

Effects of dietary sardine oil and tomato powder supplementation on laying performance and egg quality of Mojosari duck

Faizal Andri, Eko Widodo¹ and Irfan H Djunaidi

Graduate Program of Animal Husbandry, Faculty of Animal Husbandry,
University of Brawijaya, Malang-65145, Indonesia

¹ Department of Animal Nutrition and Feed Sciences, Faculty of Animal
Husbandry, University of Brawijaya, Malang-65145, Indonesia
eko.widodo@ub.ac.id

Abstract

The purpose of this research was to evaluate effects of dietary sardine oil (SO) and tomato powder (TP) supplementation on laying performance and hatching egg quality of Mojosari duck. A total of 120 female and 20 male Mojosari ducks, aged at 40 weeks old, were used in this research. Ducks were randomly allotted into 20 pens (6 female and 1 male ducks for each pen) and fed 1 of 5 dietary treatments, either basal diet (control), basal diet + 1% SO, basal diet + 2% SO, basal diet + 1% SO + 1% TP or basal diet + 2% SO + 1% TP. Results showed that dietary treatments had no effect ($p > 0.05$) on feed intake, egg production, egg weight, egg mass, feed conversion ratio and income over feed cost. Dietary treatments also did not affect ($p > 0.05$) egg shape index, egg weight sample, yolk weight, yolk percentage, albumen weight, albumen percentage, shell weight, shell percentage, specific gravity, shell thickness and Haugh unit, but significantly affected ($p < 0.05$) yolk color score. Supplementation of sardine oil in combination with tomato powder had higher ($p < 0.05$) yolk color score compared to both control and sardine oil without tomato powder groups. It is concluded that dietary sardine oil supplementation until 2%, either without or with tomato powder, had no detrimental effects on laying performance and egg quality of Mojosari ducks. It is evident that supplementing Mojosari ducks diet with sardine oil in combination with tomato powder could improve yolk color score.

Keywords: *laying duck, lycopene, omega-3 fatty acid, poultry, yolk color score*

Introduction

Recently, corn and soybean meal are two major feedstuffs used in poultry diet. In addition, corn and soybean oils are also widely used to increase the caloric value of the diet. The use of such oil in poultry diet may cause high or even excess of omega-6 fatty acids content. On the other hand, the use of dietary omega-3 fatty acids in commercial poultry diet is promoted, particularly for health reason.

In a study conducted by Guo et al (2004), laying hens fed diet supplemented with fish oil had higher antibody production and serum lysozyme activity compared to those fed diet supplemented with corn

oil. In another study, He et al (2007) reported that dietary fish oil treatment had higher immune response and growth performance in cyclophosphamide immunosuppressed broiler as compared to dietary corn oil treatment. It could be stated that besides providing improvement on health status, fish oil inclusion may also improve performance of poultry.

Due to those benefits, the use of dietary fish oil had a great interest in poultry breeder diet. This dietary strategy aimed to increase omega-3 fatty acids content in the yolk of hatching egg, which then expected to produce hatched bird with better immune response and growth potential. However, inclusion of fish oil at high level (5.5%) in broiler breeder diet could decrease hatching egg and chick weight (Pappas et al 2006). The reason might be high content of omega-3 fatty acids in fish oil is highly susceptible to oxidation. Hence, antioxidant is required to overcome easily oxidized fish oil supplementation.

Tomato powder is one of the potential natural source of dietary antioxidant. Bioactive compound in tomato was carotenoid, which mainly consists of lycopene, neurosporene, β -carotene and lutein (Perveen et al 2013). Lycopene is a major carotenoid found in tomatoes, which gives tomato its reddish colour (Mostapha et al 2014). In a study conducted by Akdemir et al (2012), dietary tomato powder supplementation could increase egg production, egg weight, yolk color score, and yolk weight of laying hens. These mentioned studies showed a great potential of tomato powder, which could act as antioxidant and also may improve laying performance and egg quality. Therefore, this research was conducted to evaluate effects of dietary sardine oil and tomato powder supplementation on laying performance and egg quality of Mojosari duck.

Materials and methods

Birds

A total of 120 female and 20 male Mojosari ducks were used in this research. The ducks were reared in open-sided house with wire floor. The ducks received 12 hours of natural lighting, from 05.00 to 17.00. Prior to experiment, the ducks were fed commercial diet from 1 to 39 weeks of age. At 40 weeks of age, initial egg mass of duck was 52.67 ± 5.23 g (coefficient of variation was 9.93%). They were then randomly allotted into 20 pens (6 female and 1 male ducks for each pen). The size of each pen was 2 m x 0.7 m x 0.5 m (width x length x height). All diets used during experimental period of 40 to 45 weeks of age contained no antibiotics.

Research design and diet

Method used in this research was experiment in a Completely Randomized design with 5 dietary treatments and 4 replications. Dietary treatments consisted of basal diet (control), basal diet + 1% SO, basal diet + 2% SO, basal diet + 1% SO + 1% TP and basal diet + 2% SO + 1% TP. Dietary treatments were lasted for 6 weeks (from 40 to 45 weeks of age). Ingredient and nutrient content of experimental diet showed in Table 1. Diet was provided twice daily in the total of 160 g/bird/day, 60 g/bird was given at 08.00 and another 100 g/bird was given at 14.00. Drinking water was provided *ad libitum*.

Table 1. Ingredient and nutrient content of experimental diet

Ingredient	Control	0% TP		1%
		1% SO	2% SO	1% SO
Corn (%)	48	48	48	48
Soybean meal (%)	20	20	20	20
Rice bran (%)	13.2	13.2	13.2	13.2
Meat bone meal (%)	8	8	8	8
Grit (%)	5	5	5	5
Soybean oil (%)	2	1	-	1
Sardine oil (%)	-	1	2	1
Mineral premix (%)	2	2	2	2
Tapioca flour (%)	1	1	1	-
Tomato Powder (%)	-	-	-	1
Vitamin premix (%)	0.5	0.5	0.5	0.5
DL-methionine (%)	0.2	0.2	0.2	0.2
Iodized salt (%)	0.1	0.1	0.1	0.1

Total (%)	100	100	100	100
Calculated analysis				
Metabolizable energy, Kcal/kg ¹	2845	2846	2847	2846
Crude protein, % ¹	19.6	19.6	19.6	19.6
Ether extract, % ¹	4.90	4.90	4.90	4.91
Crude fiber, % ²	3.97	3.97	3.97	3.97
Calcium, % ²	3.25	3.25	3.25	3.25
Phosphorus, % ²	0.5	0.5	0.5	0.5
Lysine, % ²	1.06	1.06	1.06	1.06
Methionine, % ²	0.54	0.54	0.54	0.54
Methionine + Cysteine, % ²	0.85	0.85	0.85	0.85
Threonine, % ²	0.79	0.79	0.79	0.79
Tryptophan, % ²	0.23	0.23	0.23	0.23

¹ Notes: SO: Sardine Oil, TP: Tomato Powder

² Calculation according to proximate analysis of feed ingredient

Calculation according to data of nutrient content (Leeson and Summers, 2005)

Laying performance

Feed intake (g/bird/day) was calculated by = feed offered – feed refusal. Egg production (%) was calculated by = (number of egg produced / number of female duck) x 100%. Egg weight (g) was

determined using electrical balance. Egg mass (g/bird/day) was calculated by = egg production x egg weight. Feed conversion ratio was calculated by = feed intake / egg mass. Income over feed cost (IDR/bird/day) was calculated by= (egg production x egg price) - (feed intake x feed price).

Egg quality

A total of 60 eggs (3 from each replication) were randomly collected at the end of experimental period. Egg quality analysis was done directly upon collection. Firstly, egg shape index was determined using Vernier caliper and calculated by = (egg length / egg width) x 100. Secondly, egg was weighed using electrical balance. Thirdly, egg specific gravity (g/cm ³) was determined using gradual salt solution with 5 incremental specific gravity ranging from 1.080 to 1.100. Next, egg was broken and egg contents were poured onto a horizontal glass. Albumen height was determined using tripod micrometer, which then used to calculate the Haugh unit using formula = 100 x log (albumen height - 1.7 x egg weight^{0.37} + 7.57). Yolk color score was determined using DSM yolk color fan (color score ranging from 1 to 15). After that, albumen and yolk were separated and yolk was weighed using electrical balance. Albumen weight was calculated by formula = egg weight sample – (yolk weight + shell weight). Shell thickness (mm) was determined using micrometer and calculated by average value of 3 different measurement (upper end, middle and lower end). Shell weight (g) was determined by weighing the shell after air-dried overnight. The percentage of yolk, albumen and shell weight was calculated relative to the egg weight sample.

Data analysis

Data of laying performance and hatching egg quality were analyzed using Analysis of Variance. Data with significant effect was further tested using LSD Duncan Test. Data was considered significant at *p*<0.05.

Results and discussions

Effects of dietary sardine oil and tomato powder supplementation on laying performance of Mojosari duck showed in Table 2. Results showed that there was no effect (*p*<0.05) of dietary treatment on feed intake, egg production, egg weight, egg mass, feed conversion ratio, and income over feed cost. Previously, it was reported that dietary fish oil treatments at the level of 1.25% had no negative effect on egg weight, but at the level of 2.5, 3.5 and 5% could decrease egg weight in laying hens (Saleh, 2013). In another study, supplementation of fish oil at the level of 1.5% had no effect on egg weight, egg mass and feed conversion ratio of broiler breeder, while supplementation at the level of 3% could decrease those parameters (Delezie et al 2016). Moreover, the reduction of egg weight was also reported by the inclusion of fish oil at the level of 5.5% in broiler breeder diet (Pappas et al 2006). In this study, inclusion of sardine oil at 1 and 2%, either without or with tomato powder, had no negative effect on laying performance of Mojosari ducks. According to above-mentioned study, it seems that inclusion of fish oil more than 2% may had negative effect on laying performance.

Table 2. Effects of dietary sardine oil and tomato powder supplementation on laying performance of Mojo to 45 weeks of age

Variables	Control	0% TP	1% TP

		1% SO	2% SO	1% SO
Feed intake (g/bird/day, as fed)	143	141	145	142
Egg production (%)	61.9	62.7	65.4	66
Egg weight (g)	64.1	64.2	63.6	65.1
Egg mass (g/bird/day)	39.7	40.2	41.6	42.9
Feed conversion ratio	3.61	3.53	3.49	3.31
Income over feed cost (IDR/bird/day)	466	508	554	555

SO: Sardine Oil, TP: Tomato Powder, 1 US\$ = 13500 IDR

Effects of dietary sardine oil and tomato powder supplementation on hatching egg quality of Mojosari duck showed in Table 3. Dietary treatments did not affect ($p>0.05$) egg shape index, egg weight sample, yolk weight, yolk percentage, albumen weight, albumen percentage, shell weight, shell percentage, specific gravity, shell thickness and Haugh unit, but significantly affect ($p<0.05$) yolk color score. Supplementation of sardine oil in combination with tomato powder had higher ($p<0.05$) yolk color score compared to control and sardine oil without tomato powder. This result is in agreement with Andri et al (2016) who also reported that diet supplemented with fish oil and tomato powder did not affect egg shape index, yolk weight, albumen weight, shell weight, shell thickness and Haugh unit in laying hens. The increase of yolk color score as affected by supplementation of sardine oil in combination with tomato powder may be due to the lycopene content, which was responsible for the red color in tomato (Mostapha et al 2014). It could be explained that lycopene content in the diet was absorbed to the body and then deposited to the yolk, consequently it could improve yolk color score. In the previous study, it was noted that addition of lycopene in quails diet could increase yolk lycopene content and yolk color score (Sahin et al 2008).

Table 3. Effects of dietary sardine oil and tomato powder supplementation on hatching egg quality of Mojosari duck from 40 to 45 weeks of age

Variables	Control	0% TP		1% TP		
		1% SO	2% SO	1% SO	2% SO	
Egg shape index	82.4	80.7	80.2	80.6	81.6	0.0001
Egg weight sample (g)	65.2	65.1	64.9	67.9	67.5	0.0001
Yolk weight (g)	21.8	21.4	21.3	23.3	23.2	0.0001
Yolk percentage (%)	33.8	33.1	33	34.4	34.5	0.0001
Albumen weight (g)	37.3	37.4	37.1	38.2	37.4	0.0001
Albumen percentage (%)	56.7	57.3	57	56.1	55.1	0.0001
Shell weight (g)	6.08	6.25	6.5	6.42	6.92	0.0001
Shell percentage (%)	9.51	9.64	10.1	9.47	10.3	0.0001
Specific gravity (g/cm ³)	1.092	1.089	1.092	1.091	1.089	0.0001
Shell thickness (?m)	256	264	276	266	267	0.0001
Haugh unit	87.4	85.3	89.5	89.6	87.1	0.0001
Yolk color score	7.92 ^a	8.00 ^a	8.09 ^a	9.17 ^b	9.25 ^b	0.0001

^{ab}Treatment means followed by different superscript are significantly different at p <0.05
SO: Sardine Oil, TP: Tomato Powder

Conclusion

- It is concluded that dietary sardine oil supplementation until 2%, either without or with tomato powder, had no detrimental effects on laying performance and egg quality of Mojosari ducks.
- It is evident that supplementing Mojosari ducks diet with sardine oil in combination with tomato powder could improve yolk color score.

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