Physical quality of local duck meat with addition of different vegetable oils in the ration

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Abstract. The increasing need for meat can be done by optimizing the utilization of the potential of local livestock resources, one of which is local duck. This study aimed to determine the physical quality of duck meat with the addition of vegetable oil in the ration. The research design used was Completely Randomized Design 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 physical quality of meat. 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 tenderness of duck meat but not significantly different (P>0.05) on cooking losses, pH, and water holding capacity. It can be concluded that the addition of vegetable oil in the ration affects the tenderness of duck meat but did not affect the cooking losses, pH, and water holding capacity.

1. Introduction
Duck meat is an option in the push to satisfy creature protein sources that are effortlessly gotten by the network. Duck meat can possibly be created and used as an elective wellspring of meat creation other than ovens, local chickens, and laying hens in Indonesia [1]. With the quick advancement of the serious poultry industry, fats and oils are as a rule broadly utilized as the best high-vitality feed fixings. Lipids added to poultry diets can improve their development execution, and furthermore advance assimilation and ingestion of supplements and fat-solvent nutrients [2,3]. Lipids (fats and additionally oils) are frequently included to increase vitality thickness in diets of poultry. It is all around recorded that dietary lipid quality can be altered by utilizing distinctive lipid sources, for example, soybean oil, palm oil, grease, and fat [4,5]. It is for the most part accepted that the estimation of vegetable oils is superior to that of creature fats [6].

Various distinctive oil sources are accessible for poultry from vegetable sources. Normal oil sources in grill sustenance are sunflower oil, canola oil, and soybean oil [7]. Oils have generally been utilized as vitality sources in the eating regimens for poultry. Points of interest in using oils in poultry diet incorporate a diminishing of sustenance dust, an expansion in ingestion and assimilation of lipoproteins, noteworthy measure of fundamental unsaturated fats, and their lower heat toward...
starches and proteins [8]. Most vegetable oils are good sources of linoleic acid, but very few vegetable oils contain significant amounts of α-linolenic acid. Among vegetable oils, perilla oil has the highest α-linolenic acid (omega-3) content, the difference in LDL is 50% cholesterol and 25% protein while HDL is 20% cholesterol and 50% protein [9]. Vegetable oil acts as an energy source, which when available, exceeds the energy required, it will be converted into body fat so that the presence of fat deposits increases heat conductivity in muscles and accelerates the glycolysis process causing the pH of the meat to be low [10]. Therefore, research was needed on physical quality of local duck meat with addition of different vegetable oils in the ration so that there is an increase in carcass quality and nutritional content of duck meat.

2. Materials and methods

2.1. Research materials
A total of 144 ducks were divided into 4 treatment groups, with 6 replicates and each replicate consisted of 6 head ducks. The feeding treatments were:
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 experiments were conducted for 9 weeks

2.2. Research methods
The research feed is arranged and formulated manually starting from the largest proportion of feed ingredients arranged first then mixing it with the smallest proportion of feed ingredients so that a layer of each feed ingredient is formed and then mixed until it is homogeneous. The diets were consisted of yellow corn, pollard, rice polish, soy bean meal, premix, NaCl, limestone, and vegetable oils. The basal diets contained crude protein 19-20% and energy 3200-3300 Kcal/kg. Feedstuffs composition and nutrient content of experimental diets were presented in Table 1.

2.3. Carcass collection
Data collection of cut weight and carcass weight was carried out when the ducks were nine weeks old. Before slaughtering, two of the ducks were slaughtered in an experimental slaughterhouse with prior fasting for twelve hours. The process of slaughtering ducks were done by cutting the carotid artery, jugular vein, trachea, and esophagus. The carcass is the body part of ducks after slaughtering based on Islamic Shari'ah, with removal of feathers, and removal of offal, without head, neck and legs. The breast section is taken for meat chemical analysis.

2.4. Sampling of meat
Thigh muscle data were collected when the ducks were slaughtered at 9 weeks of age. The samples were slaughtered as much as 1 head per replication so that the total number of ducks that were cut was 24 ducks. Slaughtering ducks is carried out by fasting for 12 hours with the aim of emptying the food in the digestive tract. The process of slaughtering ducks is done by cutting the carotid artery, jugular vein, trachea, and esophagus. The process of hair removal by hard scalding at a temperature of 71-82ºC for 30-60 seconds because ducks have a waxy coating that makes hair difficult to remove. Then the carcass was carried out to separate the carcass and non-carcass parts. The existing carcasses are partitioned to divide the carcass into smaller parts in order to make it easier to group them by type of meat. Collected thigh meat is separated from the bone (deboning) to facilitate the sampling of muscles in the same position and muscles. The bicep femoris, which has a broad cross-section, will be cut into several parts to be tested for pH, water holding capacity, cooking loss, and tenderness. Then the sample weight was weighed as determined, for analysis of pH 3g, analysis of the water-binding
capacity of 0.3g, cooking loss of 100g, and tenderness of 5g. Furthermore, the physical characteristics of the meat were analyzed including the pH value of the meat, the water holding capacity, cooking losses, and tenderness.

**Table 1. Feedstuffs composition (on dry matter basis) and nutrient content of experimental diets**

| 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 (%)      | 24.50         | 23.25           | 23.75            | 23.50            |
| Soy Bean Meal (%)    | 21.50         | 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             |
| Vegetables 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          | 3258.97       | 3262.89         | 3241.44          | 3266.61          |
| 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             |

2.5. **Research parameters**

The parameters observed in the study were cooking loss, tenderness, pH, and water holding capacity.

2.5.1. **Meat pH.** The meat sample was ground then 3g of the milled sample was put into a beaker and diluted with 17 ml aquadest added. After that, the mixer uses a Becker glass and stirrer for 1 minute and then measured with a pH meter that was previously calibrated at pH 4 and 7 [11].

2.5.2. **Water holding capacity.** Water binding capacity was measured using the [12] method by weighing the sample as much as 0.3g the sample was pressed with a load of 35kg, after five minutes the area covered by the meat sample and the area of the wet area around it were marked and measured. The wet area is the area of the outer circle minus the area of the inner circle measured by a planimeter and the g H2O value is obtained, with the formula:

\[ g \text{ H}_2\text{O} = \frac{\text{wet area} - 8.0}{0.0948} \]

The value of the water holding capacity is calculated by the following formula:

\[ \text{Water holding capacity} = \frac{x - y}{x} \times 100\% \]

Information :

- x: Amount of sample water (g)
- y: The amount of water released (g H2O)
2.5.3. Cooking loss. Cooking loss is the difference between the weight of meat before and after cooking, expressed as a percentage (%). The meat sample weighing 100 g which has been attached to a bimetallic thermometer is boiled in boiling water until it reaches an internal temperature of 80˚C. Meat samples were removed and cooled [13]. Cooking losses are calculated using the following formula:

\[
\text{Cooking losses} = \frac{\text{initial} - \text{final sample weight}}{\text{final sample weight}} \times 100\%
\]

Percentage of carcass portion = \(\frac{\text{Carcass portion weight}}{\text{Carcass weight}}\) \times 100%

2.5.4. Tenderness. The thigh meat sample was cut about 100 g, then the meat sample was cut to a size of 1.57 x 0.67cm following the direction of the meat fiber, the tenderness test was carried out using a Warner-Blatz with a bimetal plate pressing it into the inside of the meat sample to determine its breaking strength value in kg / cm2 and measurements were repeated three times and averaged [14].

2.6. Data analysis
This research used one way 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 cooking loss, tenderness, pH, and water holding capacity can be seen in Table 2.

3.1. Cooking loss
Cooking loss is the amount of water lost and nutrients that dissolve in water due to the effects of cooking. The average cooking loss for local duck meat aged 9 weeks are presented in Table 2. The results of statistical analysis showed that cooking loss of local duck meat with the addition of different vegetable oils in the ration had no significant effect (\(P>0.05\)). 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 cooking loss of duck meat because the four treatments showed no significant differences.

| Variable                  | Treatment          | P Value |
|---------------------------|--------------------|---------|
| Cooking loss (%)          | P1: 35.77±1.97     | 0.620   |
|                           | P2: 35.60±1.94     |         |
|                           | P3: 32.78±8.53     |         |
|                           | P4: 35.60±1.55     |         |
| Tenderness (g/cm²)        | P1: 2.98±0.53b     | 0.041   |
|                           | P2: 2.28±0.44a     |         |
|                           | P3: 2.54±0.17a,b   |         |
|                           | P4: 2.38±0.43a     |         |
| pH                        | P1: 5.43±0.20      | 0.252   |
|                           | P2: 5.62±0.15      |         |
|                           | P3: 5.5±0.14       |         |
|                           | P4: 5.48±0.16      |         |
| Water holding capacity (%)| P1: 8.84±8.51      | 0.230   |
|                           | P2: 14.71±4.18     |         |
|                           | P3: 18.40±11.77    |         |
|                           | P4: 19.15±0.61     |         |

\(^{a,b}\) 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

The cooking loss of local duck meat in this study were higher than that of Polish Pekin, Danish Pekin, and English Pekin ducks. The results of research by [15] stated that cooking loss in male Polish Pekin, Danish Pekin, and English Pekin ducks were 32.1%, 32.2%, and 32.4% in breast muscle while leg muscle was 34.4%, 30.7% and 34.0%. The results of this study were different from the research of
[16] stated that the addition of red fruit oil in feed had an effect on cooking loss of broiler chicken. The cooking loss of broiler chicken meat which was given additional 6% palm oil increased compared to the treatment without the addition of red fruit oil and the addition of 4% red fruit oil.

The results of this study were almost the same as research by [17] that the used of soybean oil had no significant effect on cooking loss of turkey, both the breast muscles and thigh muscles. The cooking loss of turkey for the breast muscles and thigh muscles that were added with soybean oil were lower than this study, namely 14.66% and 22.47%. Cooking loss is influenced by pH, length of muscle fiber sarcomere, and myofibril contraction status [18].

3.2. Tenderness
Tenderness is one of the qualities of meat related to consumer acceptance. The average tenderness for local duck meat aged 9 weeks are 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 local duck meat tenderness. Based on the research results, it can be seen that the P1 treatment was significantly different from the P2 and P4 treatments, but not significantly different from the P3 treatment, while the P2, P3, and P4 treatments were not significantly different. Treatment P1 had the highest meat tenderness compared to other treatments, this was influenced by one of the causes of palm oil content in the ration. The palm fruit (Elaeis guineensis) yields palm oil, a palmitic-oleic rich semi solid fat and the fat-soluble minor components, vitamin E (tocopherols, tocotrienols), carotenoids and phytosterols. Palm fruit contains pigments, which are around 700 - 800 ppm carotenoids. Some of these carotenoids are included in palm oil (about 500 ppm) [19].

The results of this study were different from the research of [16] stated that the addition of red fruit oil in feed had no significant effect on the tenderness of broiler chicken meat but had significant effect on the addition of palm oil. The tenderness of the flesh with the addition of palm oil was lower than that of the addition of red fruit oil. Diets with high oil clearly can increase the retention time of feed in the intestine and also cause the digestion process and absorption of non-fat constituents to be more complete [20]. Meat tenderness is influenced by several factors, namely factors before slaughter including genetics, management, species, livestock physiology, and age. Factors after slaughter include withering, freezing, processing methods, fat and water holding capacity [21].

3.3. pH
The pH value is one of the factors in determining the quality of meat. The average pH of local duck meat aged 9 weeks are presented in Table 2. The results of statistical analysis showed that the pH of local duck meat with the addition of different vegetable oils in the ration had no significant effect (P>0.05). 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 pH of the 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 used of soybean oil had no significant effect on the pH of turkey meat on the breast muscles. The pH value of turkey meat in the breast muscles which was added with soybean oil was higher than this study, namely 6.01. The pH value of local duck meat in this study was also higher than the pH in Polish Pekin, Danish Pekin, and English Pekin ducks. The results of research by [15] stated that the pH in male Polish Pekin, Danish Pekin, and English Pekin ducks were 5.7, 6.1 and 6.0 in breast muscle, while in leg muscle were 5.8, 6.4, and 6.1. The results of this study were different from the research of [16] stated that the addition of red fruit oil in feed affects the pH of broiler chicken meat. The higher the level of red fruit oil given, the higher the pH value, but it was not significantly different from the positive control treatment of 6% palm oil. The pH value of the meat given red fruit oil, the pH of the broiler chicken meat produced ranged from 6.35 to 6.67.
3.4. Water holding capacity

Water holding capacity is the ability of meat to bind free water. The average water holding capacity of local duck meat aged 9 weeks are presented in Table 2. The results of statistical analysis showed that the water holding capacity of local duck meat with the addition of different vegetable oils in the ration had no significant effect (P>0.05). 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 holding capacity 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 used of soybean oil had no significant effect on the water holding capacity of turkey meat on the breast muscles. The water holding capacity of turkey, the breast muscles, which were added with soybean oil, was lower than this study, namely 7.91%. The results of this study were different from the research of [16] stated that the addition of red fruit oil in feed had an effect on the water holding capacity of broiler chickens. The greater the red fruit oil given the higher the water holding capacity of broiler meat. The addition of 6% palm oil showed the water holding capacity of broiler meat, namely 50.37%.

Water holding capacity affects the cooking loss of meat. The results of this study did not have a significant effect on water holding capacity, so that the cooking loss of meat had the same effect. The water holding capacity of meat is very influenced by pH, species, age and muscle function as well as feed, transport, humidity, storage, sex, health, treatment before slaughter and fat intramuscular [22]. Water holding capacity will increase if the pH value of the meat increases. This is because the low pH value of the meat causes the structure of the meat to open, which reduces the water holding capacity, and the high pH value of the meat results in a closed meat structure so that the water holding capacity is high [23].

4. Conclusion

It can be concluded that the addition of vegetable oil in the ration affects the tenderness of duck meat but did not affect the cooking loss, pH, and water holding capacity.

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