Nutritional Value of Chicken Meat Fed Diet Supplemented with Purslane Rich in Omega-3 Fats

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Abstract. This study aims to examine the effect of dietary supplementation in the form of purslane meal (Portulaca oleracea) as a source of omega-3 fats on the nutritional value of broiler chickens. A total of 180 one-day old unsexed Lohmann broiler chickens was randomly allocated into 30 pens, with each one consisting of 6 chickens. Thereafter the pens were randomly assigned to five experimental diets with 3 replicates (36 birds per treatment). The diets were formulated by adding a basal diet to 0, 1.5, 3.0, 4.5 and 6.0% purslane meal. The water and diets were provided ad libitum throughout the experiment. Furthermore, after 35 days, six chickens per treatment group were slaughtered and processed as carcass. Breast meat were collected for chemical analysis of protein, fat, moisture and collagen using FoodScan Near-Infrared Spectrophotometer, while the data were analysed using ANOVA. Moreover, differences among treatment means were further analysed using Tukey’s test. The results showed that diets enriched with omega-3 fats in the form of alpha-linolenic acid had no effect on the collagen content of chicken meat with an average of 1.41%. In addition, the meat protein level which was approximately 22% was the same among dietary treatments. There was also no significant difference in the fat content of meat fed the dietary purslane meal with an average of 2.83%. Based on the results, it was concluded that the nutritional value of broiler chicken meat was not altered by the dietary inclusion level of 6% Portulaca oleracea (purslane) meal as a source of omega-3 fats. Further studies are needed to evaluate whether the supplementation of purslane meal at a higher level is capable of improving the chemical quality of broiler chicken meat.

Keywords: alpha-linolenic acid, diet, nutritional value, omega-3 fat, purslane

1. Introduction

Based on previous studies, there is a relationship between broiler chicken meat and the accumulation of fatty acids using feed supplemented with omega-3 long-chain polyunsaturated fatty acids (n-3 LCPUFA), that is usually obtained from fish meal or oil [1,2]. To increase the formation of n-3 LCPUFA in chicken meat, the strategy often considered is by giving fish meal as well as oil alone, or in combination with n-3 PUFA (alpha-linolenic, ALA) sources [2]. However, it was reported that the use of marine sources in changing the fatty acid composition of meat quality resulted in a negative effect on the sensory properties of chicken products such as off-flavour [3,4] resulting in decreased product acceptance by consumers.

One alternative to this challenge is to increase the accumulation of n-3 LCPUFA in chicken products by involving plants or seeds containing high levels of n-3 PUFA (ALA, 18: 3n-3) which is a precursor to n-3 LCPUFA. Previous studies [5,6] have reported an increase in the content of n-3 fatty acids (n-3 LCPUFA), such as eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA, 22: 5n-3), and
docosahexaenoic acid (DHA) using supplements rich in plant-sourced ALA-rich ingredients. Furthermore, Kartikasari et al. [7] reported that the use of flaxseed oil in broilers’ diets may have potentially increased the meat n-3 fatty acid content. The use of omega-3 sources from plants, rich in ALA is preferred because it has no negative effect on broiler performance and meat quality hence, it is accepted by consumers. Therefore, the addition of plant seeds or oil rich in ALA to broiler is a potential dietary approach to improve the meat quality by increasing the n-3 fat content in chicken meat.

An example of a plant suited for this purpose is purslane (Portulaca oleracea). This plant contains many beneficial biological active compounds, such as β-carotene, alpha-tocopherol, as well as ascorbic acid, together with high levels of n-3 PUFA (ALA) [8]. Meanwhile, several studies have examined the effects of purslane on egg quality and n-3 fatty acid deposition in eggs [9,10,11] as well as on broiler production performance [12]. However, publications regarding the use of purslane on the nutritional value of meat have not been widely reported. Zhao et al. [12] found that 0.4% purslane supplementation tended to reduce the feed conversion ratio and increase broiler body weight, both at day 28 and 42. In addition, regarding carcass quality, the use of 10% purslane seeds together with broiler feed had no effect on the slaughter weight, carcass, and cut yield of quail carcass [13].

The growth pattern for broiler fat depots can potentially be modified by feed formulation. The reduction in this content is closely related to the fatty acid composition of the feed [14]. In addition, previous studies have reported that broilers fed diets containing high levels of ALA had less accumulated abdominal fat pads, compared to chickens fed diets containing high levels of saturated fatty acids or monounsaturated fatty acids [14]. Therefore, this study aims to determine the nutritional value of meat obtained from broiler chickens fed diets supplemented with 6% purslane meal rich in omega-3 fats.

2. Materials and method

2.1 Research Materials
A total of 180 one-day old unsexed Lohmann broiler chickens was used in this study. The broilers were randomly allocated into 30 pens (each pen contained 6 birds) and then assigned to five dietary treatments with 6 replicates (36 birds per treatment). Meanwhile, the basal diet was a corn-soybean based diet containing crude protein 23% and energy 3090.79 kcal/kg.

2.2 Research Methods
This study was conducted using a one-way classification design. Meanwhile, the variable factor was the varying levels of dietary purslane meal as a source of ALA. In addition, a total of five diets consisting of a control diet and four experimental diets were used. The diets were formulated by supplementing a basal diet with 0 (T0), 1.5 (T1), 3 (T2), 4.5 (T3) and 6% (T4) Portulaca oleracea meal (w/w). The basal diet was also composed of yellow corn (32.00%), soybean meal (29.95%), rice polish (3.00%), copra meal (14.95%), DDGS (10.00%), coconut oil (4.50%), di-calcium phosphate (2.20%), limestone (1.00%), DL-Methionine (0.40%), L-Lysine (0.24%), salt (0.50%), CaCO3 (0.06%), filler (0.99%), and vitamin E (0.02%). The level of fat in the experimental diets was held constant at approximately 5.8%. The nutrient content of the dietary treatments is presented in Table 1. Upon arrival, the broilers were immediately weighed and housed six birds per cage. Furthermore, each dietary treatment was replicated six times (n = 6 chickens for each replication). The broiler chickens were fed for 35 days, with water and feed provided ad libitum. Thereafter, the chickens were observed at frequent intervals during the first few days to ensure that they had adequate access to feed and water, and were comfortable with the environmental conditions. The procedure for meat evaluation was in line with Anderson [15]. A total of 35 day old 30 chickens (n = 6 chickens for each treatment) was slaughtered to evaluate the chemical composition of the meat. Moreover, the breast meat samples were further analyzed using FoodScan Near-Infrared Spectrophotometer. The procedure of analysis is as follows; tested samples were homogenized by grinding in line with AOAC Official Method 983.18. Next, each chicken meat sample was weighed (180 g) and placed in a round sample dish which was further adjusted in the FoodScan tools. Afterwards, the operator ID was entered on the software, and the meat sample profile appeared as chosen. The scanning process was initialized by pressing the "start" button while analysis results including collagen, protein, fat, and moisture percentages were displayed (g/100 g).
2.3 Data Analysis
The data were analysed using analysis of variance (ANOVA). Meanwhile, differences between the treatment means were further analysed using Duncan’s New Multiple Range Test (DMRT) with a significance level of P<0.05.

### Table 1. Nutrient content of dietary treatments

| Nutrient value                  | R0   | R1   | R2   | R3   | R4   |
|---------------------------------|------|------|------|------|------|
| DM (%)                          | 86.97| 87.07| 87.17| 87.27| 87.37|
| Metabolizable energy (kcal/kg)  | 3090.79| 3069.71| 3048.62| 3027.53| 3006.45|
| Crude protein                   | 23.10| 23.03| 22.96| 22.89| 22.82|
| Ether extract                   | 5.77 | 5.78 | 5.78 | 5.78 | 5.78 |
| Crude fiber                     | 3.25 | 3.51 | 3.78 | 4.04 | 4.31 |
| Ash                             | 3.97 | 3.95 | 3.92 | 3.89 | 3.87 |
| Calcium                         | 1.07 | 1.12 | 1.18 | 1.23 | 1.29 |
| Phosphorus                      | 0.87 | 0.86 | 0.86 | 0.85 | 0.84 |
| Available phosphorus            | 0.57 | 0.56 | 0.55 | 0.55 | 0.54 |
| Lysine                          | 1.22 | 1.21 | 1.20 | 1.20 | 1.19 |
| Methionine                      | 0.65 | 0.65 | 0.66 | 0.67 | 0.68 |

3. Result and Discussion
Previous studies reported that the dietary inclusion of 6% Portulaca oleracea (purslane) into chicken diets had no effect on the body, slaughter, and carcass weight as well as yields of carcass cuts [16]. Similarly, based on the results, this study shows that the dietary inclusion of 6% purslane meal had no effect on the nutritional value of chicken meat including protein, collagen, fat, and water content. The average of protein and fat content was 22.07 and 2.83% respectively, indicating that the components were approximately in the normal range. These results were consistent with Živković et al. [17] who reported that the diet together with extruded flaxseed at a level of 6% had no effect on the chemical composition including fat and protein, with breast meat protein ranging from 21.06 to 22.02% after 45 days. In addition, Mridula et al. [18] also found that when the dietary inclusion of flaxseed as a source of omega-3 fatty acids was increased up to 10%, the chemical composition of broiler meat was unaltered, with protein and fat content achieving 20.23 and 2.49% respectively. Kartikasari et al. (2012) noted that the fat content of the breast and thigh of the broiler chickens was unaltered even with increasing the dietary levels of alpha-linolenic acid up to 8%. In this study, there were no significant changes in the protein levels, therefore, the collagen levels were also not altered.

However, Ajuyah et al. [19] found that the addition of flaxseed or ground flaxseed up to a level of 10 or 20% significantly reduced the lipid content of breast meat. This shows that the use of plants rich in omega-3 fatty acids is suitable for maintaining the chemical quality of the meat produced. For example, flaxseed plants at a level of up to 10% may potentially be added to diets to maintain the nutritional value of the meat. Furthermore, Habibian et al. [20] showed that the use of purslane is capable of reducing triglycerides (TG), cholesterol and low-density lipoproteins (LDL), but increase high-density lipoproteins (HDL) thereby improving the chemical content of meat, especially fat. Other studies have also found that applying purslane flour at a level of 7.5% [21] or 10% [22] in commercial rations improved the chemical quality of broiler chicken meat, by increasing protein content and reducing moisture. However, in this study, the addition of purslane meal was limited to 6%. Hence, there was no increase in protein content or decrease in moisture. In addition, the application of 10% fermented purslane flour provides the best chemical quality in broiler chicken meat [22]. This occurred due to the higher purslane flour content. Therefore, the application of 6% purslane meal is unable to improve the chemical quality of broiler chicken meat which is also influenced by the metabolizable energy and crude protein content in the feed. The difference in energy levels of the feed influenced the chemical content of the broiler chicken meat [23]. The energy and protein content in the feed affected the metabolism, therefore influencing the growth of these chickens [24]. Soeparno [25], reported that livestock growth
affected the chemical composition of meat. In this study, the 6% purslane meal was used, while the diet contained energy and protein iso. Hence, there was no difference in the meat chemical content.

Table 2. Chemical composition of chicken meat at 35 days

| Variables  | R0 (%) | R1 (%) | R2 (%) | R3 (%) | R4 (%) | P value | Significance |
|------------|--------|--------|--------|--------|--------|---------|-------------|
| Collagen   | 1.39±0.163 | 1.44±0.054 | 1.42±0.066 | 1.41±0.151 | 1.39±0.129 | 0.937 | NS |
| Protein    | 22.20±0.414 | 22.10±0.247 | 22.23±0.416 | 21.92±0.467 | 21.92±0.453 | 0.538 | NS |
| Fat        | 2.91±0.371 | 3.13±0.439 | 2.80±0.559 | 2.56±0.577 | 2.74±0.666 | 0.444 | NS |
| Moisture   | 72.38±0.322 | 72.44±0.267 | 72.32±0.542 | 72.32±0.139 | 72.64±0.324 | 0.674 | NS |

R0: Basal diet + 0% purslane meal, R1: basal diet + 1.5% purslane meal, R2: basal diet + 3% purslane meal, R3: basal diet + 4.5% purslane meal and R4: basal diet + 6% purslane meal
NS= not significant

4. Conclusion

Based on the results, the nutritional value of broiler chicken meat was unaltered by the dietary inclusion of 6% Portulaca oleracea (purslane) meal as a source of omega-3 fat. This indicates that the addition of 6% purslane meal had not been able to improve the chemical quality of the meat. Further studies are needed to investigate whether the use of purslane meal at a higher level is capable of increasing the chemical quality of broiler chicken meat.

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