Effect of dietary palm kernel meal on laying hens

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Abstract. Indonesia has the potential for palm kernel meal, which has the largest production in the world. Palm kernel meal has been commonly used as an ingredient in ruminant and poultry feeds. However, the various studies conducted have produced very varied results. This article aimed to analyze various research data on the use of palm kernel meal in the chicken feed. The data used were 38 data points from 10 journal articles. The use of palm kernel meal ranged from 0% to 70% in rations. The statistical model used is linear regression. The database was analyzed using SPSS software version 25. Results showed that the use of palm kernel meal in laying hens reduced (P<0.01) egg production. Palm kernel meal also increased FCR (P<0.05) and tended to decrease Haugh Unit (P<0.1). Other parameters such as consumption, egg weight, mortality, egg shell thickness, and yolk color were not influenced by dietary inclusion of palm kernel meal. In conclusion, palm kernel meal cannot be given to poultry directly, it is necessary to process the ingredient to enhance its nutritive value.

1. Introduction

In the new normal era, the food supply chain has to continue to move and ensure the availability of nutritious food as a weapon to maintain immunity to prevent the transmission of COVID-19. Food commodities that have the opportunity to survive in this era are the livestock sector, especially poultry. In from 2019 to 2020, several small-scale layer chicken farmers suffered losses due to falling prices. Egg products are a source of protein and minerals needed in a nutritionally balanced diet and at an affordable price for the wider community. Scientifically, eggs have been shown to contain all the proteins, lipids, vitamins, minerals, and growth factors needed to maintain immunity during the Covid-19 pandemic [1]. [2] also support that supplementation of vitamins A, D, E, and the mineral selenium can be obtained from the consumption of eggs.

Egg production during a pandemic is demanded to be as efficient as possible, one effort is to maximize the use of feed. The feed is the biggest cost in the livestock business, 60%-70% of production costs are determined from the feed. corn and soybean meal are the main ingredients commonly used in poultry rations [3]. The number of maize which depends on the season and the distribution of the location of its wide production makes the price of maize very expensive at certain times. While soybean meal is obtained by importing from other countries, so the price is expensive.

Indonesia is a country with the highest palm oil production in the world. Production of palm oil and palm kernel in 2018 reached 36 594 813 and 7 318 963 tonnes, respectively [4]. According to [5] the proportion of PKM (Palm Kernel Meal) ranges from 45-46% of the palm kernel or 2.0% -2.5% of the
weight of the palm kernel meal bunches, so the potential production is around 3,293,533 tonnes of PKM. Therefore palm kernel meal has the potential to be used as a feed ingredient which does not depend on the season also the price is cheap. Optimizing the use of palm kernel meal is expected to push the importation of feed ingredients during the pandemic. The nutritional content contained in the palm kernel meal is 92.1% dry matter, 15.9% crude protein, 9.4% crude fat, and 3.9% ash. The main mineral content in palm kernel meal, namely calcium, phosphorus, and potassium, respectively 3.9, 5.5, 6.4 g / kg [6]. Palm kernel meal has been widely used in ruminant and poultry rations. However, the various studies carried out produced many differences. Therefore, this article aims to analyze various research data regarding the use of palm kernel meal in laying hens.

2. Methods
The database was created from a collection of data from various journals regarding the use of palm kernel meal in poultry. The journals used are sourced from Google Scholar, Research Gate, and Science Direct. 60 journals were obtained and then selected by title. Until finally there were 10 journals with 38 data points. Data inputted into MS Excel 2016, namely egg production (%), feed intake (grams), Feed Conversion Ratio, egg weight (grams), weight gain (grams), mortality (%), egg shell thickness (mm), egg yolk color, and haugh units. Then it is selected again based on the contents, namely the data selected is the use of PKM in laying hens. PKM usage ranges from 0% to 70%. Regression analysis was performed using SPSS version 25.

Table 1. The study used in assessing the effectiveness of using palm kernel meal on laying hens

| No | Reference                  | PKM level (%) |
|----|----------------------------|---------------|
| 1  | Perez et al. [7]           | 0-50          |
| 2  | Aderolu et al. [8]         | 20            |
| 3  | Lee et al. [9]             | 5             |
| 4  | Ryu et al. [10]            | 0-8.7         |
| 5  | Onwudike et al. [11]       | 0-37.5        |
| 6  | Ridla et al. [12]          | 12-28         |
| 7  | Wihandoyo [13]             | 0-36          |
| 8  | Zanu et al. [14]           | 0-15          |
| 9  | Anya 2014 [15]             | 15-20         |
| 10 | Diarr 2018 [16]            | 0-20          |

3. Results and Discussion
Descriptive analysis of the parameters of egg production, feed intake, feed conversion ratio, egg weight, weight gain, mortality, eggshell thickness, yolk color, and haugh unit can be seen in Table 2.

Table 2. Descriptive statistics on the effects of using palm kernel meal on the ration of laying hens

| Parameter              | n  | Mean   | SD  | Min  | Max  |
|------------------------|----|--------|-----|------|------|
| Egg Production (%)     | 38 | 68.39  | 8.85| 41.9 | 81   |
| Feed Intake (gr)       | 37 | 116.38 | 12.02| 95.41| 140.17|
| FCR                    | 32 | 2.98   | 0.70| 2    | 4.44 |
| Egg Weight (gr)        | 37 | 57.76  | 3.94| 50   | 65.8 |
| Weight gain (gr)       | 5  | 522.8  | 44.09| 481  | 594  |
| Mortality (%)          | 24 | 3.5    | 2.95| 0    | 8.3  |
| Egg Shell Thickness (mm)|16 | 0.36   | 0.95| 0.18 | 0.47 |
| Yolk Color             | 8  | 5.34   | 2.68| 1.92 | 8.78 |
| HU                     | 24 | 84.35  | 7.45| 75.7 | 97.96|

Note: n: the amount of data, SD: standard deviation, Min: minimum, Max: maximum, FCR: Feed Conversion Ratio, HU: Haugh Unit.
The use of PKM had dramatically effect (P <0.01) in reducing egg production. Hen-day egg production is the number of eggs produced from total laying hens and multiplied by 100. The decrease in production was caused by an increase in crude fibre content in the ration. The high fibre content will make it difficult for monogastric animals to digest feed. Poultry as monogastric livestock has a minimal ability to hydrolyze or degrade fibre into simpler compounds; this is because the activity of cellulolytic enzymes in the digestive process is very low [5]. The palm kernel meal contains NSP of 610g / kg [6]. Mannan is the main component of NSP in palm kernel meal (Sathitkowitchai et al., 2018) [17]. The NSP content in PKM is known to bind water in the lumen, so that increasing the viscosity of the digestive tract and reducing its flow rate [18]. Increasing the feed flow rate will decrease feed digestibility. In addition to reducing egg production, the consumption of high-fibre feed makes fecal wet. The variety of shell contamination in PKM also results in various quality. The crude fibre content in palm kernel meal will also be higher following the amount of shell contamination. According to [19] the shell contamination of PKM ranges from 10% to 20% depending on the process of separating the shell from the kernel before extracting palm oil from the palm kernel.

Table 3. Analyzes the regression results of the use of palm kernel meal in laying hens

| Parameter                 | Intercept | Slope     | P value   | R²  |
|---------------------------|-----------|-----------|-----------|-----|
| Egg Production (%)        | 74.578    | -0.304    | **        | 0.364 |
| Feed Intake (gr)          | 117.17    | -0.038    | NS        | 0.003 |
| FCR                       | 2.65      | 0.15      | *         | 0.152 |
| Egg Weight (gr)           | 58.99     | -0.059    | NS        | 0.071 |
| Weight gain (gr)          | 553.40    | -1.63     | NS        | 0.301 |
| Mortality (%)             | 2.79      | 0.023     | NS        | 0.022 |
| Egg Shell Thickness(mm)   | 0.376     | -0.001    | NS        | 0.007 |
| Yolk Color                | 4.356     | 0.083     | NS        | 0.078 |
| HU                        | 87.95     | -1.66     | <0.10     | 0.173 |

Note: FCR: Feed Conversion Ratio, HU: Haugh Unit. This model is very significant (**) at P <0.01, (*) significant at P <0.05, tends to be significant at P <0.10, not significant (NS) at P> 0.10.

The use of palm kernel meal has not affected by the feed intake of layer hens (P > 0.05). The amount of feed consumption is the same but the results showed lower egg production in layer hens that are fed with palm kernel meal. This shows that the inefficient use of nutrients to produce eggs. Therefore, given feed containing palm kernel meal could increase (P <0.05) FCR of layer hens. FCR is the amount of feed needed to produce per egg weight in one day [15]. The haugh unit has a downward tendency (P <0.1). Haugh unit is one way to determine the quality of an egg. HU was obtained by measuring albumin height and egg weight. The higher of the HU’s value, than the albumen vicosity getting high. Ovomucin albumin which plays a role in binding water to form a gel on albumin which causes albumin to become thick. The more and stronger the ovomusin mesh will increase the albumin viscosity. The higher the HU value shows the better the egg quality [16]. Although the use of palm kernel meal tends to decrease the HU value, this result is still in the normal range above 70. The protein content in feed can affect egg quality. The tendency of PKM to reduce the value of HU was caused by the high NSP (Non-Starch Polysaccharide) in PKM. A diet with high NSP will reduce protein digestibility and increase endogenous amino acid secretion [6].
PKM has low amino acid digestibility. The ileal digestibility coefficient on PKM was 0.42-0.46. Therefore, if the ration formulation based on crude protein will be inaccurate. Formulation based on amino acids will increase its accuracy [6]. Things that can be done to improve the quality of palm kernel meal using physical, chemical, or biological processing methods. Physical processing that can be done is by filtering the palm kernel meal so that contaminated shells can be removed. Based on research [19] filtering with a filter size of 2 mm can reduce shell contamination from 22.8% to 9.92%. Reducing the levels of shells in PKM can increase the proportion of the nutritional content in it. This is because the shells on PKM do not contain nutritional value. Although it can increase the nutrient content in PKM, the filtering process cannot increase metabolic energy, dry matter, and protein digestibility. Palm kernel meal contains 30% -35% β-mannan which is the main component of NSP from palm kernel meal. β-mannan has been shown to have strong anti-nutritional effects in monogastric livestock. Therefore, an enzyme is needed to hydrolyze, namely the enzyme mannanase. Hydrolysis of β-mannan using the enzyme mannanase can release sugar, manno-oligosaccharides, and protein [17].

4. Conclusion
The use of palm kernel meal as a feed ingredient without undergoing processing it can reduce egg production tends to reduce the haugh unit value, and increase FCR. However, it does not affect the parameters of weight gain, feed intake, egg weight, mortality, eggshell thickness, and yolk color.

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