EFFECT OF FISH OIL ALONE OR IN COMBINATION WITH TOMATO POWDER SUPPLEMENTATION IN FEED ON EGG QUALITY OF LOCAL DUCKS

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ABSTRACT

The purpose of this research was to investigate the effect of fish oil alone or in combination with tomato powder supplementation in feed on egg quality of local ducks. Fivety 28-weeks old female local ducks with initial egg production of 4 days before research was 55.00 ± 4.08% (coefficient of variation 7.42%) were randomly distributed to five treatments with 2 repetition and 5 birds of each. The treatmens were T0: basal feed (control); T1: basal feed + 1500 ppm fish oil ; T2: basal feed + 3000 ppm fish oil; T3: basal feed + 1500 ppm fish oil + 150 ppm tomato powder; T4: basal feed + 3000 ppm fish oil + 150 ppm tomato powder. Variable observed in this research were egg shape index, egg shell weight, yolk weight, and albumen weight. Data were analyzed using one-way Anova based on Completely Randomized Design, if significant effect appear was then continued with Duncan Multiple Range Test. The result showed that there were no significant effect (P>0.05) of fish oil alone or in combination with tomato powder supplementation in feed on egg shape index, egg shell weight, yolk weight, and albumen weight of local ducks. The conclusion of this research is that there was no effect of fish oil alone or in combination with tomato powder supplementation in feed on egg quality of local ducks.

Keywords*: fish oil, tomato powder, local duck, egg quality, yolk weight*

INTRODUCTION

Fish oil supplementation in feed is the most common method to produce omega-3 egg. Supplementation of fish oil not only can change fatty acid composition on egg yolk, but also possibly give effect on egg quality (Ahmad, 2010). Fish oil contain 9000 kcal/kg metabolizable energy which provides a concentrated source of energy for poultry. Relative small supplementation of fish oil will give significant increase on metabolizable energy of the feed (Leeson and Summer, 2005). Amount of metabolizable energy in feed will possibly influence egg shape index. Rashid *et al*. (2004) reported that high energy level in feed significantly increase egg shape index of laying hen as compared to low energy level in feed. This indicate that fish oil supplementation in feed possibly increase egg shape index. Fish oil can increased fat-soluble vitamin absorption included vitamin A, D, E, and K (Leeson and Summer, 2005). Bölükbasi *et al*., (2005) reported that Vitamin D_3 supplementation significantly increased Ca concentration in plasma. Wistedt (2013) reported that egg shell mainly composed by calcium that indicate calcium will play important role affecting egg shell weight. Fish oil contain 99% of fat (Leeson and Summer, 2005).

Anton (2007) found that fat contribute to about 65% of dry matter content of egg yolk, which indicated fat consumption was the most important thing affected yolk weight.

One of the most important consideration of fish oil usage is high content of PUFA (including EPA and DHA) which are highly susceptible to oxidation (Boran *et al*., 2006). High content of PUFA in feed increases susceptibility of cellular membranes to the induction of oxidative stress (Miret *et al*., 2003), which associated with the deterioration of many physiological functions including health, growth, reproduction and immunity (Surai, 2002). These mechanism then will be responsible to some negative effect on egg quality of poultry. Previous research noted that feed containing fish oil reduced yolk and egg weights in laying hens (Cherian, 2008; An *et al*., 2010; Dunn-Horrocks *et al*., 2011).

Possible effort to minimize negative effect of fish oil supplementation is by adding antioxidant. Tomato is one the potential natural antioxidant sources. Tomato contains some phytochemicals including lycopene, folic acid, vitamin C, vitamin A, vitamin E, and phenolics which possess antioxidant activity (Agarwal and Rao, 2000; Borguini and Torres, 2009; Kotkov *et al*., 2011). These compounds may play an important role to inhibit activity of reactive oxygen species (Crozier *et al*., 2009). Previously, Sahin *et al*. (2008) found that tomato powder supplementation reduce negative effect on performance of quails affected by heat stress. Brenes *et al*. (2008) reported that enrichment of vitamin E in feed increased fat digestibility of broiler chicken. Lin *et al*. (2002) found that vitamin A have an important role maintain integrity of magnum and ovaries. These finding indicated that tomato powder could be potential as antioxidant to reduce negative effect of fish oil supplementation and also possibly support fish oil to increase egg quality.

Development of omega-3 egg nowadays still limited on laying hens and quails as animal model. Research on local poultry animals including local ducks are still very rare. However, their potency as egg producer for Indonesian society was very good. The purpose of this research was to investigate the effect of either fish oil alone or in combination with tomato powder supplementation in feed on egg quality of local ducks.

MATERIALS AND METHODS

Materials used in this research was fivety 28-weeks old female Local Ducks. Initial duck day production of local ducks 4 days before research was 55.00 $\pm$ 4.08% (coefficient of variation 7.42%). Local duck was obtained from Blitar Regency, with the price IDR 90,000,-/bird.

Basal feed used in this research consisted of corn, rice bran, soybean meal, meat bone meal, corn gluten meal, oyster shell, limestone, salt, and premix. Composition and calculated nutrient content of basal feed was showed in Table 1. Fish oil used in this research was extracted from sardine fish (*Sardinella longiceps*), which was obtained from Muncar, Banyuwangi Regency. The price of fish oil was IDR 25,000,-/liter. Fish oil was stored in referigerator (-4^{0}C) until used. Tomato powder which was used in this research obtained from Materia Medica Institute, Batu City. The price of tomato powder was IDR 200,000,-/kg. Tomato powder was stored in plastic bags at room temperature. Feed mixing was done once a week. Basal feed for each group calculated by 5 birds multiplied by 150 g/bird/day multiplied by 7 days required 5250 g. Basal feed for each group were prepared in a

bucket, then mixed with fish oil and tomato powder according to the treatments. Feeding of local ducks were done twice daily at 08.00 and 14.00 with ratio 40:60.

Housing used in this research was ten colony housing which contain 5 birds of each. The size of housing was 2 x 1 x 0.5 m (length x width x height) with rice husk floor and equipped with feeder and drinker.

Methods used in this research was experiment arranged in a Completely Randomized Design with 5 treatments and 2 repetitions. Each repetition used 5 birds.

Treatments used in this research were:
T0: basal feed (control)
T1: basal feed + 1500 ppm fish oil
T2: basal feed + 3000 ppm fish oil
T3: basal feed + 1500 ppm fish oil + 150 ppm tomato powder
T4: basal feed + 3000 ppm fish oil + 150 ppm tomato powder

Treatments were given during 4 weeks (28-31 weeks old). In the end of experiment, five eggs from each repetition were randomly collected and analyzed for egg qualities.

Tabel 1. Composition and Calculated Nutrient Content of Basal Feed

Feedstuff	Composition (%)
Corn	40.00
Rice Bran	30.00
Soybean Meal	16.90
Meat Bone Meal	4.20
Corn Gluten Meal	2.00
Oyster Shell	1.90
Limestone	4,30
Salt	0.10
Premix	0.60
Total	100.00
Nutrient Content*	
Metabolizable Energy (Kcal/kg)	2,751.54
Crude Protein (%)	17.27
Ether Extract (%)	2.32
Crude Fiber	4.84
Calcium (%)	3.01
Phosphorus (%)	0.68
Lysine	0.81
Methionine	0.45
Methionine + Cysteine	0.64
Price/kg (IDR)**	4,584.70

Notes: * Calculation According to Feednet
** Calculation According to Feed Price in May 2014

Variables observed in this research were egg quality of local ducks included:

a. Egg shape index is calculated by length of egg divided by width of egg, then multiplied by 100 (Sandi et al. 2013)
b. Egg shell weight (g/egg) is measured by broken down the eggs, then egg shell separated from albumen and yolk. Egg shell is cleaned from the rest of albumen and then weighed (An *et al*. 2010)
c. Yolk weight (g/egg) is measured by separate yolk from albumen then weighed (An *et al*. 2010)
d. Albumen weight (g/egg) is calculated by egg weight minus by egg shell weight and yolk weight (An *et al*. 2010)

Data were analyzed by using one-way Anova based on Completely Randomized Design, if significant effect appear was then continued with Duncan Multiple Range Test.

RESULTS AND DISCUSSIONS

Effect of fish oil alone or in combination with tomato powder supplementation in feed on egg shape index, egg shell weight, yolk weight, and albumen weight of local ducks were showed in Table 2.

Table 2. Effect of Fish Oil Alone or in Combination with Tomato Powder Supplementation in Feed on Egg Shape Index, Egg Shell Weight, Yolk Weight, and Albumen Weight of Local Ducks

Treatment	Egg Shape Index	Egg Shell Weight (g/egg)	Yolk Weight (g/egg)	Albumen Weight (g/egg)
T0	81.35 ± 5.04	7.70 ± 0.14	20.20 ± 0.14	31.75 ± 0.21
T1	80.28 ± 1.32	8.20 ± 0.85	19.70 ± 1.56	30.40 ± 0.85
T2	78.62 ± 1.19	7.80 ± 0.57	20.70 ± 2.69	31.60 ± 1.98
T3	80.34 ± 6.00	8.30 ± 0.28	20.90 ± 2.40	30.90 ± 2.26
T4	80.53 ± 0.15	7.80 ± 0.14	21.80 ± 0.28	32.10 ± 1.41
p-value	ns	Ns	ns	ns

Notes: ns: No Significant Effect (P>0.05)

Egg Shape Index

Table 2 showed the effect of fish oil alone or in combination with tomato powder supplementation in feed on egg shape index of local ducks. The result showed that egg shape index of local ducks from higher to lower was T0 (81.35), T4 (80.53), T3 (80.34), T1 (80.28), and T2 (78.62). Egg shape index obtained in this current research still in the normal range. Srigandono (1991) states that the normal index of duck eggs ranged from 61.30 to 81.70.

Statistical analysis showed that there was no significant effect (P>0.05) of fish oil alone or in combination with tomato powder supplementation in feed on egg shape index of local duck. This current research also in agreement with An *et al*. (2010) that reported there was no significant effect of different oil sources (corn oil vs fish oil) and vitamin E supplementation on egg shape index of breeder hens.

This result can be explained that feeding treatment may did not cause any significant effect on egg shape index. Previous research noted that there was no significant effect of methionine and

Lancang (*Atlanta sp.*) supplementation on egg shape index of Tegal Ducks (Roesdiyanto, 2002). Alfian (2014) also reported that there were no significant effect of *Ipomoea aquatic* waste supplementation on egg shape index. These result may also possibly in fish oil and tomato powder supplementation in feed which also give no significant effect on egg shape index. This result may due to egg shape index is more influenced by the breed of the birds. Sopiyana and Prasetyo (2007) reported that egg shape index was significantly different in two breed of local duck. Pekin x Mojosari female ducks have higher egg shape index (77.28) compare than Pekin x Alabio female ducks (76.43).

Egg Shell Weight

Table 2 showed the effect of fish oil alone or in combination with tomato powder supplementation in feed on egg shell weight of local ducks. The result showed that egg shell weight from higher to lower was T3 (8.30 g), T1 (8.20 g), T4 (7.80 g), T2 (7.80 g), and T0 (7.70 g). Statistical analysis showed that there was no significant effect ($P>0.05$) of fish oil alone or in combination with tomato powder supplementation in feed on egg shell weight. This result in agreement with Gul *et al*. (2012) who reported supplementation of canola oil as omega-3 PUFA sources in feed did not give significant effect on shell weight of laying hens, although supplementation at the level of 4% and 6% tended to decrease shell weight numerically as compared to the control. Al-Daraji *et al*. (2011) reported that there was no significant effect of different oil sources supplementation (sunflower oil, linseed oil, maize oil, and fish oil) on egg shell weight of laying quail. Therefore Cherian (2008) reported that a significant decreased in egg shell weight observed in low omega-3 PUFA supplementation when compared with high omega-3 PUFA. Ahmad (2013) reported that supplementation of canola oil (omega-3 PUFA sources) and vitamin A (antioxidant sources) to laying hen feed did not give significant effect on egg shell weight and egg shell thickness.

Egg shell mainly composed of calcium carbonate, and some of trace minerals such as magnesium (Leeson and Summer, 2005). Calcium plays important role in affecting egg shell weight. Table 2 showed that T3 tended to improve egg shell weight compared with other treatments, this may due to calcium consumption which also higher in T3 treatment as showed in Table 3. Bölükbasi *et al*., (2005) reported that increase Ca level in feed linearly increased ($P<0.01$) plasma Ca in laying hen.

Yolk Weight

Table 2 showed the effect of fish oil alone or in combination with tomato powder supplementation in feed on yolk weight of local ducks. The result showed that yolk weight from higher to lower was T4 (21.80 g), T3 (20.90 g), T2 (20.70 g), T0 (20.20 g), and T1 (19.70 g). Statistical analysis showed that there was no significant effect ($P>0.05$) of fish oil alone or in combination with tomato powder supplementation in feed on yolk weight of local ducks. This result is in agreement with previous research, omega-3 PUFA supplementation in feed can alter fatty acid composition in yolk but no effect in egg weight or yolk weight (Pekel *et al*., 2009). Supplementation of vitamin A in Canola oil containing-feed also didn't give effect on yolk weight (Ahmad, 2013). In contrast, Cherian (2008) reported that a significant decrease in yolk weight observed in low omega-3 PUFA when compared with high

omega-3 PUFA supplementation in feed. An *et al*., (2010) also reported that there was a decreasing effect of fish oil supplementation on yolk weight.

Yolk synthesis was complex mechanisms that involve nutrient metabolism and physiological function. Anton (2007) found that lipids contribute to about 65% of dry matter content of egg yolk, which indicated lipid/fat consumption was the most important thing affected yolk weight. Table 2 showed that supplementation of fish oil in the amount of 1500 ppm tended to decrease yolk weight compare to the control. This may be due to the crude fat consumption which lower in fish oil treatments as showed in Table 3.

Table 3. Calculated Nutrient Consumption

Treatments	Nutrient Consumption (g/bird/day)		
	Crude Protein	Crude Fat	Calcium
T0	25.13 ± 0.31	3.38 ± 0.04	4.40 ± 0.05
T1	25.08 ± 0.03	3.37 ± 0.00	4.39 ± 0.01
T2	25.08 ± 0.01	3.37 ± 0.00	4.39 ± 0.00
T3	25.34 ± 0.38	3.41 ± 0.00	4.43 ± 0.01
T4	25.21 ± 0.12	3.39 ± 0.02	4.41 ± 0.02
p-value	ns	ns	ns

Notes: ns: No Significant Effect (P>0.05)

Table 2 showed that supplementation of fish oil in combination with tomato powder (T3 and T4) tended to improve yolk weight compared to control treatment and fish oil alone. This result might due related with crude fat consumption which higher in these treatments as showed in Table 3. Supplementation of tomato powder in fish oil contribute to the antioxidant component included lycopene, folate, vitamin C, vitamin A, vitamin E, and phenolics (Agarwal and Rao, 2000; Borguini and Torres, 2009; Kotkov *et al*., 2011). Sahin *et al* (2006) reported that lycopene (one of major phytochemical found in tomatoes) supplementation increased feed consumption in Japanese quails rear under stress caused by high ambient temperature. Brenes *et al*. (2008) reported that enrichment of vitamin E in feed increased fat digestibility of broiler chicken. These mechanism indicated that tomato powder can improved fish oil utilization, then will contribute in an improvement of yolk precursor and then will increase yolk weight.

Albumen Weight

Table 2 showed the effect of fish oil and tomato powder supplementation in feed on albumen weight of local ducks. Albumen weight ranged between 30.40 ± 0.85 until 32.10 ± 1.41 g. The result showed that albumen weight from higher to lower was T4 (32.10 g), T0 (31.75 g), T2 (31.60 g), T3 (30.90 g), and T1 (30.40 g). Statistical analysis showed that there was no significant effect (P>0.05) of fish oil and tomato powder supplementation on albumen weight. In contrast An *et al*. (2010) reported that supplementation of fish oil in feed decreased albumen weight of breeder hens when compare to maize oil supplementation. Therefore, Al-Daraji *et al*. (2011) reported that supplementation of fish oil or maize oil resulted in significant increase of albumen weight of laying quail,

compare to sunflower oil or linseed oil supplementation.

Supplementation of 3000 ppm fish oil + 150 ppm tomato powder tend to give higher albumen weight. This result may be due to the presence of tomato powder that provide vitamin C and E which can act as antioxidant to prevent oxidative stress caused by fish oil. Ajakaiye *et al*. (2010) reported that vitamin C and E supplementation significantly increase egg weight, egg yolk weight, albumen weight, and egg shell weight in heat stress laying hen. Ciftci *et al*. (2005) reported that both of these vitamin can synergistically quenching free radical caused by stress. Ševčíková *et al*., (2008) reported that lycopene have ability provide protection from harmful free radicals which can decrease oxidative stress in poultry. Lin *et al*. (2002) found that vitamin A have an important role maintain integrity of magnum and ovaries. These finding indicated that tomato powder could be potential as antioxidant to reduce negative effect of fish oil supplementation and also possibly support fish oil to increase egg quality.

CONCLUSION AND SUGGESTION

There was no effect of fish oil alone or in combination with tomato powder supplementation in feed on egg quality of local ducks. Supplementation of 3000 ppm fish oil + 150 ppm tomato powder in feed give best result on yolk weight and albumen weight of local duck. Further research needed with higher level of fish oil and tomato powder supplementation to know optimum level for production of omega-3 egg, without any negative effect on egg quality.

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