Physical quality of broiler chickens fed diets containing fish oil and different levels of purslane meal

L. R Kartikasari, B S Hertanto, S Y Sutanto and A M P Nuhriawangsa
Department of Animal Science, Faculty of Agriculture, Universitas Sebelas Maret, Jl. Ir. Sutami No. 36A Surakarta 57126, Indonesia

Email: lilikretna@staff.uns.ac.id

Abstract. The aim of the study was to investigate the effect of dietary supplementation of purslane meal (Portulaca oleraceae) and sardines fish oil as a source of omega-3 fats on physical quality of broiler chickens. A total of 180 one-day old unsexed Cobb broiler chickens were used in this study. Chickens were randomly placed into 30 pens with each pen consisted of 6 birds. The pens were randomly assigned to five dietary treatments with 6 replicates (36 birds per treatment). The diets were prepared from a basal diet (P0). The experimental diets were formulated by adding the basal diet containing 1.5% sardines fish oil and levels of purslane meal 0 (P1), 6 (P2), 12 (P3), and 18% (P4). Water and diets were provided ad libitum for a period of 35 days. Six chickens for each treatment were processed as carcass and breast meat (Pectoralis Major) samples were collected for physical quality analysis. The data were analysed using analysis of variance (ANOVA). Differences between treatment means were further analysed using Duncan’s New Multiple Range Test. Results showed that the results showed that adding Portulaca oleracea (purslane) meal into the diets at a level of 12 and 18% did not influenced pH value. Feeding diets enriched with purslane meal up to a level of 18% for 35 days did not alter meat WHC with the average of approximately 51%. Diets containing purslane meal decreased meat cooking loss. Meat tenderness of chickens fed diets supplemented with 12% purslane meal (1.12) was higher than those fed 18% purslane meal (1.93). It was concluded that dietary levels of purslane meal up to a level of 12% did not affect the physical quality of broiler chickens.

1. Introduction
The use of marine sources in broiler diets in order to increase broiler performance, meat quality and the accumulation of meat omega-3 long chain polyunsaturated fatty acids (n-3 LCPUFA) has been investigated by previous researchers [1, 2]. However, there are some negative impacts on the sensory properties of chicken products by using fish meal or fish oil to manipulate meat fatty acid profiles or meat quality, as reported by the presence of an off-odour or off-flavour [3,4]. Therefore, an alternative to the supplementation of fish meal or fish oil to chicken diets is needed, for example the use of ALA-rich plant sources [5, 6]. Moreover, a study conducted by Kartikasari et al. [7] found that all chicken meat n-3 LCPUFA including eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA, 22:5n-3), and docosahexaenoic acid (DHA) increased as a result of dietary inclusion of flaxseed oil rich in ALA without negatively affecting broiler performance and the qualities of the meat. Therefore, this dietary strategy can be used to increase n-3 fat content in chicken meat and may improve the quality of meat.
One of plant that contains many biologically active compounds is Portulaca oleracea (purslane). These compounds include alpha-tocopherol, folic acid, β-carotene, calcium, and ascorbic acid [8]. Purslane also contains high level of n-3 PUFA, ALA [9, 10]. Dietary inclusion of purslane rich in ALA on production performance of laying hens, quality of egg, and n-3 fat content has been investigated by some researchers [10, 11, 12]. For example, a study conducted by Kartikasari et al. [13] found the supplementation of purslane up to a level of 6% did not alter performance parameters and egg quality such as yolk weight, egg weight, yolk index, albumen index, and Haugh Unit. Moreover, there was an increase in albumen weight, yolk weight, egg weight, and yolk colour intensity when the level of purslane was increased to 8% [12]. In broiler, a study conducted by Zhao et al. [14] showed that body weight gain improved and feed conversion reduced by adding purslane extract (0.4%) in the diets for both on day 28 and 42. A study in quails reported that there were no effects on slaughter weight, carcass, and carcass cut yields of quails when the diets were supplemented with 10% purslane seed [15]. In addition, Kartikasari et al. [16] reported that diets supplemented with Portulaca oleracea up to a level of 6% did not influence carcass quality and carcass cut yields of broilers. There is limited data regarding to the use of purslane meal in meat quality. Therefore, the aims of the current study were to evaluate physical quality of broiler chickens fed diets containing fish oil and purslane meal meat, rich in ALA.

2. Materials and Methods

2.1. Research Materials
A total of 180 one-day old unsexed Cobb broiler chickens were used in this study. The birds were randomly allocated in 30 pens with each pen containing 6 birds. There were five dietary treatments with 6 replicates (n= 36 birds for each treatment). The basal diet was the corn-soybean based diets. Starter diet contained crude protein 23.43% and energy 3318.94 kcal/kg and finisher diet contained crude protein 21.3% and energy 3317.73 kcal/kg.

2.2. Research Methods
A one-way classification design was used in this study. The variable factor was purslane meal levels, as a source of ALA in the diet. Five dietary treatments were formulated with a basal diet (D0) supplemented with 1.5% fish oil and added with 0 (D1), 6 (D2), 12 (D3), and 18% (D4) purslane meal (w/w). The fat content in the experimental diets was approximately 4% for both starter and finisher diets. The composition of the diets and nutrient content were presented in Table 1. Upon arrival, the broilers were immediately weighed and housed six birds per pen. There were six replicates for each of the five dietary treatments. The diets were given to the broiler chickens for 42 days. Water and feed were provided ad libitum for the experimental period. To ensure that feed and water were available in adequate amount, the chickens were observed frequently during the first few days. This activity was also to ensure that they were comfortable with the environmental conditions. The data of performance parameters were recorded and measured for a 42-days duration of period. At day 35 and 42, a total of 30 chickens, which were six chickens for each treatment, were slaughtered to evaluate meat quality.

2.3. Data Analysis
All collected data of meat quality in this research were analysed using analysis of variance (ANOVA). Differences between treatment means were further analysed using Tukey test with significance level of P<0.05.

3. Results and discussion
The meat qualities of broiler chickens fed diets supplemented with Portulaca oleracea meal for 35 days were presented in Table 1. The results showed that adding Portulaca oleracea (purslane) meal into the diets influenced pH value with the diets containing 6% purslane meal increased pH value of the meat from 5.82 for control diet to 6.30 for diets supplemented with 6% purslane meal. Similarly, there was no significant effect on water content observed by feeding purslane meal up to a level of 18%.
Importantly, meat cooking loss of broilers fed diets containing purslane meal was lower than those fed the control diet however there was no different in cooking loss among dietary treatments. When cooking loss did not change by the increasing levels of dietary inclusion of purslane meal, it appears that fat content of meat increased with the highest level achieved for diets containing 18% purslane meal (5.09%). This could be due to an increase in fat content of the diets by supplementation of dietary purslane meal.

The lipid content of broiler chickens was strongly associated with the composition of dietary fatty acid [17]. This current result was support by Watanabe et al. [18] which reported that there was no significant correlation between intramuscular fat content and meat cooking loss. In addition, a study conducted by Cannata et al. [19] found a negative correlation between cooking loss and fat content of meat. In contrast, a significant positive correlation between lipid content and cooking loss was observed. In this study, Feeding diets enriched with purslane meal up to a level of 18% did not alter meat WHC with the average of approximately 51%. This suggests that there was no relationship between total fat content of meat and WHC as reported by Watanabe et al. [18]. The findings of the study showed that dietary inclusion of Portulaca oleracea (purslane) meal up to a level of 12% compared to those fed 18% purslane meal diets (1.93).

Table 1. Meat quality of broiler chickens fed diets supplemented with Portulaca oleracea meal at day 35.

| Parameters              | D0     | D1     | D2     | D3     | D4     | P Value |
|-------------------------|--------|--------|--------|--------|--------|---------|
| pH                      | 5.82b  | 6.27a  | 6.30a  | 6.11ab | 6.11ab | 0.001   |
| WHC (%)                 | 47.39a | 43.14a | 53.03a | 50.93a | 50.86a | 0.260   |
| Cooking loss (%)        | 16.77a | 10.02b | 10.30b | 9.07b  | 10.90b | 0.000   |
| Tenderness              | 1.82ab | 1.72ab | 1.43ab | 1.12b  | 1.93a  | 0.036   |
| Water content (%)       | 75.34a | 74.17a | 76.15a | 75.07a | 74.27a | 0.464   |
| Fat content (%)         | 4.15bc | 4.23bc | 3.62c  | 4.48ab | 5.09a  | 0.001   |

D0: Basal diet, D1: basal diet containing fish oil 1.5%, D2: basal diet containing fish oil 1.5% + 6% purslane meal; D3: basal diet containing fish oil 1.5% + 12% purslane meal; D4: basal diet containing fish oil 1.5% + 18% purslane meal

** significant (P<0.01)

4. Conclusions

It was concluded that diets enriched with Portulaca oleracea (purslane meal) up to a level of 12% didn’t change the meat quality including pH, WHC, tenderness, water content and fat content. Diets supplemented with purslane meal reduced cooking loss of the meat. The dietary inclusion of Portulaca oleracea meal up to a level of 12% can be applied without affecting meat quality of the chickens.

Acknowledgment

This study was supported by the research grant “Penelitian Dasar Unggulan Perguruan Tinggi (PDUPT-DIKTI)” Project Number: 474/UN27.21/PP/2018.
References

[1] Lopez-Ferrer S, Baucells M D, Barroeta A C and Grashorn M A 2001 Poult. Sci. 80 741-52
[2] Hulan H W, Proudfoot F G, Ackman R G and Ratnayake W M 1988 Can. J. Anim. Sci. 68 533-547
[3] Bou R, Guardiola F, Barroeta A C and CodonyR 2005 Poult. Sci. 84 1129-1140
[4] Chekani-Azar A, Shahriar H A and Maheri-Sis N 2008 Asian J. Anim. Vet. Adv. 3 62-69
[5] Febel H, Mezes M, Palf T, Herman A, Gundel J, Lugasi A, Balogh K, Kocsis I and Blazovics A 2008 J. Anim. Physiol. Anim. Nutr. (Berl) 92 369-376
[6] Zelenka J, Schneiderova D, Mrkvicova E and Dolezal P 2008 Vet. Med. 53 77-85
[7] Kartikasari L R, Hughes R J, Geier M S, Makrides M and Gibson R A 2012 Prostaglandins Leukot. Essent. Fatty Acids 87 103-109
[8] Irawan D, Hariyadi P, Wijaya H 2003 Indonesian Food and Nutrition Progress 10 (1)
[9] Uddin M K, Juraimi A S, Hossain M S, Nahar M A U, Ali M E and Rahman M M 2014 Scientific World J. 1-6
[10] Aydin R and Dogan I 2010 J. Sci. Food Agric. 90 1759-63
[11] Evaris E, Sarmiento-Franco L A, Segura-Correal J C and Capetillo C M 2015 Trop. Subtrop. Agroec. 18 33-38
[12] Kartikasari L R, Hertanto H S, Pranoto D, Salim W N and Nuhriawangsa A M P 2017 Int. Conf. on Food Science and Engineering 2016, 18-19th October 2016, Surakarta, Indonesia IOP Conf. Series: Materials Science and Engineering 193 (2017) 012027 doi:10.1088/1757-899X/193/1/012027
[13] Kartikasari L R, Nuhriawangsa A M P, Hertanto B S and Swastike W 2015. J Anim Production 2015, 41(1) 7-12
[14] Zhao X H, He X, Yang X F and Zhong X H 2013 Poult. Sci. 92 1343-1347
[15] Konca Y, Beyzi S B, Karabacak M and Yaylak E 2015 Tavukçuluk Araştırma Dergisi 12 1-6
[16] Kartikasari L R, Hertanto B S and Nuhriawangsa A M P 2017 Int. Conf. on Food Science and Engineering 2016, 18-19th October 2016, Surakarta, Indonesia IOP Conference Series: Earth and Environmental Science 102 (2017) 012088 doi:10.1088/1755-1315/102/1/012088
[17] Mridula D, Kaur K, Nagra S S, Barnwal P, Gurumayum S and Singh K K 2015 J. Applied Anim. Res. 43 345-351
[18] Watanabe G, Motoyama M, Nakajima I and Sasaki K 2018 Asian-Australas. J. Anim. Sci. 31 914-91812
[19] Cannata S, Engle T E, Moeller S J, Zerby H N, Radunz A E, Greens M D, Bass P D and Belk K E 2010 Meat Sci. 85 428-434