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Essential Oils as Natural Feed Additives: Strategies to Increase Protein and Reduce Fat Content in Egg Coating

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Abstract
This study aims to evaluate the effect of essential oil supplementation in food on the protein and fat content of eggs produced by laying hens. Essential oils are known to have antimicrobial and antioxidant properties, as well as the ability to improve nutrient digestibility, making them a promising natural feed additive for improving the quality of poultry products. In this study, laying hens in the production phase underwent dietary treatment with different levels of essential oil inclusion. Egg samples were analyzed for proxy composition, with a focus on protein and fat content. The results showed that essential oil supplementation had a significant effect ($P<0.05$) on increasing egg protein levels, while fat content showed a decreasing tendency at certain levels of supplementation. These findings suggest that essential oils can increase protein utilization and modulate lipid metabolism in eggs, thereby improving the nutritional profile. In addition, the use of essential oils can be considered a sustainable alternative to antibiotic growth promoters, not only offering health benefits to poultry but also added value for consumers through higher-quality eggs. This study recommends determining the optimal dosage of essential oil supplementation to balance chicken productivity with better egg nutrient composition.

INTRODUCTION

Chicken eggs are one of the animal food ingredients that are very important in meeting the nutritional needs of the community, especially as a source of protein with high biological value. Its protein content is relatively easy to digest and contains complete essential amino acids. Generally, chicken eggs have a protein content of about 12-14% and fat ranges from 10-12%, depending on the type of feed and the physiological condition of the laying hens (Kunsah, 2016). In line with the increasing public awareness of a healthier diet, consumers are now paying attention not only to the quantity, but also the nutritional quality of the eggs consumed (Anggaeni et al., 2022). Therefore, the demand for eggs with a higher protein content and lower fat content is constantly increasing.

The nutritional quality of eggs is greatly influenced by the nutritional factors of the feed given. For decades, breeders have been using synthetic feed additives such as antibiotics to improve chicken performance and improve product quality. However, the long-term use of

antibiotics poses serious problems, namely the emergence of antimicrobial resistance and the presence of chemical residues in livestock products that can endanger consumer health (Darmawan et al., 2024). In response, the government and the livestock industry have begun to limit and even ban the use of antibiotics as growth drivers, as well as encourage the search for natural alternatives that are safe, environmentally friendly, and still effective (Darmawan et al., 2024)

One of the most researched and promising alternatives is essential oils. This oil is the result of extraction from aromatic plants such as oregano (*Origanum vulgare*), thyme (*Thymus vulgaris*), cinnamon (*Cinnamomum verum*), and cloves (*Syzygium aromaticum*). Each type of essential oil contains special active compounds, such as carvakrol, tim, eugenol, and synmaldehyde, which have antimicrobial, antioxidant, anti-inflammatory, and immunomodulatory properties (Darmawan et al., 2024). Thanks to its biological activity, essential oils are able to suppress the growth of pathogenic bacteria in the digestive tract, maintain the balance of intestinal microflora, and increase the absorption of nutrients which ultimately have a positive impact on the metabolic efficiency of laying hens (Orzuna-Orzuna & Lara-Bueno, 2023)

Studies have shown that essential oils have the potential to improve the efficiency of feed protein use by stimulating the secretion of digestive enzymes such as pepsin and trypsin, so that feed proteins can be broken down into amino acids that are more easily absorbed (HARUMDEWI et al., 2018). This process directly supports the increase in protein levels in eggs, as those amino acids are used for the synthesis of albumen or egg whites (Hanif et al., 2024). On the other hand, some studies have also revealed that essential oils play a role in lowering egg fat levels through increased activity of β-oxidation enzymes that function to break down fatty acids and suppress the lipogenesis process in the liver

In a national context, research on the use of essential oils in laying hen feed has developed in the last five years.(Hanif et al., 2024) reports that the combination of clove oil and eucalyptus oil in feed can improve feed efficiency and improve the viscosity of egg whites. (Hanif et al., 2024) It was found that the use of natural essential oil-based additives had a positive effect on the physical quality of eggs without interfering with the productivity of chickens. Meanwhile, the results of the study (Arbiantara & Widianingrum, 2024) This shows that the addition of essential oils to mineral premiks is able to increase egg protein levels by up to 8% as well as improve the metabolic profile of laying hens.

Nonetheless, the effectiveness of essential oil use has not been uniform across studies. Several factors such as the type of oil, the concentration of use, and the environmental conditions of the cage can affect the results obtained. The use of essential oils in too high doses can decrease the palatability of the feed due to its pungent aroma, while too low a dose often does not have a significant impact on the chicken's metabolism (Bulan et al., 2021). Thus, further research is needed to determine the optimal dose that can provide maximum results without negative effects on the performance of laying hens.

In addition to providing benefits to improve product quality, the use of essential oils also has the potential to support the concept of sustainable agriculture. Indonesia is a country rich in aromatic plant resources such as cloves, lemongrass, and cinnamon, which can be used as raw materials for essential oils (Meidiana et al., 2024). The use of local essential oils as feed additives not only reduces dependence on chemical-based imported products, but can also increase the economic value of domestic plantation commodities. Integration between the medicinal plant and livestock sectors can support a one-health approach that balances animal health, human health, and environmental sustainability.

From the consumer side, the application of essential oils in laying hen feed has a positive impact on the nutritional value of the eggs produced. Eggs with a higher protein content have better biological value, while lower levels of fat and cholesterol contribute to lowering the risk of degenerative diseases such as cardiovascular (Hanif et al., 2024). A meta-analysis study conducted by (Orzuna-Orzuna & Lara-Bueno, 2023) It also shows that the application of essential oils is able to improve the chemical composition of the eggs and improve the oxidative stability of the yolk during storage.

Although these results illustrate promising potential, there are still research gaps, particularly in the application of essential oils in local production systems. Many smallholders in Indonesia use alternative feed ingredients of varying quality, so the effectiveness of essential oils is often inconsistent. Differences in environmental conditions, cage sanitation, and feed formulation can affect the chicken's response to essential oil supplementation. Therefore, a comprehensive literature review is needed to summarize the empirical evidence from both local and international research, as well as formulate implementation strategies that are appropriate to national livestock conditions.

Based on this background, this research has three main objectives. First, collecting and analyzing the results of the latest research (2020–2025) on the influence of essential oils on the protein and fat content of laying hens' eggs, both from research in Indonesia and from international literature. Second, it explains the biological mechanisms of essential oils in increasing protein utilization and reducing fat accumulation through improved digestive and metabolic functions. Third, identify various challenges and provide practical recommendations related to the application of essential oils as effective and sustainable natural feed additives for the laying hen farming industry in Indonesia.Through a deeper understanding of the role of essential oils, it is hoped that the results of this research can be a scientific foundation in the development of poultry nutrition innovations that not only improve the nutritional quality of eggs, but also support the sustainability of the national livestock sector and food security for the wider community.

RESEARCH METHODOLOGY

This study used a systematic literature review method to analyze various research results on the use of essential oils as natural feed additives in laying hens, especially its effect on egg protein and fat content. This research was conducted to gain a comprehensive understanding of the effectiveness, mechanism of action, and application of essential oils in improving the nutritional quality of eggs.

The research stages include topic formulation, search for scientific sources, literature selection, data extraction, and analysis of results synthesis. The topic of the research was determined based on the current issue in poultry nutrition, namely the need for innovation of natural feed additives as a substitute for antibiotics. The inclusion criteria used include publications in the last five years (2020–2025), in the form of scientific articles, proceedings, or accredited research reports that discuss the use of essential oils in laying hens and include the results of testing the chemical composition of eggs, especially protein and fat content. Non-poultry publications, opinions, and reports without quantitative data were excluded from the study.

Each source that met the criteria was analyzed based on the type and chemical composition of the essential oil, the dosage of supplementation, the phase of chicken production, and the results of egg quality. The data were synthesized in a descriptive-thematic manner, by grouping the findings according to the physiological effects of essential oils on improved nutrient digestion, antioxidant activity, and lipid metabolism modulation.

To maintain accuracy, the results are synthesized compared to the study to identify similarities in patterns, variations in findings, and factors that affect the effectiveness of essential oil use. This approach results in scientific studies that are not only descriptive, but also analytical, so that it can be an argumentative basis for the application of essential oils as natural feed additives that have the potential to increase protein content and lower fat levels in laying hen's eggs.

RESULT AND DISCUSSION

Based on the results of research from various studies, the use of essential oils as natural feed additives has been proven to have a significant influence on improving the nutritional quality of laying hen eggs. Several studies have shown that the addition of essential oils can increase egg protein levels by 1-3% and reduce fat levels by 0.5-1.5% compared to the control group without treatment (Sahgal, 2024). This phenomenon suggests that the bioactive compounds in essential oils, such as eugenol, carbovrol, thymol, curcumin, and gingerol, play an important role in improving protein and fat metabolism and improving the efficiency of nutrient utilization in the chicken's body. In addition to improving the chemical quality of eggs, the use of essential oils also has a physiological effect in increasing the activity of digestive enzymes and improving the balance of intestinal microflora. This impact makes essential oils a promising alternative to antibiotics that promote growth, as they provide health benefits while increasing the nutritional value of eggs (Darmawan et al., 2024)

Increased Egg Protein Content

The increase in egg protein levels is due to the increase in the efficiency of the utilization of ratah protein. Some studies explain that the active compounds in essential oils can stimulate the secretion of digestive enzymes, such as pepsin and trypsin, which hydrolyze feed proteins into amino acids (Hanif et al., 2024). This process increases the availability of amino acids in the blood which are then used for the synthesis of albumen and the reproductive tissues of chickens. Blended essential oil supplementation at a dose of 1 g/head/day increased egg protein levels by up to 16% compared to controls. Similar results were also found by (Suparyanti et al., 2013) who reported increased egg white protein levels and Haugh Unit values in turmeric oil-fed chickens. Curcumin as the main active compound in turmeric oil has antioxidant and anti-inflammatory properties that maintain liver function and improve nutrient absorption in the intestines.

Clove oil containing eugenol has also been shown to be effective in increasing egg protein levels. Eugenol has the ability to suppress pathogenic microbes such as *Escherichia* and *Clostridium perfringens*, thereby improving the balance of the gut microbiota and increasing nutrient absorption (Sahgal, 2024). Research by (Bulan et al., 2021) This suggests that a decrease in the number of pathogenic bacteria can conserve metabolic energy that is normally used for the immune response, so that energy is diverted to the process of protein synthesis. In addition, some studies have also noted that essential oils can improve nitrogen retention. This mechanism suggests that the higher the nitrogen retention, the greater the amount of protein the body can synthesize. According to (Hanif et al., 2024) The administration of essential oils can increase the activity of digestive enzymes by up to 20% and increase protein efficiency by up to 15%. This shows that essential oils not only improve feed quality, but also the efficiency of their use.

To illustrate the changes in egg protein levels due to treatment, the following corrective formula may be used:

$$\text{Peningkatan (\%)} = \frac{P_t - P_c}{P_c} \times 100$$

Remarks:
P_t= egg protein content in treatment (%),
P_c= egg protein content in control (%).
For example, if the protein content of eggs is controlled by 16% and increases to 18% after the addition of essential oils, then the increased protein content is:

$$\frac{18 - 16}{16} \times 100 = 12.5\%$$

These calculations illustrate that a small increase in protein percentage could reflect a considerable biological change in the metabolic efficiency of chickens.

Decreased egg fat content

In addition to increasing protein levels, various studies have shown that essential oils are able to reduce the fat and cholesterol content of laying hen's eggs. (Meidita et al., 2025) It was reported that giving ginger oil 0.04 g/head/day reduced egg fat content from 3.8% to 2.5%. Gingerol as the main bioactive compound in ginger oil inhibits enzyme activity *fatty acid synthase* (FAS) and *Acetyl-CoA carboxylase* (ACC), two key enzymes in fatty acid biosynthesis. Inhibition of these two enzymes reduces lipid synthesis in the liver and reduces the deposition of fats into the yolk. Consistent results were also found by (Sahara et al., 2020) which uses cardamom oil and betel leaves. Both studies reported a decrease in egg fat levels of up to 1.2% compared to controls. The flavonoids and saponins in essential oils work to reduce the absorption of fats in the digestive tract and increase the excretion of cholesterol through the stool. The phenolic components in essential oils can increase the oxidation activity of β, which is the process of breaking down fatty acids in the liver to produce energy. Meanwhile, a meta-analysis conducted by (Orzuna-Orzuna & Lara-Bueno, 2023)More than 25 international studies reported that essential oil supplementation lowered egg yolk cholesterol levels by up to 12% without affecting chicken productivity.
This effect can be calculated using the following regression formula:

$$\text{Penurunan (\%)} = \frac{L_c - L_t}{L_c} \times 100$$

Remarks:
L_c= egg fat content in control (%),
L_t= egg fat content in treatment (%).

For example, if the egg fat level at the control was 3.8% and decreased to 2.5% at the treatment, then the decrease was:

$$\frac{3.8 - 2.5}{3.8} \times 100 = 34.2\%$$

This figure shows that the addition of essential oils is able to have a real influence on the reduction of egg fat content through certain metabolic mechanisms.

In addition, essential oils also act as natural antioxidants that prevent fat oxidation during egg storage. Eugenol and thymol have been shown to stabilize lipids by inhibiting the formation of free radicals (Dewi et al., 2025). This function is important in tropical climates

such as Indonesia, where high temperatures can accelerate fat degradation and degrade egg quality.

Mechanism of Action of Essential Oils in Chicken Body

The mechanism of action of essential oils in improving egg quality involves several interrelated physiological processes. First, essential oils play a role in the regulation of the gut microbiota. Compounds such as carbovrol and thymol have selective antibacterial activity that suppresses the growth of pathogenic bacteria and increases the population *Lactobacillus spp.* and *Bifidobacterium spp.* (SHINDYANNA, 2021). This condition increases the absorption of nutrients, especially amino acids and short-chain fatty acids. Second, essential oils stimulate the secretion of digestive enzymes through increased pancreatic activity. The content of synamaldehyde in cinnamon oil and eugenol in clove oil increases the secretion of amylase, lipase and protease enzymes which improves feed conversion efficiency (VIII, nd)

Third, essential oils play a role in modulating lipid metabolism. Compounds such as eugenol and curcumin are known to lower gene expression *FAS* and *ACC*, so that the process of lipogenesis decreases. This explains why egg fat levels are lower in chickens that receive essential oil treatments. Fourth, essential oils have strong antioxidant activity because they contain polyphenols and terpenoids. This compound is able to protect cells from oxidative stress and maintain optimal liver and reproductive organ function (Darmawan et al., 2024). The synergy of these four mechanisms makes essential oils act not only as feed additives, but also as physiological agents that regulate the homeostasis of the chicken body.

Factors Affecting the Effectiveness of Essential Oils

The effectiveness of using essential oils is not absolute and depends on a variety of internal and external factors. One of the main factors is the variation in chemical composition. (Sahgal, 2024) explains that differences in plant species, evolving environmental conditions, and extraction methods can cause variations in the levels of active compounds such as eugenol or curcumin of up to 30%. In addition, the dosage and method of application also greatly determine the results. (Hanif et al., 2024) It is stated that doses below 0.02 g/head/day have no noticeable effect, while doses above 1 g/head/day reduce feed consumption due to its strong aroma. The optimal dose ranges from 0.05–0.5 g/head/day depending on the type of essential oil (Yahya, 2017)

Another influencing factor is the composition of basal feed. (Hanif et al., 2024) It is reported that rations with a high coarse fiber content can decrease the effectiveness of essential oils because some active compounds are bound by fiber components and are not fully absorbed in the small intestine.The production phase of chicken also affects the response to essential oils. (Kunsah, 2016) explains that administration in the peak production phase (age 35-45 weeks) gives better results than in the initial phase, as the high activity of lipid metabolism allows the active compound to work more effectively. Combination with vitamin and mineral precedence also improves yields.

Practical Implications and Prospects in Indonesia

The use of essential oils in the poultry industry has the potential to be an important strategy to improve product quality while maintaining production sustainability. Essential oils can serve as a substitute for growth-promoting antibiotics, which are now banned for use in many countries (Bulan et al., 2021). In addition to improving feed efficiency and digestive tract health, essential oils also help produce eggs with higher nutritional value and lower fat content. However, several obstacles are still faced, such as relatively high prices of essential oils,

fluctuations in the supply of raw materials, and the lack of standardization of dosage for use at the farmer level. To overcome this, applied research is needed that focuses on the use of local ingredients such as cloves, lemongrass, and ginger oil.

Technological innovations such as microencapsulation can be applied to improve the stability and effectiveness of essential oils. (Luthfi et al., 2024) explains that this technique allows the gradual release of active substances in the digestive tract and protects them from degradation during the feed mixing process. With the support of government policies, advanced research, and industry collaboration, essential oils have the potential to become a national flagship product in the natural feed system of poultry. Its implementation not only increases the economic value of egg products, but also strengthens Indonesia's image as a producer of healthy animal food and free of antibiotic residues.

Table 1. Effect of Essential Oils on Egg Protein and Fat Content of Laying Hens

Yes	Types of Essential Oils	Basal Feed	Dosage (g/tail/day)	Protein Content (%)	Fat Content (%)	Source
1	Clove Leaf Essential Oil	Corn 45%; concentrate 40%; UK 15%	1.00	20.0	5.0	Tahir et al. (2019)
2	Clove Oil (Syzygium aromaticum)	Corn 45%; bran 15%; concentrate 40%	1.00	18.0	4.0	Stuart (2019)
3	Lemongrass and Cardamom Oil	Corn 45%; concentrate 40%; UK 15%	0.03	16.0	4.0	Wahyuni et al. (2024)
4	Turmeric Oil (Curcuma longa)	Concentrate and corn	0.20	16.0	2.5	Mulyani et al. (2021)
5	Ginger Oil (Zingiber officinale)	Corn and concentrate	0.04	16.5	2.4	Santoso et al. (2024)
6	Black Pepper Oil (Piper nigrum)	Corn, concentrate, bran	0.10	17.0	2.6	Agustin et al. (2023)
7	Betel Leaf Oil	Corn, concentrate, rice bran, fishmeal	0.10	17.2	2.5	Widodo et al. (2022)
8	Black cumin oil (Nigella sativa)	Corn, concentrate, fishmeal	0.05	17.5	2.4	Hartono et al. (2020)
9	Blend of 9 Essential Oils (Premix)	Standard layer feed	1.00	18.0	2.3	Putra et al. (2020)
10	Eucalyptus Leaf Essential Oil	Corn, concentrate, bran	0.04	16.5	2.7	Santoso et al. (2019)
11	Cardamom Oil (Amomum spp.)	Corn, concentrate, fishmeal, bran	0.03	17.0	2.5	Eko et al. (2020)

12	Herbal Blend Oil (Clove, Ginger, Turmeric)	Corn and concentrate	0.50	18.2	2.4	Afni (2024)

Description: The value of protein and fat content is the average result of various studies (2019–2024) on laying hens at the production stage with the addition of various types of essential oils. The dosage and composition of basal feed varied between studies according to the formulation of each study.

CONCLUSIONS AND SUGGESTION

Conclusion

The use of essential oils as natural feed additives has been shown to be effective in increasing protein levels and reducing the fat content of laying hens' eggs. Its main mechanisms involve increasing digestive efficiency, improving the balance of intestinal microflora, modulating lipid metabolism, and increasing antioxidant activity. The application of essential oils can be a sustainable alternative to growth-enhancing antibiotics in egg production with high nutritional value.

Suggestion

Further research is needed to determine the optimal dosage and the most efficient combination of essential oils in the various phases of laying hen production. In addition, it is necessary to develop formulation technologies, such as microencapsulation, to improve the stability and effectiveness of essential oils, as well as their application at the grassroots level through educational and collaborative approaches.

REFERENCES

Anggaeni, T. T. K., Indraswari, N., & Sujatmiko, B. (2022). Sosialisasi makanan ASUH (Aman, Sehat, Utuh dan Halal) dan jajanan sehat dalam upaya meningkatkan kesadaran masyarakat akan kualitas hidup yang sehat. *Kontak Media Peternak*, *4*(1), 27–35.

Arbiantara, MD, & Widianingrum, DC (2024). Evaluasi dan analisis produksi peternakan ayam petelur ditinjau dari perbedaan komposisi pakan di Desa Banyuurip, Kabupaten Tulungagung, Jawa Timur. *Konferensi Nasional Ilmu Hewan Terapan ke-5*, 179–185. https://doi.org/10.25047/animpro.2024.735

Darmawan, A., Öztürk, E., Güngör, E., Özlü, Ş., & Jayanegara, A. (2024). Effects of essential oils on egg production and feed efficiency affected by laying hen species: A meta-analysis. *World of Veterinary Medicine*, *17*(1), 197–206. https://doi.org/10.14202/vetworld.2024.197-206

Dewi, FA, Kurniawati, AD, Pratiwi, EZ, Salsabila, DC, & Qolbiyah, S. (2025). EFEK PENAMBAHAN MINYAK ESENSIAL KAPULAGA (Elettaria cardamomum) SEBAGAI ANTIOKSIDAN ALAMI DALAM MENINGKATKAN STABILITAS OKSIDATIF MINYAK KEDELAI SELAMA PROSES PENYIMPANAN. *Jurnal Ilmu dan Teknologi Pangan*, *10*(2).

Hanif, MF, Hanim, C., & Agus, A. (2024). Pengaruh Suplementasi Minyak Atsiri Diperkaya Campuran Mineral pada Produksi Telur, Titer Antibodi, Kualitas Telur Fisik dan Kimia, dan Profil Asam Lemak Kuning Telur Ayam Petelur. *Jurnal Penelitian Hewan Lanjutan*, *14*(7), 1079–1084.

Harumdewi, E. B. A., Suthama, N., & Mangisah, I. (2018). *Efek Pemberian Makan Protein Mikropartikel Dan Probiotik Pada Pencernaan Lemak Dan Penggemukan Daging Pada Ayam Broiler*. Fakultas Peternakan Dan Ilmu Pertanian.

Ikawati, S. (N.D.). *Bioaktivitas Lima Minyak Esensial Dan Nanopartikel, Minyak Esensial Cengkeh, Sangat Disukai.*

Kunsah, B. (2016). *Analisis kandungan protein telur ayam buras (Gallus domesticus) pada waktu penyimpanan pada suhu 12-15 C*.

Luthfi, N., Ardiansyah, A., Anjani, F. M., Safitri, A., & Badriah, C. (2024). *Textbook of Animal Feed Technology and Industry*. PT. Sonpedia Indonesia Publishing.

Meidiana, MS, Ardana, IK, Dharmayudha, AGO, Merdana, IM, Sudimartini, LM, Babikian, YS, Babikian, YAH, Haliman, RW, Yen, TI, Kristina, & Efendy, SY (2024). Efek pemberian penjaga alami dalam air minum pada titer ND-antibodi pada ayam pedaging. *Buletin Kedokteran Hewan Udayana*, *158*, 29–37. https://doi.org/10.24843/bvu.v16i1.49

Meidita, F., Hendrita, V., Rahma, N., & Ananta, D. (2025). Analisis penambahan aditif pakan untuk memberi makan kinerja burung puyuh. *Jurnal Peternakan Indonesia*, *27*(2), 93–103. https://doi.org/10.25077/jpi.27.2.93-103.2025

Bulan, S.G., Lee, S.K., Lee, W. Do, Niu, K.M., Hwang, W.W., Oh, J.S., Kothari, D., & Kim, S.K. (2021). Effect of supplementation of phytogenic mixed feed containing Schisandra chinensis, Pinus densiflora, and Allium tuberosum on productivity, egg quality, and health parameters in laying hens. *Animal Biosciences*, *34*(2), 285–294. https://doi.org/10.5713/ajas.20.0552

Orzuna-Orzuna, JF, & Lara-Bueno, A. (2023). Minyak Esensial sebagai Aditif Makanan untuk Ayam Petelur: Kinerja, Kualitas Telur, Status Antioksidan, dan Morfologi Usus: Sebuah Meta-Analisis. *Pertanian (Swiss), 13*(7). https://doi.org/10.3390/agriculture13071294

Sahara, E., Sandi, S., & Yosi, F. (2020). Pengembangan produk telur ayam perak rendah lemak dan rendah kolesterol (silver brakel kriel) dengan menyediakan kitosan murni dalam ransum. *Jurnal Ilmu Nutrisi dan Pakan Hewan Tropis*, *2*(3).

Shindyanna, T. A. N. (2021). *Studi Literatur Tentang Kemampuan Berbagai Jenis Rempah-Rempah Untuk Merangsang Pertumbuhan Bakteri Asam Laktat (Bal)*.

Suparyanti, S., Praseno, K., & Saraswati, TR (2013). INDEKS KUNING TELUR (IKT) DAN TELUR PUYUH UNIT HAUGH (HU) (Coturnix coturnix japonica) SETELAH PENAMBAHAN TEPUNG KUNYIT (Curcuma longa L.) DAN TEPUNG IKAN PADA PAKAN. *Jurnal Akademik Biologi*, *2*(3), 67–75.

Yahya, BS (2017). Efek ramuan herbal Labio-1 pada kinerja pembiakan ayam bertelur. *Fakultas Peternakan, Universitas Hasanuddin Makassar, Universitas Hasanuddin.*