Effect of different vegetable oils in rations on chemical quality of local duck meat

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Abstract. Duck meat is one of the poultry food products that is high in nutritional content. This study aimed to determine the effect of vegetable oil in the ration on the chemical quality of local duck meat. The research design used was Completely Randomized Design (CRD) in a unidirectional pattern with 4 treatments, each treatment consisting of 6 replications and each replication consisted of 6 ducks. The treatments in this study include; P1: (96% basal ration + 4% palm oil); P2: (96% basal ration + 4% canola oil); P3: (96% basal ration + 4% coconut oil) and P4: (96% basal ration + 4% soybean oil). The observed variables were chemical quality of meat (collagen, fat, water content, and protein). The data obtained were analyzed by variance analysis and the real difference test between treatments. The results showed that the use of vegetable oil was a significant effect (P<0.05) on the duck meat protein but was not significantly different (P>0.05) on collagen, fat, and water content. It can be concluded that the addition of vegetable oil in the ration can increase the protein of local duck meat but did not affect collagen, fat, and water content.

1. Introduction

Ducks are a type of semi-aquatic poultry that are starting to be bred and have the potential to diversify food ingredients while reducing dependence on broiler chicken meat. Duck production is very popular and has a great demand in many parts of the world. With compared to chicken meat, duck meat is having distinctive characteristics as a red meat [1]. The nutritional content of duck meat includes protein content of 20.04%, fat of 8.2%, ash of 1.2% and energy value of 15,900 kcal kg⁻¹. The national consumption of duck meat per capita per year in Indonesian is still low at 0.052 kg, compared to native chicken meat has reached 0.78 kg year⁻¹ [2].

Poultry like chicken and duck needs a high-energy diet to help its quick growth and metabolism. Thus, approximately 2 to 5% of oil is suggested in broiler chicken diets for optimal growth performance [3, 4]. Animal fat, soybean oil, and combinations are energy resources for diets of broiler chickens. A past report showed that energy metabolism of broiler chickens is enhanced by dietary animal-vegetable oil blends (A-V blend) [5]. In that study, Mohammadreza et al [6] announced that a diet containing joined animal fat and vegetable oil could increase performance and feed efficiency, as well as breast and drumstick yields, in birds compared with those birds fed only with animal fat or vegetable oil alone. A comparative perception was made by Cera et al and Abdel Warith et al [7, 8].
Several types of plants can produce vegetable oils. One of them is that perilla seeds are seeds that contain 35–40% oil, the perilla seed oil is known to contain 52–64% α-linolenic acid [9]. The highest protein content is found in duck meat which is added with 5% perilla. The increase in meat protein content was thought to be due to the high protein content of perilla seeds, namely 25.01%. Protein (amino acid) is the main ingredient in the process of forming meat so that sufficient amino acid consumption will result in optimal meat protein content [10]. The productivity and growth of ducks can be optimized by giving feed enriched using feed ingredients rich in protein and natural antioxidants such as those contained in perilla seeds. Therefore, research was needed on the effect of different vegetable oils in rations on chemical quality of local duck meat.

2. Materials and methods

2.1. Treatment and experimental diets
The ducks used in this study were divided into 4 treatment groups, with 6 replicates and each replicate consisted of 6 head ducks. The treatment included; P1: (96% basal ration + 4% palm oil); P2: (96% basal ration + 4% canola oil); P3: (96% basal ration + 4% coconut oil); and P4: (96% basal ration + 4% soybean oil). The experiment was conducted for 9 weeks.

2.2. Research methods
In the present study, the formulation feed is organized and figured physically beginning from the biggest extent of feed fixings orchestrated first at that point blending it in with the littest extent of feed fixings so a layer of each feed fixing is shaped and afterward blended until it is homogeneous. The diets were comprised of yellow corn, pollard, rice clean, soybean meal, premix, NaCl, limestone, and vegetable oils. The basal diets regimens contained crude protein 19–20% and metabolize energy 3,200-3,300 Kcal kg⁻¹. Feedstuffs composition and nutrient content of treatment diets were presented in Table 1.

| Ingredients          | T1 (Palm oil) | T2 (Canola oil) | T3 (Coconut oil) | T4 (Soybean oil) |
|----------------------|---------------|-----------------|------------------|-----------------|
| Yellow corn (%)      | 37            | 37              | 36.75            | 37.50           |
| Pollard (%)          | 10.25         | 10.25           | 11.25            | 9.75            |
| Rich polish (%)      | 24.5          | 23.25           | 23.75            | 23.50           |
| Soy Bean Meal (%)    | 21.5          | 22.75           | 21.50            | 22.50           |
| Premix (%)           | 2.35          | 2.35            | 2.35             | 2.35            |
| Limestone (%)        | 0.30          | 0.30            | 0.30             | 0.30            |
| NaCl (%)             | 0.10          | 0.10            | 0.10             | 0.10            |
| Vegetable Oils       |               |                 |                  |                 |
| Palm oil (%)         | 4             | 0               | 0                | 0               |
| Canola oil (%)       | 0             | 4               | 0                | 0               |
| Coconut oil (%)      | 0             | 0               | 4                | 0               |
| Soybean oil (%)      | 0             | 0               | 0                | 4               |
| Total (%)            | 100           | 100             | 100              | 100             |
| ME, kcal kg⁻¹        | 3,258.97      | 3,262.89        | 3,241.44         | 3,266.61        |
| Crude protein, %     | 19.64         | 20.14           | 19.71            | 19.99           |
| Crude fiber, %       | 6.09          | 6.02            | 6.11             | 6.00            |
| Extract ether, %     | 5.64          | 5.56            | 5.61             | 5.56            |
| Ca, %                | 0.97          | 0.98            | 0.98             | 0.98            |
| P av, %              | 0.71          | 0.71            | 0.71             | 0.71            |
2.3. **Growth performance**

The live weight and feed intake of the ducks were recorded weekly during the experimental period, except for the last period, which lasted seven days. Data on the average daily gain (ADG), and feed intake (FI) were calculated.

2.4. **Carcass collection**

Data collection of cut weight and carcass weight was carried out when the ducks were 9 weeks. Duck slaughtering refers to [11], which starts with a 12-hour mastery of emptying food in the digestive tract, then the process of slaughtering ducks is done by cutting the carotid artery, jugular vein, trachea, and esophagus, after cutting the four channels, then proceeding with the removal of feathers by cutting how to dip ducks in hot water for 35–45 seconds. The carcass is a part of the body of poultry obtained after slaughtering based on Islamic sharia, namely by extracting feathers, evisceration, separation of the head, neck, and legs (shank) [12]. The carcass obtained was cut into several sections, the breast was separated at the end of the scapula and the dorsal ribs, the weight of the breast was measured by weighing the breast after being separated from the carcass; the thighs are separated in the acetabulum, the pelvix muscles are included while the pelvix bones do not participate in the thighs and the dorsal end of the tarsus metatarsus bone; the back is separated from the pelvix, the tip of the dorsal scapula of the ribs and the posterior part of the neck; wings can be separated through pieces of shoulder joints.

2.5. **Chemical analyses**

The chemical composition of meat (collagen, fat, water content, protein) [13] analysis was conducted in duplicate on fresh samples of the breast and expressed on a fresh basis.

2.6. **Data analyses**

This research used one way completely randomized design. The data were analyzed using analysis of variance (ANOVA) and differences between treatment means were further analyzed using Duncan’s New Multiple Range Test (DMRT) with significance level of p<0.05.

3. **Results and discussion**

The results of the research on the physical quality of local duck meat with the addition of different vegetable oils in the ration consisting of collagen, fat, water content, and protein can be seen in Table 2.

3.1. **Collagen**

The average collagen content in local duck meat aged 9 weeks is presented in Table 2. The results of statistical analysis showed that the addition of different vegetable oils in the ration had no significant effect (P>0.05) on the collagen content of local duck meat. Based on the results of the study, it was shown that the addition of different vegetable oils to the ration could not increase or decrease the collagen content of duck meat because the four treatments showed no significant differences. Treatment P3 had a tendency to have the lowest collagen content compared to other treatments.

Coconut oil added to duck rations can be used as an energy source. This was in accordance with the opinion of [14] that coconut oil made from 10 coconuts produces 1,500 g, coconut oil can be used as an energy source. The use of coconut oil up to 2% can increase palatability and reduce the loss of nutrients. Coconut oil also contains vitamins the body needs of livestock, this is as reported by [15] stated that in research on the metabolic process of chickens, coconut oil is needed, one of which is coconut oil, because there are vitamins A, D, E, and K as well as provitamin A (carotene) which is fat soluble. The collagen content of local duck meat in this study was higher than the collagen content in Polish Pekin, Danish Pekin, and English Pekin ducks. The results of research by [16] stated that the collagen content in male Polish Pekin, Danish Pekin, and English Pekin ducks was 1.6%, 1.4% and 1.6% in breast muscle, while in leg muscle was 1.9%, 1.7% and 1.9%.
The addition of different vegetable oils in the ration could not affect the results of research by [17] that the water content in male Polish Pekin, Danish Pekin, and English Pekin ducks were 2.4%, 1.9% and 2.4% in breast muscle, while in leg muscle was 66.2%, 68.0% and 67.5%. The water content of duck meat was 8.0%, 6.3% and 6.8%. The fat content of duck meat was higher than chicken at 3.84% and ducks by 8.47% [18].

Table 2. The average chemical quality of local duck meat aged 9 weeks.

| Variable     | P1             | P2             | P3             | P4             | P Value |
|--------------|----------------|----------------|----------------|----------------|---------|
| Collagen (%) | 2.29±0.23      | 2.06±0.20      | 1.95±0.15      | 2.05±0.22      | 0.053   |
| Fat (%)      | 3.51±0.38      | 3.69±0.77      | 3.07±0.92      | 3.81±0.78      | 0.357   |
| Water content (%) | 72.63±1.00 | 73.04±0.55     | 73.16±0.76     | 72.24±0.90     | 0.223   |
| Protein (%)  | 20.64±0.34a    | 21.32±0.72a    | 21.24±0.62a    | 22.34±0.48b    | 0.000   |

*ab different superscripts in the same row show significant differences (P<0.05).

P1: 96% basal ration + 4% palm oil; P2: 96% basal ration + 4% canola oil; P3: 96% basal ration + 4% coconut oil and P4: 96% basal ration + 4% soybean oil.

3.2. Fat
The average fat content in local duck meat aged 9 weeks is presented in Table 2. The results of statistical analysis showed that the addition of different vegetable oils in the ration had no significant effect (P>0.05) on the fat content of local duck meat. The fat content of the duck meat results from the study for treatment P1 was 3.51%, P2 was 3.69%, P3 was 3.07% and P4 was 3.81%. Based on the results of the study, it was shown that the addition of different vegetable oils in the ration could not increase or decrease the fat content of duck meat because the four treatments showed no significant differences.

The results of this study were almost the same as research by [17] that the use of soybean oil had no significant effect on the fat content of turkey meat, both the breast muscles and thigh muscles. The fat content of the turkey breast muscles which was added with soybean oil was lower than this study, namely 0.88%, while the thigh muscles were higher, namely 5.33%. The fat content of local duck meat in this study was higher than the fat content in Polish Pekin, Danish Pekin, and English Pekin ducks in the breast muscles and lower in the leg muscles. The results of research by [16] stated that the fat content in male Polish Pekin, Danish Pekin, and English Pekin ducks were 2.4%, 1.9% and 2.4% in breast muscle, while in leg muscle was 8.0%, 6.3% and 6.8%. The fat content of duck meat was higher than chicken at 3.84% and ducks by 8.47% [18].

3.3. Water content
The average water content of local duck meat aged 9 weeks is presented in Table 2. The results of statistical analysis showed that the addition of different vegetable oils in the ration had no significant effect (P>0.05) on the water content of local duck meat. The water content of the duck meat research results for treatment P1 was 72.63%, P2 was 73.04%, P3 was 73.16% and P4 was 72.24%. Based on the results of the study, it was shown that the addition of different vegetable oils to the ration could not increase or decrease the water content of duck meat because the four treatments showed no significant differences.

The water content of local duck meat in this study was higher than that of Polish Pekin, Danish Pekin, and English Pekin ducks. The results of research by [16] stated that the water content in male Polish Pekin, Danish Pekin, and English Pekin ducks were 70.1%, 71.1% and 70.7% in breast muscle, while in leg muscle was 66.2%, 68.0% and 67.5%. The water content of duck meat was 68.8% [19]. Water content in duck meat is related to the feed consumed by ducks [20]. Water in meat is found mostly in fat-free muscle tissue and a little in adipose tissue [21].

3.4. Protein
The average protein content in local duck meat aged 9 weeks is presented in Table 2. The results of statistical analysis showed that the addition of different vegetable oils in the ration had a significant effect (P<0.05) on the protein content of local duck meat. The protein content of duck meat results from the study for treatment P1 was 20.64%, P2 was 21.32%, P3 was 21.24% and P4 was 22.34%.

a,b different superscripts in the same row show significant differences (P<0.05).
Based on the research results, it can be seen that the P4 treatment was significantly different from the P1, P2 and P3 treatments, while the P1, P2, and P3 treatments were not significantly different. Treatment P4 had the highest meat protein content compared to other treatments.

The soybean oil content in meat affects the protein content of the meat. Diets with high oil can clearly increase the retention time of feed in the intestine and also cause the digestion process and adsorption of non-fat constituents to be more complete [22]. The addition of vegetable fats and oils in feed as energy providers and can increase vitamin absorption, palatability and feed efficiency. In addition, the addition of vegetable oil can reduce the rate of feed in the digestive tract which allows absorption of feed nutrients [23].

The results of this study are different from the research by [17] that the use of soybean oil had no significant effect on protein levels of turkey meat, both the breast muscles and the thigh muscles. The protein content of turkey meat in the breast muscles that was added with soybean oil was higher than this study, namely 25.39%, while the thigh muscles were lower, namely 20.32%. The protein content of local duck meat in this study was lower than the protein content in Polish Pekin, Danish Pekin, and English Pekin ducks in the breast muscles. The results of research by [16] stated that the protein levels in male Polish Pekin, Danish Pekin, and English Pekin ducks were 23.5%, 23.9%, and 23.9%, respectively.

4. Conclusion
It can be concluded that the addition of vegetable oil in the ration can increase the protein of local duck meat but did not affect collagen, fat, and water content.

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