The Quality of Chicken Eggs Fed Black Pepper (*Piper nigrum* L.*)* Flour

Jein Rinny Leke [1*], *Jacqueline T* Laihad [1], *Linda* Tangkau[1], *Florencia* Sompie[1] and *Ratna* Siahaan[2]

[1.]*Department of Animal Husbandry, Sam Ratulangi University, Manado 95115, Indonesia*
[2]*Department of Biology, Faculty of Mathematics and Natural Sciences, Sam Ratulangi University, Manado 95115, Indonesia*

Abstract: The objectives of this study were to analyze the quality of laying hen eggs fed with feed containing black pepper *(Piper nigrum* L*)* flour. A total of 200 brown laying hens strain MB 402 (50 weeks-old) were used in this experiment. The research design used was Completely Randomized Design (CRD) and further analysis was conducted using Duncan's Multiple Range Test. The Treatments given black pepper flour were 0%, 0.5%, 1%, 1.5%, and 2%. This research was conducted for 6 weeks. Parameters included egg weight (g/egg), egg yolk weight (g/egg), yolk index, and egg yolk color. The results showed that feeding chickens with up to 2 % BPF increased significantly the effect ($P < 0.01$) on egg yolk weight, yolk index, egg yolk color but not significantly different ($P > 0.05$) on egg weight. This research concluded that BPF diets can be fed to laying hens up to 2 % to produce eggs without negative effects on the egg quality.

1 Introduction

The world poultry population has increased by 86% in 2017 over the past two decades (2001–2021) [1]. The increasing world population of laying may persist in the future [2]. The quality and quantity of the final product from livestock are influenced by interaction between nutrition and health in the livestock production system. Additional factors linked to this include the environment and management, along with the supplementary components incorporated into animal feed to optimize livestock production and performance. These components should ensure the well-being of both livestock and humans, refrain from leaving residues in consumer products, and avoid environmental pollution. The most studied and used additives today are plants and their extracts which have shown good results [4,5]. Phytogenic additives play an important role in preventing disease in livestock and maintaining health. Phytogenic is good for consumers because it is considered a natural alternative to synthetic compounds.

Black pepper is commonly used as a spice or alternative medicine ingredient, because of its active ingredient called piperine. This compound has potential application as a natural additive intended for animal production because it has several advantages. It is a natural product that can be found in large quantities with low production costs [6]. In addition, it increases the metabolic potential in livestock, mammals, leaving no residue in the animal organism.

Black pepper is an herb that has been known as a spice that improves digestion. Black pepper is a medicinal herb used in human food. Black pepper is cultivated for its fruit, usually dried and used as a spice [7]. Black pepper works to help fight germs (microbes) and to stimulate the stomach to increase the flow of digestive juices. It acts as growth promoters in digestion and absorption. It is an important feed additive for increasing growth rate, feed

* Corresponding author: rinileke@gmail.com

efficiency and preventing intestinal infections. The use of herbs and plant extracts is most useful for poultry production as well as to control the negative effects of antibiotics on health and the environment [8]. Adding herbs to broiler chicken feed can increase production.

Pepper is commonly used in feed and traditional medicine as antioxidants. Black pepper contains glutathione peroxidase and glucose-6-phosphate dehydrogenase. The piperine increases absorption of selenium absorption, vitamin B complex, beta carotene and curcumin as well as the nutrient.

Piperine increases thermogenesis of lipids and accelerates energy metabolism in the body for the production of serotonin and beta-endorphin in the brain. Piperine also increases thermogenesis of lipids, speeds up energy metabolism in the body, and increases the production of serotonin and beta-endorphin in the brain. Pepper has antioxidant properties and anti-carcinogenic effects [9].

`[10] reported significant reduction in abdominal fat in broilers given black pepper at 0.2 g/kg feed and 2 mg/ml. An increase in Feed Conversion Ratio (FCR) and Body Weight Gain (BWG) was also obtained in broiler chickens fed with black pepper at 2.5, 5.0, 7.5, and 10 g/kg feed when compared with the group without black pepper [11, 12]. This increase is from activity of the bioactive constituents in black pepper in protecting the villi from oxidative damage [13] that caused higher body weight. The aim was to analyze feeding black pepper (*Piper nigrum* L.) flour on chicken egg quality.

2 Materials and Methods

2.1 Process for Making Black Pepper Flour

The black pepper used was taken from Bersehati Market, Manado City, North Sulawesi Province. Black pepper seeds were dried under the sun for 3-4 days. After dried, they were then ground into black pepper flour.

2.2 Research Materials

This research was carried out at the CV Gunawan Livestock Company, Kayuwatu Village, Mapanget District, Manado City. The research was carried out for 6 weeks.

2.3 Treatment Rations

Nutrient composition in rations for laying hens were shown in Table 1 below.

Tabel 1. Nutrient Content of Treatment Rations

Content	R0	R1	R2	R3	R4
Protein (%)	17.44	17.57	17.58	17.59	17.60
Fat (%)	7.53	7.66	7.67	7.67	7.68
Crude Fiber (%)	5.34	5.47	5.47	5.48	5.49
Ca (%)	2.17	1.87	1.87	1.87	1.87
P (%)	1.02	1.03	1.03	1.03	1.02
Metabolism Energy (Kcal/kg)	2710.90	2727.24	2727.28	2727.32	2727.36

Note: Based on results of average nutrient content

The research method used Completely Randomized Design (CRD) consisted of 5 treatments and 5 replications and 4 laying hens were placed in each replication for a total 100 laying hens. Composition of treatment rations were namely R0: 100% basal control (no black pepper flour/BPF), R1:95% basal ration/BR + 0.5% BPF, R2: 99.0% BR+ BPF 1%, R3: 98.5% BR+ 1.5% BPF, R4: 98.0% BR+ 2.0% BPF.

2.4 Research Variables

Egg weight (g/egg), egg yolk weight (g/egg), yolk index, and egg yolk color.

2.5 Data Analysis

Data were tabulated by Microsoft Excel and analyzed by Analysis of Variance (ANOVA) for Completely Randomized Design (RAL) with 5 treatments and 5 replications. Then, further analyzed by Duncan's multiple range test on variables that show significant differences [14].

3 Results and Discussion

The results showed that feeding birds with 2 % black pepper flour/BPF increased significantly ($P < 0.01$) on egg yolk weight, yolk index and egg yolk color but not significantly different ($P > 0.05$) on egg weight.

Table 2. Effect of feeding black pepper flour up to 2% level on egg weight, egg yolk, yolk index and yolk color

Treatments	Egg weight (g/egg)	Egg yolk weight (g/egg)	yolk index	egg yolk color
P0	60.77±0,57	12.43^{a}±0.46	0.36^{a}±0.01	10.14^{a}± 0.04
P1	60.54±0,43	13.14^{b}±0.36	0.36^{a}±0.02	10.22^{b}±0.17
P2	61.04±0,30	13.77^{b}±0.78	0.38^{b}±0.01	10.64^{c}±0.13
P3	60.96±0,14	13.29^{b}±0.84	0.38^{b}±0.01	10.39^{b}±0.35
P4	60.59±0,44	13.25^{b}±0.11	0.38^{b}±0.01	10.6^{c}±0.38
SE_{mean}	0.18	0.25	0.00	0.11
P_{value}	0.24	0.03	0.00	0.01

Note: the number followed by the same letter in the same column is not significant difference p=0.05

Previous study [15] reported that performance of laying hens was not significant ($p > 0.05$) but significant ($p < 0.05$) for percentage of egg shell where inclusion level of 0.30% disturbed quality of egg shell. Triglyceride levels increased significantly ($p < 0.05$) based on increasing levels of black pepper in chicken feed. Based on this, black pepper can be used in laying hen rations as a phytogenic additive without affecting their performance. However, this inclusion caused a decrease in the percentage of egg shells and increased triglyceride levels in the bloodstream.

Black pepper is rich in glutathione peroxidase and glucose-6-phosphate dehydrogenase [16 - 17] said that antioxidant and radical properties of black pepper seeds contained piperine that can increase absorption of selenium, vitamin B complex, beta-carotene and curcumin as well as other nutrients. In addition, alkaloids actively modulate benzo-a-pyrene metabolism via cytochromes which are important for metabolism and transport of xenobiotics and lipid thermogenesis metabolites and improve digestive flow.

Black pepper fruit contain tannins, alkaloids, saponins, terpenes, steroids, flavones, flavonoids (catechin, myricetin, and quercetin), and piperine, and several others [18-19]

revealed that black pepper fruit is rich in essential oils (1.0–2.5%) and alkaloids (5–9%). In addition, piperine, piperettine, chavicine, and piperidine are the main alkaloids in black pepper fruit. [20] found black pepper contains 1.7–7.4% piperine. This piperine, the main bioactive compound in black pepper, has a beneficial function to aid digestion and nutrient utilization by stimulating the release of digestive enzymes [21]. The pharmacological role of black pepper is also related to the activity of phytochemicals such as terpenoids, phenols, flavonoids, alkaloids, and carotenoids [22- 23]. [24] reported that the digestibility of ileum, crude ash, crude protein, crude fat, calcium, and phosphorus showed a linear increase associated with increasing phytogenic feed additives in the diet.

Black paper contains essential oils. The yield of essential oil from BP seeds (1.24–5.06%) and leaves (0.15–0.35%). Research on laying hens found that foods supplemented with essential oils improved the performance, immune response, and egg shell quality of laying hens. Supplementation of essential oils in laying hen feed significantly increased egg production rate and egg weight, but egg mass, feed consumption, and FCR had no effect [25]. [26] also reported that egg weight, egg mass and egg shell thickness were positively influenced by essential oil supplementation. Black pepper also contains glutathione peroxidase and glucose-6-phosphate dehydrogenase which have antioxidant and immunomodulatory effects in animals [27- 28]. Black Pepper has various benefits consisting of antidepressant, antimicrobial, antioxidant, antifungal, anticancer, anti-inflammatory and anti-coccidiostat drugs [18, 27].

The pharmacological value of black pepper is the presence of beneficial metabolites such as terpenoids, xanthophylls, phenols, and flavonoids, among others [18, 23]. Black pepper seeds contain protein, ether extract, minerals (phosphorus, calcium, potassium, magnesium, zinc, iron, etc.), and vitamins such as thiamine, ascorbic acid, riboflavin, and niacin [29]. Several studies show that black pepper does not influence aspects of zootechnical parameters of broiler chickens [30 - 31]. However, blood pressure improves feed intake, improves nutrient digestibility through digestive enzyme stimulation, and inhibits the proliferation of pathogens in the gastrointestinal tract (GIT) through its antimicrobial properties and increases the absorptive capacity of villi to aid nutrient absorption and assimilation [32 - 33]. It has also been found that blood pressure supplementation increases ileal muscle contraction [34 - 35], increasing the thickness of the mucosa and submucosa of the duodenum, jejunum, and ileum in broiler chickens [36]. [37] found an increase in egg quality in laying hens fed diets with black pepper at 0.1–0.5 g/kg feed when compared with laying hens fed diets without black pepper supplementation. Similarly, [31] reported a significant reduction in abdominal fat pad content in broilers fed BP of 0.2 g/kg feed and 2 mg/ml, respectively. An increase in feed conversion ratio (FCR) and body weight gain (BWG) was also obtained in broiler chickens fed with black pepper of 2.5, 5.0, 7.5, and 10 g/kg feed when compared with the group fed with 0 g black pepper/kg feed [32]. This increase can be ascribed to the activity of bioactive constituents in black pepper in protecting the villi from oxidative damage [18, 23], leading to higher Body Weight Gain.

4 Conclusion

Black pepper flour in laying hen rations up to 2% level can increase significantly on egg yolk weight, yolk index, and egg yolk color but not on egg weight.

Acknowledgement. This research was funded by Superior Applied Research Grand/Hibah Riset Terapan Unggulan of University of Sam Ratulangi 2023. Thank you to CV Gunawan as our research partner.

References

1. Statistica. https://www.statista.com/statistics/263962/ number-of-chickens-worldwide-since-1990/, (2023) Accessed online on 31st January 2023.
2. WPP World Population Prospects: The 2017 Revision: Key Findings and Advance. *United Nations Department of Economic and Social Affairs, Population Division.* (2017) Accessed on-line 30th January 2023.
3. U. Gonzales-Barron, F.B. Campagnollo, D.W. Schaffner, A.S. Sant'Ana, V.A.P.Cadavez. Food Microbiology Journal, **91** (2020).
4. A.Valero, M.Hernandez, De Cesare, A. Manfreda, G. Gonzalez-García, P. Rodríguez, D. Lazaro. Journal of Food Microbiology, **184** (2014)
5. A.Valero, M. Hernandez, O. Esteban-Carbonero, D. Rodríguez-Lazaro. Int. J. Food Microbiol. **286** (2018)
6. S.P.Tatli, I. Seven, M. Yılmaz, U.G Şimşek. Animal Feed Science and Technology. **146** (1-2), (2008)
7. M. Moorthy, S. Ravikumar, K. Viswanathan, S. C. Edwin. International Journal of Poultry Science, **8** (2009).
8. O.El-Husseiny, O. S. M. Shalash, H. M. Azouz. Egyption Poutry Scinece, **22** (2002).
9. Nalini, N., Y. Manju, V. Menon. Journal of Medicinal Food, **9** (2006).
10. H. Ghaedi, J. Nasr, F. Kheiri, Y. Rahimian, Y. Miri. Res Opin Anim Vet Sci. **4**, (2014)
11. G.A.M. Al-Kassie, M.A.M. Al-Nasrawi, S.J. Ajeena. Res Opin Anim Vet Sci**. 1**, (2011).
12. K.Ashokkumar, Pandian A, Murugan M, M.K. Dhanya, T. Sathyan, P. Sivakumar, Nat. Prod. Res. **34** (2020).
13. K. Ashokkumar, M.Murugan, M. K.Dhanya, A.Pandian, T.D.Warkentin, Clin Phytosci. **7** (2017).
14. R. G. D Steel, J. H. Torrie. (1995).
15. R.D Melo, F.G. Guimarães Cruz , J. da Costa Feijó, J.P.F. Rufino, L.P. Melo,J.L. Damasceno, Acta Scientiarum. Animal Sciences. **38**, 4 (2016).
16. J.Karthikeyan, P. Rani. India J Exp Biol, **41** (2003).
17. A.N.Khalaf, A. K. Shakya, A. Al-Othman, Z. El-Agbar, H. Farah, J.Biologi, **32** (2008).
18. K. Ashokkumar, A. Pandian, M. Murugan, M.K. Dhanya, T. Sathyan, P. Sivakumar, S. Raj, T.D. Warkentin. Nat Prod Res. **34** (2020).
19. J. Zheng, Y. Zhou, L. Li, DP. Xu, S Li, HB.Li . Nutrients, **8** (2016).
20. S.Khan, K.J. Mirza, F.Anwar, M.J. Abdin. Env Int J Sci Techn. **5** (2020)
21. M.Moorthy, S. Ravikumar, K. Viswanathan, S. C. Edwin. Int. J. Poult. Sci. **8** (2009).
22. L.Zou, Y.Y.Hu, W.X Chen. J. Food. Sci. Technol. **52** (2015).
23. K.Ashokkumar, M.Murugan, M.K.Dhanya, A.Pandian, T.D.Warkentin, Clin Phytosci. **7** (2021)
24. A.A. Amad, K. Männer, K.R. Wendler, K. Neumann, J. Zentek. Poultry Scie, **90** (2011)
25. M. Çabuk, M. Bozkurt, A. Alçiçek, A.U. Çatli, K.H.C. Başer. S Afr J Anim Sci, **36** (2006).
26. O.Olgun, A. Aygun. World's Poultry Science Journal. **72** (2016).
27. J.Karthikeyan, P.Rani. Indian J Exptal Biol. **41** (2003)
28. S.El Tazi, M.A.Mukhtar, K.A. Mohamed, M.H. Tabidi. Glob Adv Res J Agric Sci. **3** (2014)
29. G.E. Nwofia, C. Kelechukwu, B.K.Nwofia. Int. J. Med.Aromat Plants. **3** (2013)
30. A. Galib, M.Al-Kassie, A.Mamdooh, M. Al-Nasrawi, J.A. Saba Res. Opin.Anim.Vet. Sci. **1** (2011).
31. H.Ghaedi, J.Nasr ,F. Kheiri, Y. Rahimian, Y. Miri. Res. Opin.Anim.Vet.Sci. **4** (2014)
32. S. Sanjyal, S. Sapkota. J.Sci.Technol. **12** (2012).

33. A.B. Pliego, M. Tavakoli, A. Khusro, A. Seidavi, M.M.M.Y Elghandour, A.Z.M.Salem. Anim.Biotech. **33** (2020).
34. A.B.Saba, O.A.Tomori. Pak.J.Nutr. **6**.(2007).
35. M.K.G.Naseri, H.Yahyavi . Pak.J. Biol.Sci.**11** (2008)
36. A. Shahverdi, F. Kheiri, M.Faghani, Y. Rahimian, A. Rafiee . Eur. J. Zool. Res. **2** (2013).
37. A.O Akinwumi, O.A,Oshodi, R.A.Atandah, O.O. Okunlola, O, Adeosun, B.D. Odeleye Ann. Res. Rev. Biol. **37** (2022)