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GROWTH PERFORMANCE OF LAYING HENS FED DIETS CONTAINING DIFFERENT LEVELS OF PALM KERNEL MEAL AND COPRA MEAL

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Abstrak

Pakan memegang peranan penting dalam metabolisme ternak, terutama untuk menunjang pertumbuhan, menjaga kondisi tubuh, dan produksi. Oleh karena itu, diperlukan solusi untuk mencari bahan pakan yang bermutu tinggi, mudah diperoleh, tersedia secara terus menerus, tidak bersaing dengan kebutuhan manusia, tidak beracun, dan memiliki harga ekonomis. Salah satu alternatif bahan pakan yang dapat dioptimalkan untuk menekan biaya pakan adalah limbah industri, seperti bungkil kelapa dan bungkil inti sawit. Penelitian ini dilaksanakan di Laboratorium Fakultas Peternakan dan Perikanan Universitas Tadulako, Palu, selama lima minggu, yaitu mulai tanggal 19 Maret 2022 sampai dengan 20 Mei 2022. Sebanyak 80 ekor ayam petelur umur 64 minggu digunakan dalam penelitian ini, dengan lima perlakuan dan empat kali ulangan. Penelitian ini menggunakan rancangan acak lengkap (RAL) dengan analisis lanjutan menggunakan Uji Beda Nyata Jujur (BNJ). Variabel yang diamati meliputi konsumsi pakan (g), produksi telur (g), konversi pakan, asupan energi (kkal), dan asupan protein (g). Hasil penelitian menunjukkan bahwa perlakuan memberikan pengaruh sangat nyata terhadap konsumsi pakan (P<0,01), dan memberikan pengaruh nyata terhadap produksi telur, konversi pakan, asupan energi, dan asupan protein (P<0,05). Dari hasil penelitian dapat disimpulkan bahwa penambahan bungkil inti sawit 5% dan bungkil kelapa 5% merupakan kombinasi yang paling direkomendasikan sebagai bahan pakan alternatif dalam ransum ayam petelur.

Keywords: Ayam petelur, bungkil kelapa, bungkil inti sawit,

KINERJA PERTUMBUHAN AYAM PETELUR YANG DIBERI PAKAN MENGANDUNG BUNGKIL INTI SAWIT DAN BUNGKIL KELAPA DENGAN LEVEL YANG BERBEDA

Abstract

Feed plays a crucial role in livestock metabolism by supporting growth, maintaining body condition, and sustaining production. Therefore, it is essential to identify high-quality feed ingredients that are easily accessible, sustainably available, non-competitive with human food sources, non-toxic, and economically viable. Industrial by-products such as coconut meal and palm kernel meal represent potential alternative feed ingredients to reduce ration costs. This study was conducted at the Laboratory of the Faculty of Animal Husbandry and Fisheries, Tadulako University, Palu, for five weeks, from March 19 to May 20, 2022. A total of 80 laying hens aged 64 weeks were used, arranged in a completely randomized design (CRD) with five treatments and four replications. Variables measured included feed consumption, egg production, feed conversion, energy intake, and protein intake. Data were analyzed using ANOVA followed by the Honestly Significant Difference (HSD) test. The results indicated that the treatments had a highly significant effect on feed consumption (P<0.01) and significantly affected egg production, feed conversion, energy intake, and protein intake (P<0.05). It can be concluded that the inclusion of 5% palm kernel meal combined with 5% coconut meal is the most recommended alternative feed ingredient formulation for laying hen diets.

Keywords: Copra meal, laying hens, palm kernel meal

INTRODUCTION

The primary challenge in egg-laying poultry farming is the high cost and limited availability of feed ingredients. Some feed ingredients are not consistently available throughout the year, while others are still imported, which contributes to the rising cost of feed. In intensive poultry production, feed accounts for approximately 60–70% of the total production cost, making it the largest expense. Therefore, reducing feed costs through the use of alternative, locally available, and affordable feed ingredients, such as coconut meal and palm kernel meal, is crucial to improving the competitiveness of egg production.

Palm kernel meal (PKM) is a by-product of palm oil processing plants that is abundantly available but has not been fully utilized as a feed ingredient for poultry. PKM contains approximately 14–18% crude protein, 12–20% crude fiber, and 3–9% ether extract, making it a promising alternative to partially replace soybean meal and corn in poultry rations (Azizi et al., 2021). However, its relatively high crude fiber content often limits its use in poultry diets. In contrast, copra meal (CM) generally contains higher protein (about 20–22%) but is deficient in essential amino acids, particularly lysine, and is more susceptible to aflatoxin contamination in humid conditions. These distinct limitations (low lysine in CM and excessive fiber in PKM) contribute to the challenges of their utilization in laying hen diets.

Several strategies have been proposed to address these limitations, including enzyme supplementation to enhance fiber digestibility, fermentation or sieving to reduce crude fiber in PKM, and amino acid fortification (e.g., lysine or methionine supplementation) to improve the nutritional balance of CM. By applying these approaches, the nutritional value of CM and PKM can be enhanced, making them more viable alternatives to conventional protein sources. Nevertheless, the optimal inclusion level of CM and PKM in laying hen diets that maximizes benefits while avoiding negative effects on feed consumption, egg production, and feed conversion still needs further investigation.

This study aims to evaluate the growth performance of laying hens, consisting of feed consumption, egg production, and feed conversion, by providing feed containing 5–10% palm kernel meal and 5–10% coconut meal.

MATERIALS AND METHODS

Animals and housing

This research was conducted at the Research Cage of the Faculty of Animal Husbandry and Fisheries, Tadulako University, located in Sibalaya Village, Sigi Regency, Central Sulawesi. The research was conducted for five weeks, starting from March 19 to May 20, 2022. A total of 80 Lohman strain laying hens, brand MB (Multi-Breeder) code 402, produced by PT. Japfa Comfeed Indonesia, aged 64 weeks, was used in the experiment.

The chickens were placed individually in 40 battery cages separated by iron partitions. Each cage measures 30 cm in length and width, with a front height of 35 cm and a rear height of 28 cm. The floor of the cage is designed to be slightly sloping to facilitate egg collection. Each cage is filled with two hens, and each experimental unit is filled with four hens. The feeder is made of PVC pipe and partitioned according to treatment group, while water is supplied through a nipple drinker designed for laying hens.

Experimental Design

The study employed a Completely Randomized Design (CRD) with five dietary treatments and four replications per treatment. Each replication consisted of four laying hens housed in one cage, and the cage was considered the experimental unit. The dietary treatments were as follows: P0, control diet (without copra meal or palm kernel meal); P1, diet containing 5% copra meal; P2, diet containing 5% palm kernel meal; P3, diet containing 10% copra meal; and P4, diet containing 10% palm kernel meal. Table 1 presents the nutrient content of the feed ingredients incorporated in the dietary treatments, including crude protein, metabolizable energy, amino acids, and mineral composition.

Table 2 summarizes the feed formulation used across treatments, detailing the inclusion level of each ingredient in the experimental diets.

Observation Variables

The variables observed in this study included feed consumption, egg production, and feed conversion ratio (FCR)

Feed consumption (g): Feed consumption is the difference between the weight of feed before being given and the remaining feed each week. Feed measurements are measured every week and are carried out cumulatively during the study, namely feed consumption from the beginning to the end of the study.

Egg Production (g): Egg production is calculated based on the number of eggs produced during the study (g/head) in each observation each day. Then, it was calculated by dividing the total weight of eggs by the number of eggs each day.

Feed Conversion Ratio (FCR): Feed conversion ratio was used to assess the efficiency with which hens converted feed into egg mass. FCR was calculated using the following formula:

$$\text{Feed Conversion} = \frac{\text{Feed consumption (g)}}{\text{Egg production (g)}}$$

Energy intake (g): Energy consumption is the amount of metabolic energy (ME) consumed by livestock through feed each day, calculated based on the energy content (kcal/kg) in the feed multiplied by the amount of feed consumed (g/head/day), then converted to kcal/head/day.

$$\text{Energy Intake} = \frac{\text{Feed consumption (g)} - \textit{Energy content in feed (kcal/kg)}}{1000}$$

Protein intake (g): Protein consumption is the amount of crude protein (CP) consumed by livestock from feed each day, protein consumption is obtained from the protein content in the feed (in percent) multiplied by the amount of feed consumed (g/head/day), then expressed in g/head/day.

$$\text{Protein Intake} = \frac{\text{Feed consumption (g)} - \textit{Crude protein in feed (\%)}}{1000}$$

Data Analysis

The collected data were analyzed using analysis of variance according to the Completely Randomized Design (CRD) model (Steel and Torrie, 1991), with the following mathematical model:

$$Yij = \mu + \alpha_i + \varepsilon_{ij}$$

Where Y_{ij} is the response observed; i is the treatment (1,2,3,4,5), j is the replication (1,2,3.4); μ is the overall mean; α_I is the effect of the i-th treatment, and ε_{ij} is the experimental error associated with the i-th treatment and j-th replication. If the ANOVA results indicated significant treatment effects, further analysis was conducted using the Honestly Significant Difference (HSD) test.

Table 1. Nutrient Content of Research Feed Ingredient.

Feed Ingredients	Nutrient Content								
	Crude Protein (%)	Metabolizable Energy (Kcal/Kg)	Crude Fiber (%)	Methionine (%)	Lysine (%)	Arginine (%)	Cysteine (%)	Calcium (%)	Phosphorus (%)
Palm kernel meal[1]	13.7	2260	22	0.2	0	1.9	0.2	0.7	0.7
Copra meal[1]	19.2	2100	25.5	0.2	0.2	1.9	0.3	0.0	0.3
Corn[2]	8.6	3350	3.81	0.2	0.3	0.3	0.2	0.1	0.0
Fish Meal[2]	60.0	2580	0.5	1.6	4	4	0.7	6.0	3.3
Rica Bran[2]	12	2980	28.3	0.2	0.6	0.9	0.2	0.0	0.2
Soybean Meal[2]	44	2230	12.9	0.6	2.7	3.1	0.6	0.3	0.2
Calcium Carbonate[2]	0	0	0	0	0	0	0	40	0
Palm Oil[2]	0	9001	0	0	0.0	0	0	0	0
Dicalcium Phosphate[2]	0	0	0	0	0	0	0	23.3	10
Salt[2]	0	0	0	0	0	0	0	0	0
Premix[2]	0	0	0	0	0	0	0	0	0
Lysine[2]	76	0	0	0	76	0	0	0	0
Methionine[2]	98	0	0	98	0	0	0	0	0

Note: [1]NRC (1984)
[2]NRC (1994)

Table 2. Feed Composition

Feed Ingredients	Nutrient Content				
	P0	**P1**	**P2**	**P3**	**P4**
Palm kernel meal[1]	0	0	5	0	10
Copra meal[1]	0	5	0	10	0
Corn[2]	57	50	50	56.1	54
Fish Meal[2]	7	7.9	8.2	8	8
Rica Bran[2]	12	15	15	7	8
Soybean Meal[2]	15.3	12.8	13.1	11	12.1
Calcium Carbonate[2]	6	5.43	5.74	6.1	6.1
Palm Oil[2]	0	0.8	0.56	0	0
Dicalcium Phosphate[2]	2	2.1	1.4	2	1
Salt[2]	0.2	0.2	0.3	0.2	0.2
Premix[2]	0.3	0.3	0.3	0.3	0.3
Lysine[2]	0.1	0.1	0.1	0.1	0.1
Methionine[2]	0.1	0.2	0.2	0.1	0.1
Total Nutrient Content	100	100	100	100	100
Crude Protein (%)	17.4	17.8	17.8	17.5	17.3
Metabolizable Energy (Kcal/Kg)	2788.9	2790.8	2790.4	2749.6	2749.6
SK (%)	7.6	9.1	9.0	8.1	8.1
Met (%)	0.4	0.5	0.5	0.5	0.5
Lys (%)	1.0	1.1	1.0	1.0	1.0
Arg (%)	1.1	1.1	1.1	1.1	1.1
Cys (%)	0.3	0.3	0.3	0.3	0.3
Ca (%)	3.3	3.2	3.2	3.2	3.2
P (%)	0.5	0.5	0.5	0.6	0.6

Note: Nutrient content is calculated based on Table 1.

Table 3. Average feed consumption, egg production, and feed conversion ratio during the study.

Variabels	Treatments				
	P0	**P1**	**P2**	**P3**	**P4**
Feed consumption**	137.0±0.6^{b}	127.1±1.3^{a}	135.0±1.0^{b}	129.1±0.8^{a}	129.1±1.6^{a}
Egg production*	42.6±5.2^{b}	42.6±9.3^{b}	41.0±5.7^{ab}	41.0±1.2^{ab}	39.8±2.1^{a}
Feed conversion ratio*	3.2±0.1^{ab}	2.9±0.2^{a}	3.2±0.20^{b}	3.1±0.0^{ab}	3.2±0.0^{b}
Energy intake*	3819.8 ± 17.1^{a}	3546.5 ± 38.3^{b}	3787.4 ± 26.6^{a}	3556.5 ± 30.9^{b}	3533.0 ± 23.1^{b}
Protein intake*	26.04 ± 0.12^{a}	24.16 ± 0.26^{b}	25.84 ± 0.18^{a}	23.85 ± 0.21^{b}	23.41 ± 0.15^{b}

Note: P0: Control diet; P1: 5% copra meal inclusion; P2: 5% palm kernel meal inclusion; P3: 10% copra meal inclusion; P4: 10% palm kernel meal inclusion

* = significantly different (P<0,05)
** = highly significantly different (P<0,01)

RESULTS AND DISCUSSION

The average results of the study on the effect of feed containing palm kernel cake and coconut cake on feed consumption, egg production, and feed conversion of laying hens during the study are shown in Table 3.

Feed Consumption

Feed consumption in this study ranged from 127.1±1.3 to 137.0±0.6 g/head/day. The results of the statistical analysis showed that chickens in treatments P0 and P2 had significantly higher feed consumption compared to those in treatments P1, P3, and P4 ($P < 0.01$). The decrease in feed consumption observed in treatment P1 was likely related to the higher crude fiber content (9.1%) compared to other treatments (P0 = 7.5%; P2 = 8.9%; P3 = 8.1%; P4 = 8.1%). Likewise, the energy content of P1 showed a slightly higher metabolic energy value (2790.7 kcal/kg) compared to other feeds (P0 = 2788.8 kcal/kg; P2 = 2790.4 kcal/kg; P3 = 2749.6 kcal/kg; P4 = 2749.6 kcal/kg). The higher crude fiber and energy content in P1 are believed to be the primary factors contributing to lower feed consumption in this study. Lower feed consumption in P0 may be due to lower crude fiber content compared to other treatments. High crude fiber content is voluminous, which causes birds to feel full quickly, thereby reducing feed consumption. Additionally, feed with high crude fiber content is less palatable, resulting in lower consumption (Tillman et al. 1991).

The maximum metabolic energy recommended for laying hen feed is 2650 kcal/kg (SNI, 2006). Coconut cake has an energy content of 2100 Kcal/kg (NRC, 1984), and palm kernel cake has 1817 Kcal/kg. Feeds containing high metabolic energy will result in less feed being consumed by chickens, while feeds with lower energy content encourage greater consumption because chickens are trying to meet their energy needs (Sari et al., 2004).

Another description explains that the crude fiber content in laying hen feed is a maximum of 7% (SNI, 2006). Due to its relatively high fiber content, the addition of copra cake and palm kernel cake in poultry rations is usually limited to 5–15% (Stein et al., 2015). Another study stated that the addition of palm kernel cake at a level of 10% can reduce the presence of Salmonella bacteria (Adrizal et al., 2011), which otherwise can suppress feed consumption by negatively affecting bird's appetite.

Egg Production

Egg production in this study ranged from 39.85±2.15 to 42.66±9.32 g/head/day. Statistical analysis revealed that the control treatment (P0) was not significantly different from P1, P2, and P3, indicating that the control ration produced egg production comparable to that of the other treatments. However, chickens fed with 5% coconut meal (P1) showed significantly higher egg production compared to chickens fed with 10% palm kernel meal (P4). This finding suggests that the inclusion of 5% coconut meal in the ration is more effective in enhancing egg production compared to 10% palm kernel meal.

The increase in egg production in P1 may be influenced by the higher nutritional content and fatty acid composition of copra meal compared to palm kernel meal. Febrina (2020) reported that palm kernel cake contains around 11.68% oleic acid, while copra cake contains up to 39% oleic acid (Al-Hamid et al., 2020), and the amino acid content in coconut cake consists of 0.27% methionine and 0.42% lysine, while palm kernel cake contains around 0.22% methionine and 0.36% lysine (Stein et al., 2015).

Higher egg production is generally supported by adequate levels of metabolizable energy and protein in the diet. Key factors that influence egg productivity include nutrient composition, feed intake, and age of the birds. Diets that meet the requirements for protein and energy promote higher egg mass and laying rate, whereas diets deficient in these nutrients may reduce body weight and, consequently, egg production. In contrast, high crude fiber levels and antinutritional factors such as phytic acid can interfere with nutrient utilization, particularly phosphorus absorption, and thereby depress egg output. In the present study, hens fed diets containing 5% CM or PKM (P1 and P2) maintained egg production comparable to the control, while higher inclusion levels (P3 and P4) reduced productivity. This outcome suggests that moderate inclusion of CM and PKM can be used without negative effects, but excessive levels may lower nutrient availability and energy density, thus impairing laying performance.

Feed Conversion Ratio

Feed conversion in this study ranged from 2.99 ± 0.20 - 3.29 ± 0.20. The results of the further significant difference (HSD) test showed that the control (P0) was not significantly different from P1, P2, P3, or P4, indicating that the use of both ingredients could match the FCR in the control ration. P1 feed had the best and most efficient conversion value compared to other treatments, indicating that it was quite efficient in converting feed into eggs. These results are supported by the consumption data for P1 and P3, which numerically show the lowest conversion values, specifically P1 = 2.99 and P3 = 3.15. So it can be stated that chickens are quite efficient in converting feed into eggs.

The efficiency of palm kernel meal feed is improved because palm kernel meal undergoes physical treatment before use. The physical treatment carried out is sieving. Sieving can reduce shell contamination by up to 50% in PKM. Reducing shell contamination through sieving can increase the nutritional value of BIS by reducing crude fiber from 17.63% to 13.28%, increasing crude protein from 14.49% to 14.98%, this is supported by research by Sundu et al (2006) which states that physical processing methods such as screening to reduce shell content can further improve the nutritional quality of palm kernel cake by reducing its crude fiber content and increasing protein digestibility.

Another factor is that palm kernel cake and coconut cake contain protein, energy, and antioxidant content in the form of isoflavones, which play a role in maintaining productivity and preventing chickens from experiencing oxidative stress. Isoflavones can enhance chicken productivity and egg quality, and act as natural antioxidants, thereby supporting overall chicken health (Gjorgovska & Kiril, 2013). The feed conversion ratio is a primary indicator of how efficiently feed is converted into egg mass in laying hens (Anene et al., 2021). Supporting this, Dao et al. (2023) reported that laying hens fed a diet based on recycled food waste obtained lower feed consumption while maintaining egg production, resulting in increased feed efficiency (lower FCR) compared to hens fed conventional diets.

Energy Intake

Energy consumption in this study ranged from 3533.0 to 3819.8 kcal/head/day. The results of the analysis showed that treatments P0 (control) and P2 (5% PKM) had higher energy consumption compared to other treatments, while treatments P1 (5% CM), P3 (10% CM), and P4 (10% PKM) showed lower energy consumption. This difference is related to the level of feed consumption and metabolic energy content in the ration of each treatment. The higher the level of feed consumption and feed energy content, the energy consumption also increases.

The level of energy consumption is influenced by the energy needs of chickens to maintain basic life functions and egg production. According to SNI (2006), laying hens require approximately 2650 kcal/kg of ration for metabolic energy. However, the coconut cake and palm kernel cake-based feed in this study had a lower energy content than the corn and soybean meal-based feed. Therefore, chickens tend to adjust their feed consumption to meet their energy needs, although rations with high crude fiber can limit total consumption.

Optimal energy consumption is essential to support maximum egg production (Harms and Rusel, 2001). If energy consumption is too low, egg production may decrease because more available energy is used to maintain life than for production. Conversely, excessive energy consumption can cause body fat accumulation. Therefore, feed formulation with balanced energy content, even using alternative raw materials such as coconut meal and palm kernel meal, is essential to maintain the productivity of laying hens.

Protein Intake

Protein consumption in this study ranged from 23.41 to 26.04 g/head/day. The results of this study indicate that chickens fed control feed (P0) and feed with additional 5% PKM (P2) had higher protein consumption compared to treatments with additional 5-1-% coconut meal and 10% palm kernel meal. The low protein consumption in treatments P1, P3, and P4 was due to the lower protein content in palm kernel meal and coconut meal compared to the control feed.

Protein plays a crucial role in supporting body tissue growth and egg production, particularly in the formation of albumen (egg white) and egg yolk. If protein consumption is insufficient, egg growth and productivity can be disrupted; conversely, optimal protein consumption will improve egg production and quality. According to Scappaticcio et al. (2021), the content of digestible energy and lysine in the ration greatly affects the performance and quality of laying hen eggs, including egg weight and albumen quality. Although coconut meal and palm kernel meal have a relatively high protein content, their essential amino acid content, particularly lysine, is relatively low.

Therefore, although quantitative protein consumption appears sufficient, protein quality remains a determining factor. To maximize the benefits of this alternative ingredient in laying hen feed, attention should be paid to the balance of amino acids through supplementation or a combination of other feed ingredients rich in lysine and methionine.

CONCLUSIONS

According to the study's results, it can be concluded that the addition of 5% palm kernel meal to laying hen feed maintains feed consumption, energy, and protein levels equivalent to those of the control. Additionally, the addition of 5% coconut meal increases egg production and feed conversion efficiency. Therefore, the combination of 5% coconut meal and 5% palm kernel meal is the most recommended alternative feed ingredient for laying hen rations.

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