtini, T., & Nova, K. (2014). Pengaruh lama penyimpanan terhadap kualitas internal telur ayam ras pada fase kedua. *Jurnal Ilmiah Peternakan Terpadu*, *2*(2), 81–86.

Siregar, R., Hintono, A., & Mulyani, S. (2012). Perubahan sifat fungsional telur ayam ras pasca pasteurisasi. *Animal Agriculture Journal*, *1*(1), 521–528.

Swacita, I. B. N., & Cipta, I. P. S. (2011). Pengaruh Sistem Peternakan dan Lama Penyimpanan terhadap Kualitas Telur Itik. *Buletin Veteriner Udayana*, *3*(2), 91–98.

Warmana, I. W. G. T., Dewi, G. A. M. K., & Wijana, I. W. (2019). Pengaruh Penyimpanan Terhadap Kualitas Telur Itik. *Jurnal Peternakan Tropika*, *7*(2), 415–429.

Widarta, I. wayan R. (2018). Teknologi Telur. *Journal of Chemical Information and Modeling*, *53*(9), 1689–1699.

Winarno, F. G., & Koswara, S. (2002). *Telur, Komposisi, Penanganan dan Pengolahannya*. Bogor: M-BRIO Press.

Yuwanta, T. (2010). *Telur dan Kualitas Telur*. Yogyakarta: Gadjah Mada University Press.