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Effects of Garlic Flour (*Allium sativum*) and Pecan Oil (*Aleurites mollucana*) Combination in Feeding Against Egg's Performance and Quality from the MB 402 Egg-Layers

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Abstract. The research is purposed to examine effects of garlic flour (*Allium Sativum*) and pecan oil (*Aleurites Mollucana*) combination in feeding against egg's performance and quality from the MB 402 egg-layers. 200 egg-layers of the MB 402 were taken as samples in this research. Complete Randomized Design was utilized for 35 treatments and repetitions. Each of repetitions contained 8 egg-layers of the MB 402. Then, the treatment used was as follows: P0 = 100 % of Basal Feed (PB), P1 = 95% of Basal Diet (BD) + 4% Garlic Flour (GF) + 1% of pecan oil (PO); P2 = 95% of Basal Diet (BD) + 3 % (GF) + 2 % (PO), P3 = 95% of Basal Diet (BD) + 2 % (GF) + 3% (PO), P4 = 95 % of Basal Diet (BD) + 1 % (GF) + 4 % (PO). Additionally, variables observed comprised of egg's protein, albumen protein, cholesterol, and egg shell's calcium and phosphor. As result, this research finds that combination of garlic flour and pecan oil in feeding up to 1% GF and 4 % PO demonstrated significant difference ($P < 0,01$) against egg's albumen, protein and cholesterol, and egg shell's calcium and phosphor, but it did not give significant effect ($P > 0,05$) against egg's yolk protein. In conclusion, 1 % GF + 4% of garlic flour and pecan oil respectively, in feeding can improve egg's albumen protein, cholesterol, and egg shell's calcium and phosphor, but not provide similar effect on egg's yolk protein.

1. Introduction

Egg-layer is one of considerably potential poultries in Indonesia. It is especially cultivated to commercially produce eggs. Recently, there are 2 groups of egg-layer, consisting of medium and light type. Medium type, typically, has brown shell egg, while the latter, light type, has white shell [1]. Consumable egg is usually produced by egg-layer, which is one of poultries cultivated in Indonesia. It notices that egg-layers population is increasing year by year due to growing demand of society on consumable eggs. According to Directorate General of Husbandry, population of egg-layers in Indonesia improved 0,61% during 2000-2012, yet this improvement in production has not followed by productive acceleration of egg-layers. In addition, egg-layer are an efficient type of chicken to produce eggs since it can lay egg by the age of ± 5 months with total of eggs of 250-300 egg/egg-layer averagely. Its average weight is about 57,9 gr and average production of egg is 70%. Egg-layers circulated in public is final-stock egg-layers. Final stock is special egg-layer cultivated to produce eggs and the result of crossbreeding and selection [2]. Optimal egg production is heavily depended on feeding employed. 70 – 80 % of feeding cost takes a large portion of expenses in the process of egg production.



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Garlic is seasonally herb and clustered plant whose lower part has bulb jointly grouped to form white giant stalk. Garlic contains phytochemical substance, beneficially for feeding due to containing water and protein. It has common characteristics, such as secondary metabolite contents, comprising of high organosulfur substance. This secondary metabolite effects on taste, smell, and pharmacology of garlic. Additionally, it contains 33 organosulfur substances, enzymes, amino acid and mineral. Such substances are allicin, ajoene, *atsiri* oil and flavonoid. Allicin has role as anti-bacteria, anti-fungi and antiviral[3]. Moreover, garlic also has bioactive components having significant role in providing fitness and high anti-microbe endurance. In fact, substances contained in garlic acts as inhibitor against bacterial development. In their research, [4] used garlic extract in feeding against performance of tropical egg-layers in starter phase. The usage of 10% garlic extract showed insignificant effect against ransom consumption, weight growth and ransom conversion.

Meanwhile, Pecan is materials having tremendous potency since it can produce high-productive oil, be obtained and planted easily, and result fruit across the year [5]. Specifically, pecan consists of outer bulk skin (green or dark brown in color during harvest time), while its seed skin has blacked brown and the color of its inner part of seed is light yellow. [6] argued that 100 gr of pecan seed contains 19 gr of protein, 60 gr of fat, 8 gr of carbohydrate, 0,8 gr of calcium, and 2 gr of phosphor. It, also, contains toxalbumin, toxic in nature, but it can disappear during heating process to produce its oil. The egg's quality can be seen from its characteristics, such as cleanness, freshness, egg's weight and shell, index of egg's yolk and albumin, and chemical composition of egg [7]. Based on above description, this research is aimed to know effects of garlic flour (*Allium Sativum*) and pecan oil (*Aleurites Mollucana*) combination against egg's quality and performance from the MB 402 egg-layers.

2. Material and methods

2.1. Process of garlic flour (*Allium sativum*)

Garlic was purchased from Bersehati Market in the City of Manado, Province of North Sulawesi. Its price was Rp. 40,000/kg. It, then, was sunbathed under sunlight and grinded to produce brown flour of garlic.

2.2. Process of Pecan (*Aleurites mollucana*) oil

Pecan seed used was purchased in Kotamobagu, Province of North Sulawesi. It was grinded and added with water by ratio of 1:3 from total of pecan seeds. After completely mixed in suntan form, it was poured into container. Later, it was idle for a night. Upper part was taken and cooked to produce oil.

The control diet (based diet) was formulated to contain 51% corn, 10 % rice bran, 4% CaCo₃, 35 % commercial diet. Garlic flour and pecan oil in four experimental levels to substitute based diet. The treatments were: P0 = 100% based diet (BD); P1 = 95% BD + 4% Garlic flour (GF)+ 1 % Pecan oil (PO); P2 = 95% + 3% (GF)+2%(P0); P3 = 95% + 2%(GF)+3%(P0);P4 = 95% + 1% (GF)+4%(P0). Chemical composition of garlic flour were: 22,53% crude protein, 4,44 % crude fiber, 3,61 %fat,3,12 % 22. 1,29 % P, and 3822,53 Kcal/kg. Pecan oil were: 98,97 % fat, 9315 Gross Energi (kcal/kg), and chemical composition of the diets are shown in Table 1.

Table 1. Chemical composition of the diets

Nutrients	Diets				
	P0	P1	P2	P3	P4
Crude protein (%)	17.45	17.48	17.25	17.03	16.80
Fat (%)	4.67	4.61	4.57	4.52	4.49
Crude Fiber (%)	6.78	7.58	8.54	9.49	10.44
Ca (%)	2.33	2.34	2.30	2.27	2.24
P (%)	1.142	1.13	1.12	1.111	1.09
ME(Kcal/kg)	2781.5	2869.85	2906.14	2942.442	2978.73

Materials used in this research was Medium Brown (MB) egg-layers aged of 22-30 weeks with homogenous body weight ($1.458 \pm 20,85$ g). Those egg-layers were obtained from egg-layer breeder of CV Gunawan, located in the Sub-district of Mapanget, the City of Manado.

2.3. Cages

In this research, cages used was battery cage, and each unit of unit was for 4 egg-layers. Specifically, battery cage had 25 squares. It had four layers equipped with door and contained 8 egg-layers. The equipment for this research contained of feeding box, drinking container, basket (for containing feed given during a week), egg's tray (to collect egg), label (to mark treatment given in drinking and feeding for egg-layers), digital scale (by 5kg of capacity with calibration of 1 gr to weight feed's weight), plastic coating (to collect egg-layers' carcass), stationary (to record result obtained during research), egg's yolk color fan (to determine egg's yolk), and screw micrometer with 0,05 mm of calibration.

Further, in measuring egg variable during the research, digital scale was used to weight egg's weight, yolk, albumen, and shell. Other tools were spatula to separate egg's yolk and albumen, observation glass to examine egg's yolk and albumen, container to place observed eggs, screw micrometer to measure thickness of egg's shell, porcelain dish to weight egg or egg's yolk, and observation table to record observed result. Feeding materials used in this research was corn, husk, fish flour, CaCO_3 , Cal 9.36 concentrate, and added with combination of garlic flour and pecan oil.

Eggs taking was done every morning after feeding for 8 weeks of cultivation period. Later, eggs were arranged in egg tray having been given code according to treatment and repetition. There were 50 eggs for each treatment. Observation and measurement of physical quality was directly performed in the Husbandry of CV Gunawan. For chemical analysis, 5 eggs were used for each treatment of egg's protein and cholesterol, calcium, phosphor and shell.

2.4. Variables

2.4.1. Protein content

Hence, protein content of egg's yolk was examined in the Laboratory of Biochemical, Faculty of Husbandry, Universitas Gadjah Mada. In observation, protein content of egg's yolk was observed once, which was in the last week of the research, using 2 eggs taken from each unit of treatments. Principally, semi-micro *Kjeldahl* method [8], used to observe egg's protein content, is a method which nitrogen binding of material can be broke down and bound by solid sulfate acid in ammonium sulfate.

2.4.2. Cholesterol

Observation of egg's cholesterol was done once, which was in the last week of the research, using 2 eggs taken from each unit of treatments. The result was compared with DO from standard solution, so that the level of sample's cholesterol could be measured. The test of egg's cholesterol was performed in the Laboratory of Biochemical, Faculty of Husbandry, Universitas Gadjah Mada.

2.4.3. Calcium and Phosphor

The analysis utilized AAS instrument. Sample of eggshell was taken in accordance with treatment code. This experiment was analyzed by AAS performed in the Laboratory of Biochemical, Faculty of Husbandry, Universitas Gadjah Mada.

2.5. Data analysis

The result was statistically calculated with completely randomized design (RAL) method. Whereas, there was difference between treatment, the following test was performed with DMRT (Duncan's Multiple Range Test), according to [9].

3. Results and discussion

3.1. Protein content

The data of average protein content of egg's yolk derived from the MB 402 egg-layers was around 15.40 %-16.10 %. In addition, protein content of mixed egg's yolk and albumen was 14.02%-15.41 %. [10] postulated that protein content of egg's albumen and yolk was 9,70%-10,60% and 15,70%-16,60%, respectively. From the research's experiment, the result of egg's protein content was still in normal condition with treatment feeding using garlic flour and pecan oil.

Based on the result of statistical analysis, it demonstrates that utilization of 1 % of garlic flour and 4 % of pecan oil in feeding for egg-layers had insignificant effect ($P > 0,05$) against protein content of egg's yolk, but, on the other hand, it provided significant effect ($P < 0,01$) against egg's protein content. It, then, shows that ransom giving containing garlic flour and pecan oil provided significant effect against protein substance of egg's yolk and egg. Additionally, protein had some chemical natures, such as ionization, crystallization, denaturation, and colloid system, and it could be soluble in water (polar) and dissolvable protein into water. [11] argued that small size of poultry's eggs had been affected by protein substance and amino acid in its feeding. Amino acid, thus, had significant impact on egg's weight. Therefore, improvement in egg's weight could be happened since garlic (*Allium Sativum*) contained acid amino, such as allicin, sordini, allyl and diallyl sulfide, helping in protein absorption for poultry's needs.

Increasing of raw protein substance in egg's yolk was also caused by effectiveness in active substance contained in garlic, which could accelerate pancreas enzyme activity, so that digestion process enzymatically in duodenum could improve and protein absorption was also optimal. Similarly, previous statement is supported by [12], one of working mechanisms from bioactive in improving reproduction performance in poultry was inhibiting pathogenic microorganism growth inside digestion system, or it could be said as anti-bacteria.

Also, [13] explained that egg's albumen was one of parts in egg having 58%-60% of egg's weight and had to layers, thick and aqueous layer. [14] added that thick layer consisted only 3% of total volume of egg's albumen, while aqueous layer contained protein having gel in nature related to total of protein ovomucin. Following, in their research, [15] stressed out that albumen increased due to O₂ disposing through shell's pores. In an egg, egg's albumen had higher percentage than egg's yolk. Based on [16] 53 gr of egg had 65,64% of egg's albumen, 23,61% of egg's yolk, and 10,75% of egg's shell. Protein of egg's albumen, then, was constructed from 54% of ovum-albumin [17]. This albumin contained most of liquid in egg, which was 67% and more than 50 % of egg's protein, it also had niacin, riboflavin, chlorine, magnesium, kalium, sodium and sulfur. Subsequently, albumin comprised of four different layers, a layer having thick and thin layer consistency.

3.2. Cholesterol

Egg's cholesterol average was 196,1-222,5 mg/100 gr. While, [18] conveyed that egg's cholesterol was 238,19-287,58 mg/100gr. It depicts that egg's cholesterol from the MB 402 egg-layers fed by combination of garlic flour and pecan oil was still in normal state, and it could decrease cholesterol level, caused by bioactive substance from garlic playing role in decreasing egg's cholesterol. Pecan oil consisted of E vitamin, carotenoid, and C vitamin, having anti-oxidant characteristic. Further, E vitamin in *Aleurites mollucana* (pecan) oil was lipid anti-oxidant effectively maintaining biology system.

The decreasing of cholesterol was caused by active substance in garlic, such as ally sulfide; it functioned as anti-cancer, anti-microbe, anti-oxidation, anti-inflammation, stimulated immune system, regulated blood pressure, and decreased blood cholesterol. [19] argued that decreasing of HDL level could be caused by incoming cholesterol from lipoprotein, which its HDL headed to cell membrane. HDL utilization was for steroid synthesise, such as hormone or bile salt located in liver. Meanwhile, HDL was influenced by feed, gene, environment and poultry condition. A better production of egg was further extracted and disposed to bile pouch as bile acid (liquid). [20] said that 5% utilization of garlic's

leaves extract through drinking water in fact increased egg production and decreased cholesterol in serum and egg's yolk.

In addition, pecan oil (*Aleurites mollucana*) could improve egg's production through essential fatty acid. Production and reproduction increasing of egg was heavily depended on feeding given, mainly essential fatty acid, high-multiple binding fatty acid was responsible against permeabilities and membrane activation in binding enzyme and managing cell proliferation, bile acid component and composer of steroid hormone including reproduction hormone. Another benefit was that omega-3 fatty acid would be metabolized in producing eicosanoid, such as prostaglandin [21].

Table 2. Effect of garlic flour (*Allium sativum*) and pecan oil (*Aleurites mollucana*) combination in egg's production and performance from the MB 402 egg-layers

Variables	Treatments					Pvalue ²
	P0	P1 4% GF+1% PO %	P2 3 % GF + 2% PO	P3 2 % GF + 3 % PO	P4 1 % GF + 4 % PO	
Protein content of egg's yolk (%)	16.10 ±0.71	15.72± 0.91	15.82± 0.88	15.74± 1.42	15.40± 0.45	Ns
Egg's protein content (%)	14.02 ^a ±1.43	14.48 ^a ± 1.21	14.35 ^a ± 1.02	15.41 ^b ± 0.33	15.38 ^b ± 0.30	*
Egg's cholesterol (mg/100g)	222.5± 0.42	221.7± 0.60	219.4±10.84	222.4± 1.26	196.1± 15.68	*
Eggshell's calcium (%)	23.25 ^c ±0.16	22.23 ^b ± 0.68	23.13 ^c ± 0.46	22.61 ^b ± 0.86	21.79 ^a ± 1.69	*
Eggshell's phosphorus (%)	0.13 ^a ± 0.00	0.13 ^a ± 0.00	0.13 ^a ± 0.00	0.13 ^a ± 0.00	0.14 ^b ± 0.00	*

Note: ^{a-c}=Means in row with different superscripts are significantly different at the P-value shown

¹SEM= pooled standard error of mean (n=4)

²significance level: *P<0.05; ** P<0.01; NS=not significant P>0.05

3.3. Calcium and phosphor

Based on above table 2, the research finds that eggshell's calcium was 21.76-23.25, and eggshell's phosphor was 0.13-0.14. While, [23] found that eggshell's calcium was 28.48-31.13 under the treatment of 12% supplementation of papaya leaf and eggshell's phosphor was 0.46-0.54 %.

Moreover, based on analysis result, this research discovers that combination of garlic flour and pecan oil provided significant effect (P<0.01) against eggshell's calcium and phosphor. Thus, it demonstrates that, under the treatment, garlic flour and pecan oil contained calcium level easily absorbed through mixed feeding. [24] stated that poultry's ability to absorb and utilize calcium and phosphor was depended on D vitamin supply in ransom. [25] put out, then, that the main nutritional factor closely related to egg's quality was calcium, phosphor, and D vitamin. Source of calcium used in egg-layers feeding would influence on calcium absorption, subsequently affected against calcium metabolism in eggshell formation. Hence, the most determining mineral in eggshell formation was calcium and phosphor. If there was lack of mineral absorption, mineral disposing (calcium and phosphor) would directly take mineral reserves in tibia bone for eggshell formation process. Calcium deficiency would lead to easily cracked and thin eggshell. Whereas calcium absorption in feeding did not meet requirement in eggshell formation, calcium them was taken from medullar bone. In medium-size egg-layers aged 21-40 weeks, calcium need was 3,00 %, while egg-layers aged more than 40 required calcium of 3,25%. Eggshell is outer part of egg, functioning as protector of egg's content.

4. Conclusion

Based on above research's findings, it concludes that a combination of garlic flour (*Allium Sativum*) and pecan oil (*Aleurites Mollucana*) given in feeding for egg-layers can refine egg-layers' production and improve performance of the MB 402 egg-layers.

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