Edamame isoflavones and omega-3 source supplementation to quail (Coturnix coturnix japonica): Effect on egg production and physical quality

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Edamame isoflavones and omega-3 source supplementation to quail (*Coturnix coturnix japonica*): Effect on egg production and physical quality

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ABSTRACT: In the present study, we investigated the effects of dietary edamame isoflavones (eISF) and fish oil lemuru (*Sardinella lemuru*) (MIL) supplementation on Japanese quail (*Coturnix coturnix japonica*) egg production and physical egg quality. Birds (n = 140; 14 wk old) were randomly assigned to 1 of 5 groups consisting of 28 birds (4 replicates of 7) and were fed a basal diet or the basal diet supplemented with either 0.5% or 1% of eISF and 2% or 4% of MIL. The experimental period lasted 16 wk old with a 16L:8D lighting schedule. Dietary eISF supplementation and fish oil lemuru did not affect feed intake, egg production, egg weight, and shell thickness on the other hand they improved feed efficiency to a greater extent than the other levels (1% eISF and 4 % MIL). However, egg yolk color was increased ($P < 0.0001$) at the highest level eISF 1% and 4% supplementation. It can be concluded that the present study indicated that supplementing with dietary eISF and fish oil lemuru improved egg yolk color but did not affect egg production.

Keywords: edamame, egg, is flavones, omega-3, quail

1 INTRODUCTION

The incidence of stunting in Indonesia is higher than in other countries in Southeast Asia (Sutarto *et al.* 2018) thus demanding special attention. One of the food ingredients in an effort to prevent stunting cases by fulfilling the nutrition of pregnant women and toddlers with nutritious food is quail eggs. Despite quail eggs being a nutrient-rich food (Shibi *et al.* 2016), consumption of quail eggs is still limited due to public stigma about the high cholesterol levels in quail eggs (Hertamawati *et al.* 2021). High cholesterol is suspected to be the cause of cardiovascular disease, high blood pressure, and obesity; therefore, there is a need for a solution to overcome these obstacles, namely by feeding manipulation.

Feeding manipulation can produce eggs that are low in cholesterol, rich in good fatty acids such as Omega-3, and rich in antioxidants and other nutrients. Isoflavone compounds contained in edamame soybeans have functions such as antioxidants, and they can be accumulated in animal products (Jiang *et al.* 2007) for the production of functional foods for humans. Another significant aspect of feeding manipulation is the enrichment of eggs with omega-3 from lemuru fish, which has been proven by Febrianto and Puspitasari (2015) and Arini *et al.* (2017). The content of omega-3 fish oil is 58,418 mg/g (Rusmana & Natawiharja 2008). Lemuru fish oil has the advantage of being a source of healthy fatty acids (omega-3) in the form of a fairly high content of EPA and DHA (Iriyanti *et al.* 2012).

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Research on feed enrichment with a combination of isoflavones and lemuru fish oil is still limited so the objectives of this study were to evaluate the effectiveness of dietary edamame isoflavones (eISF) and fish oil lemuru (*Sardinella lemuru*) (MIL) supplementation on Japanese quail (*Coturnix coturnix japonica*) egg production and physical egg quality.

2 MATERIAL AND METHOD

2.1 *Experimental diets*

Two hundred Japanese quail (8 wk old; *Coturnix coturnix japonica*), provided by a commercial company Peksi Yoyakarta, Central Java, were used in accordance with animal welfare regulations at the State Polytechnic of Jember, East Java, Indonesia. After a 7-d adaptation period, the birds were randomly assigned to 5 groups, 40 birds each as 4 replicates.

The treatment feed was P0: control feed (without eISF and MIL); R1: feed containing 2% MIL and 0.5% eISF addition; R2: the feed contains 2% MIL and the addition of eISF 1%; R3: the feed contains 4% MIL and the addition of eISF 0.5%; and R4: feed contains 4% MIL and 1% eISF addition. The diets were prepared by self-mixing. Quails in the laying phase, 85 days old, were fed dietary 20% crude protein and 2800–3000 kcal/kg.

Table 1. Feed formulation and nutrient contents of diet treatments.

Ingredient	Treatments				
	R0	R1	R2	R3	R4
	..... (%)				
Corn	43	45	45	45	45
Rice brand	8	6.5	6.5	6	6
Soybean meal	30	27.9	27.9	28	28
Fish meal	4	5	5	4.9	4.9
Meat bone meal	5	6	6	6	6
Oil	3.9	1.5	1.5	0	0
Lemuru fish oil	0	2	2	4	4
CaCO3	6	6	6	6	6
Premix	0.1	0.1	0.1	0.1	0.1
Additive edamame	0	0.5	1	0.5	1
Total	100	100	100	100	100
Nutrients content[1]					
Energy metabolism (kcal/kg)	2813.4	2823.96	2823.96	2861.24	2861.24
Crude protein (%)	20.72	20.76	20.76	20.70	20.70
Crude fiber (%)	3.02	2.8	2.8	2.78	2.78
Crude fat (%)	6.44	6.16	6.16	6.67	6.67
Ca (%)	3.11	3.3	3.3	2.67	2.67
P available (%)	0.57	0.6	0.6	0.39	0.39

Note: [1]Count from feed formulation.

2.2 *Edamame concentrate isoflavones preparation*

The edamame concentrate isoflavone (eISF) was prepared using the following (Utami & Hertamawati 2020) procedures. The material used is low-grade edamame from PT Mitra Tani 27 Jember. Edamame were sun-dried until the water content was 10% and the

procedure of making eISF was used to begin the extracting procedure, which involves macerating it with hexane and then macerating it with methanol.

2.3 *Procedure, performance, and egg quality variables*

Laying quails were divided into 5 groups, each treatment was subjected to four replications. The quail hens were given 25 g of feed per bird each day, and they were fed in the morning and afternoon. Drinking water was given ad-libitum. Edamame isoflavone concentrate (eISF) and lemuru fish oil (MIL) in the ration activity test were carried out in feed supplementary for 14 days. Each group was observed for laying performance (feed intake, egg weight and average hen day production, and feed egg ratio) and physical egg quality (yolk and albumen index, yolk color, and thickness eggshell).

2.4 *Data analysis*

The data obtained were tabulated using excel and analyzed using SPSS ver. 26 Completely Random Design (CRD). Any significant or very significant effect of treatments was followed by Duncan's multiple range test.

3 RESULT AND DISCUSSION

3.1 *Egg production*

Data on production performance are shown in Table 2. The feed intake during the study ranged from 20.11 grams/day to 23.73 grams/day. The results of the analysis of variance showed that the administration of edamame concentrate isoflavones (eISF) and fish oil (MIL) to the level of 1% and 4% reduced feed consumption ($p<0.05$). The decrease in feed intake is thought to be due to a decrease in feed palatability with increasing fish oil administration. A decrease in feed consumption due to the addition of fish oil by up to 4% was also reported by Istiqomah *et al.* (2017).

The average egg production ranged from 78.30% to 85.019%. The results of the analysis of variance showed that the administration of eISF and fish oil had no significant effect on quail egg production ($p>0.05$), as well as on egg weight and feed efficiency. The addition of eISF and fish oil proved not to affect the egg formation process so that it did not affect egg production (Sestilawarti & Mirzah 2013).

Table 2. The average egg quail production performance.

Parameter	Dietary Treatment				
	R0	R1	R2	R3	R4
Feed intake (g/bird)	23.73 ± 0.96^{b}	23.06 ± 1.04^{b}	23.23 ± 1.24^{b}	22.66 ± 0.56^{b}	20.11 ± 2.45^{a}
Egg weight (g)	10.69 ± 0.23^{ns}	10.82 ± 0.14^{ns}	10.79 ± 0.24^{ns}	10.66 ± 0.15^{ns}	10.51 ± 0.44^{ns}
Hen day production (%)	79.79 ± 6.61^{ns}	85.01 ± 4.11^{ns}	78.79 ± 6.61^{ns}	80.59 ± 7.41^{ns}	78.30 ± 8.83^{ns}
Feed egg ratio	2.22 ± 0.12^{ns}	2.13 ± 0.11^{ns}	2.15 ± 0.16^{ns}	2.13 ± 0.05^{ns}	1.92 ± 0.29^{ns}

[a,b]Different superscripts on the same row show a significant difference ($P<0.05$).
[ns]Non-significant difference ($P>0.05$)

3.2 *Physicalegg production*

The data on physical egg production are shown in Table 3. The results of the analysis of variance showed that the administration of edamame concentrate isoflavones (eISF) and fish oil (MIL) to the level of 1% and 4% increased yolk color ($p<0.05$). The increase in egg yolk color was due to the presence of lemuru fish oil in the feed, as reported by Darmawan *et al.* (2017), giving lemuru fish oil up to 2% can increase the yolk color in ducks. The intensity of yolk color is influenced by the presence and role of xanthophyll, a pigment that could be transferred from the feed. Egg yolk color is a quality indicator that can be altered by manipulating a hen's diet.

Table 3. The average physical egg quail production.

Parameter	Dietary Treatment				
	R0	R1	R2	R3	R4
Yolk index	1.15 ± 0.18	1.02 ± 0.25	1.14 ± 0.19	1.11 ± 0.08	1.09 ± 0.02
Albumen index	0.29 ± 0.04	0.36 ± 0.05	0.28 ± 0.04	0.33 ± 0.08	0.27 ± 0.02
Shell thickness	0.16 ± 0.03	0.19 ± 0.05	0.10 ± 0.07	0.16 ± 0.01	0.16 ± 0.06
Yolk color	5.75 ± 0.96^{a}	7.00 ± 0.82^{b}	7.50 ± 1.00^{b}	6.75 ± 0.50^{ab}	7.25 ± 0.50^{b}

^{a,b}Different superscript on the same row shows a significant difference ($P<0.05$).
^{ns}Non-significant difference ($P>0.05$).

The results of the analysis of variance showed that the administration of eISF and fish oil had no significant effect on the yolk and albumen index ($p>0.05$), as well as the eggshell thickness. The results of the present study were different from those reported by Sahin *et al.* (2007) who found that providing isoflavones in quails' diet will increase the eggshell thickness.

4 CONCLUSION

The present study indicates that supplementing with dietary eISF and fish oil lemuru decreased feed intake and improved egg yolk color but did not affect egg production.

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