THE EFFECT OF SARDINES FISH OIL WASTE INTO THE DIETS ON THE CHEMICAL QUALITY OF LAYING HEN EGG

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ABSTRACT

The Functional eggs could be used as food for stunting sufferers. Functional eggs could be produced by feed modification using sardines fish oil waste (SFOW) into diets. This research determined the effect of sardines fish oil waste on the diets of UD Sumber Rejeki. The material used chicken eggs produced by 60 laying hens aged 12 months. The method used in this study was laboratory analysis with a completely randomized design consisting of 4 treatments and 3 replications. The treatments were mainly fed by adding 0%, 5%, 10%, and 15% SFOW. Laying hens were given treatment for 1 month and then the eggs produced were tested for chemical quality which included levels of protein, fat, water, carbohydrates, total energy, and cholesterol. The research data were analyzed using analysis of variance and continued by testing the average smallest significant difference (BNT). The sardines fish oil waste into the diets did not affect the protein, fat, moisture, and carbohydrate content of laying hen eggs, and significant effect on energy total and cholesterol content of laying hen egg. The chemical quality of laying hen egg consist of a protein content was 12.18–12.47%, fat content was 7.79–8.89%, moisture content was 76.45–77.58%, carbohydrate content was 0.93–1.44%, ash content eggs was 0.88–0.94%, the energy total was 125.75–134.54 Kcal/100 gram, and egg cholesterol content was 267.04–365.68 mg/100g egg. Based on the results of this research, the best addition of waste sardine fish oil was 5% to production costs efficient to produce functional eggs in UD Sumber Rejeki for stunting sufferers, especially in the Lamongan Regency.

Keywords: Sardines; Fish; Oil; Chemical; Egg.
INTRODUCTION

The incidence of short toddlers commonly known as stunting is one of the nutritional problems experienced by toddlers in the world. Based on August 2020 Weighing Month data, the percentage of underweight toddlers (BB/U) was 9.8%, the percentage of stunted toddlers (TB/U) was 12.4% and the percentage of toddlers wasting was 8.0% (East Java Health Office, 2021). In 2021, the Lamongan Regency reached 20.5% of toddlers experiencing stunting (Lamongan Regency Government, 2022).

Stunting is a growth and development disorder in children due to chronic malnutrition and recurrent infections. Stunting is characterized by a height that is below standard child growth in general (Setiawan et al., 2018). Stunting is directly caused by a lack of nutritional intake, especially carbohydrates and protein from food, in addition to the presence of infectious diseases. Dietary protein plays an important role in the child’s body, especially in the growth and development of the brain.

Eggs are a source of protein that is easily digested and inexpensive. Eggs are widely consumed as side dishes, ingredients for cooking mixes, mixed ingredients for appearance, or boiled eggs. Production of chicken eggs has been a lot to produce eggs with good quality in terms of nutritional content, especially in terms of protein and fat content. Feed is the main factor that greatly influences the nutritional quality of the eggs produced so that the egg content can be modified to meet the nutritional needs of stunting. Feed modification can be done by using ingredients that contain high protein and fat, and have affordable feed prices. Utilization of sardine fish oil waste could be done to produce eggs with high protein and fat. Sardine fish oil was an alternative ration ingredient as a ration ingredient because it contains omega-3. The fat content in fish was unsaturated fatty acids that were beneficial to the body. The composition of unsaturated fatty acids was 75% while saturated fatty acid content was 25%. One of the unsaturated fatty acids in fish was omega-3. Omega-3 content could be found in mackerel, milkfish, lemuru, kites, and tuna (Gunawan et al. 2014). The fatty acid groups found in lemuru fish oil were Saturated Fatty Acid (SFA), Monounsaturated Fatty Acid (MUFA) and Polyunsaturated Fatty Acid (PUFA). Sequentially, the fatty acid content of the SAFA group (46.946%) was higher than that of MUFA (37.660%) and PUFA during low temperature storage (5°C).

There were 3 types of omega-3 fatty acids contained in lemuru fish oil, namely linoleic acid, EPA and DHA with a total of 18.882%. (Andikawati et al. 2020). Lemuru fish (Sardinella longiceps) was a type of marine fish that was commonly found in Indonesian waters, so it was very possible as an additional ration in laying hen rations. Lemuru fish waste was obtained from the rest of the canning process for sardines which had no economic value.

Fish oil sources were divided into two groups, namely fish liver oil and fish body oil. In addition to omega-3, fish oil also contains vitamins A and D. Utilization of fish oil could be processed into body supplements, food and feed mixtures as well as raw materials for non-food industries. Fish oil, especially the content of omega-3 fatty acids, had an important role in health and intelligence because omega-3 contains EPA (Eicosa Pentaenoic Acid), DHA (Docosahexaenoic Acid) and Linoleic acid.
which were useful for increasing brain intelligence (Sarker, 2020). The waste lemuru fish oil in the ration of laying hens produced good egg production performance, especially the level of egg production, egg weight, and Haugh Unit (HU) value.

Laying hens fed omega-3 source rations from lemuru fish oil waste produced consumption chicken eggs with high omega-3 fatty acid content and low cholesterol levels. The use of various fish oils in several laying hen rations had been carried out and affected on the resulting nutritional content such as the content of protein, fat, carbohydrates, cholesterol, and others.

Therefore UD Sumber Rejeki and the UNISLA matching fund team are working together to produce the best quality eggs to fulfill the needs of stunting in the Lamongan district so before mass production, this research on the chemical quality of eggs is needed on adding sardine fish oil waste to the feed used by UD Sumber Rejeki, to production costs efficient to produce functional egg in UD Sumber Rejeki for stunting sufferers especially in the Lamongan District.

P1: Main Feed + 0% Sardines Fish Oil Waste
P2: Main Feed + 5% Sardines Fish Oil Waste
P3: Main Feed + 10% Sardines Fish Oil Waste
P4: Main Feed + 15% Sardines Fish Oil Waste

The following was the proximate content of the feed used in this research:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>P0</th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ash content</td>
<td>%</td>
<td>10.63</td>
<td>10.26</td>
<td>12.05</td>
<td>10.80</td>
</tr>
<tr>
<td>Total fat</td>
<td>%</td>
<td>5.91</td>
<td>8.57</td>
<td>14.42</td>
<td>17.55</td>
</tr>
<tr>
<td>Moisture content</td>
<td>%</td>
<td>9.96</td>
<td>9.81</td>
<td>8.96</td>
<td>8.73</td>
</tr>
<tr>
<td>Total Calories</td>
<td>Kcal/100 g</td>
<td>347.19</td>
<td>362.57</td>
<td>188.06</td>
<td>409.63</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>%</td>
<td>58.61</td>
<td>56.10</td>
<td>50.44</td>
<td>49.92</td>
</tr>
<tr>
<td>Protein content</td>
<td>%</td>
<td>14.89</td>
<td>15.26</td>
<td>14.13</td>
<td>13.00</td>
</tr>
</tbody>
</table>

(Data Source: (Fadlilah et al, 2023).

Laying hens were given treatment for 1 month and then the eggs produced were tested for chemical quality which included levels of protein, fat, water, carbohydrates, total energy, and cholesterol. Egg quality testing was carried out at the Saraswanti Indo Genetech (SIG) Laboratory in Surabaya. The method used for testing protein content was Titrimetri 18-8-31/MU/SMM-SIG, Fat content was Weibull 18-8-5/MU/SMM-SIG point 3.2.2, Water content was SNI 01-2891 - 1992, point 5.1, carbohydrates content was Calculation of 18-8-9/MU/SMM-SIG, ashes content was
SNI 01-2891-1992 point 6.1, Total energy was SIG calculations, and cholesterol content was gas chromatogram 18-6-5/MU/SMM-SIG. The research data were analyzed using analysis of variance and continued by testing the average smallest significant difference (BNT).

RESULTS AND DISCUSSION

The results of the chemical quality of laying hen eggs based on the content of protein, fat, water, carbohydrates, ash, total energy, and cholesterol can be seen in Table 2. Based on Table 2, the protein content in layer chicken eggs fed a ration with the addition of sardine waste oil showed an average yield of between 12.18-12.47%, it was the same as the Wulandari (2018)’s research that the protein egg of laying hens was 12.76%. The results of the data analysis showed that the addition of waste sardine oil did not have a significant effect on egg protein. The addition of sardine fish oil waste of 15% had a higher protein content. A higher concentration of sardine fish oil waste could increase the protein content. The protein content in eggs depends on the amount of protein consumed by the laying hen, so if the protein content in the ration consumed was high, it would increase the protein content in the eggs (Leeson, 2008). Protein was the main component in the preparation of albumen and yolks apart from water and fat, the function of protein in the rations consumed by livestock to supply amino acids for maintenance, muscle growth, and egg protein synthesis (Murphy et al., 2016). Through a certain processing process, sardine fish oil waste has nutritional content consisting of Omega 3, Omega 6, vitamin A, protein, fat, antioxidants, and glucose (Janczak and Riber, 2015).

Factors that affect protein requirements in laying hens were size and breed of chickens, ambient temperature, production stage, and energy content in the ration. Chickens that lack protein and amino acid intake at their growth age would slow down sexual maturity and reduce the size of the eggs produced (Siahaan, et al., 2013). Albumen contains about 9.7-12% protein. Egg protein was a system built from water-soluble globular proteins (Alleoni, 2006). The protein content was about 88% water, and the water in the albumen as a whole occupies about 60% of the egg percentage (Benton et al., 2001).

Table 2. The Content of Chemical Quality of Laying Hen Eggs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>P0 (0%)</th>
<th>P1 (5%)</th>
<th>P2 (10%)</th>
<th>P3 (15%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein (%)</td>
<td>12.18</td>
<td>12.36</td>
<td>12.43</td>
<td>12.47</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>8.45</td>
<td>8.89</td>
<td>8.82</td>
<td>7.79</td>
</tr>
<tr>
<td>Moisture (%)</td>
<td>77.58</td>
<td>76.82</td>
<td>76.45</td>
<td>77.42</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>0.86</td>
<td>0.91</td>
<td>0.94</td>
<td>0.88</td>
</tr>
<tr>
<td>Carbohydrate (%)</td>
<td>0.93</td>
<td>1.02</td>
<td>1.36</td>
<td>1.44</td>
</tr>
<tr>
<td>Energy Total (Kcal/100 gram)</td>
<td>128.49&lt;sup&gt;a&lt;/sup&gt;</td>
<td>133.53&lt;sup&gt;b&lt;/sup&gt;</td>
<td>134.54&lt;sup&gt;b&lt;/sup&gt;</td>
<td>125.75&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cholesterol (mg/100g)</td>
<td>303.32&lt;sup&gt;b&lt;/sup&gt;</td>
<td>358.82&lt;sup&gt;c&lt;/sup&gt;</td>
<td>365.68&lt;sup&gt;c&lt;/sup&gt;</td>
<td>267.04&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

The fat content of eggs in Table 2 was P0: 8.45%, P1: 8.89%, P2: 8.82%, and P3: 7.79%. The results of the data analysis showed that the addition of waste sardine oil did not have a significant effect on egg fat. From these data, it could be seen that the fat content decreased if the concentration of oil was higher. This was because the composition of fatty acids in the ration affects the composition of the eggs, and the amount of fatty feed added to the ration of laying hens was generally less than 10%. The amount of lipid that layers obtained from feed was approximately 3g per day, and 5–6g of lipid was required for the formation of each egg (Gao et al., 2021).

This observation also forms the theoretical basis for adding lipid additives to the ration to regulate egg production performance and egg quality of laying hens. Many sources of fat obtained from fish oil contain long chain fatty acids which when
consumed would increase the fat content in the body. The addition of fish oil containing L-carnitine was expected to accelerate the metabolism of fatty acids contained in fish oil because of the presence of L-carnitine which functions to help metabolize fatty acids so that the utilization of fat as an energy source could be optimal.

Utilization of energy from the oxidation of these fatty acids could save the formation of energy from protein. So that protein in the body could be used to increase production and improve egg quality. The addition of L-carnitine to feed containing fat was very necessary. L-carnitine played a role in the transfer of long-chain fatty acids across the membrane and mitochondria to the matrix to the mitochondria (Owen et al., 2018).

Lemuru fish oil in chicken rations, both for laying hens and broilers with the use of 3-6% lemuru fish oil had a good effect on the appearance of fat, cholesterol, and omega-3 and omega-6, also had a good effect on egg production (Supadmo, 2005). Most lipids in poultry feed were in the form of fatty cholesterol acids, triglycerides, and cholesterols which got into the intestine and produced fatty acids and glycerol and then developed cyclomicron. Cyclomicron along with protein (lipoprotein) was then absorbed in the blood circulation and transformed into VLDL, HDL, LDL, and cholesterol. The small amount of lipids was in the form of free fatty acids. Lipid metabolism manifestations could be performed as lipid and cholesterol contents in eggs (Iriyanti et al, 2012).

The research data of the moisture egg in Table 2 showed P0: 77.58%, P1: 76.82%, P2: 76.45%, and P3: 77.42%. The results of the data analysis showed that the addition of waste sardine oil did not have a significant effect on the water content of the eggs. With the high concentration of fish oil, the water content in the eggs would decrease. Ovumucin contained in thick albumen was four times greater than runny albumen, due to the high protein in the ration given, the formation of egg ovomucim would be even greater (Aqilla et al., 2021). The water in the egg was very visible on the albumen. The albumen formed is thick in the form of a thin gel containing approximately 15 g of water or half of the total water. During the first 6-7 hours the egg was in the magnum, the water content of the albumen doubled, reaching 3.5-7 g of water per gram of protein. The mechanism of absorbing water together with protein in the process of forming albumen was called plumping.

The ash content of eggs was 0.88-0.94%. The ash content was an inorganic substance from the residue of burning organic material. The ash content in the egg was closely related to the various minerals contained in the egg. The ash content and composition depend on the material and method of ashing. Determination of ash content in this study by oxidizing (combusting) all organic substances at high temperatures, which was around 500-600ºC, and then weighing the substances left behind after the combustion process (Sudarmadji et al., 1996).

Egg yolks contain several minerals, especially phosphorus (P), manganese (Mn), iron (Fe), iodine (I), copper (Cu), and calcium (Ca) which are much more than those contained in albumen and contain a small amount of zinc (Zn). The most abundant mineral component was phosphorus which was in the form of bonds with phospholipids, especially lecithin, and more than 60% of phosphorus in egg yolk was contained in lecithin. Albumen contains minerals such as chloride (Cl), magnesium (Mg), potassium (K), sodium (Na), and sulfur (S) in large quantities compared to egg yolks (Andriani et al., 2015).

The research data of carbohydrate egg was P0: 0.93%, P1: 1.02%, P3: 1.36% and P3:1.44%. Eggs contain carbohydrates in small amounts. Carbohydrates found in eggs were free and bound to protein or fat. Free carbohydrate was usually found in the form of glucose, and a combination of mannose and galactose. The amount of
glucose in albumen was around 0.55% and in egg yolk was around 0.27%. Carbohydrates that combine in egg yolk are phospholipids, phosphoproteins, and cerebrosides, while albumen are glycoproteins and simple proteins (Thohari, 2018). Free carbohydrates in eggs were glucose through the hepatic portal vein to enter the liver sinusoids. Glucose in the liver undergoes metabolism and excess glucose is partially converted into glycogen in the liver and fat. Leeson (2001) stated that if the carbohydrates accumulated in eggs were high, the fat contained would be low. This could be seen from the metabolic potential based on the productivity data of the eggs produced.

The total energy of the laying hen egg was 125.75 – 134.54 Kcal/100 gram. Based on the data analysis, the addition of sardines fish oil waste was a significant effect on total energy (P<0.05), and the best treatment to produce the high energy total was the addition of 5% sardines fish oil waste in the main feed of UD Sumber Rejeki. Colvara et al (2002) the effect of energy levels, which ranged from 2.700-3.000 kcal/kg in diets of laying hens during the second productive cycle and found no changes in egg quality. Increasing energy intake had significant positive effects on egg weight.

Metabolic energy in the diet of broiler breeders was very important. A deficiency may lead to poor performance, as well as an increase in body fat due to an excess in energy levels (Leeson and Summers, 2000). Laying hens also need carbohydrates, fat, and vitamins as a source of energy in carrying out activities, for example, for growth, increasing endurance, and egg production. If the ration contains little energy, egg production would be hampered. Laying hens that lack internal energy would experience decreased egg production, and the eggs produced were not good. Lack of energy caused some of the protein's carbon skeleton to be converted into energy. If the energy content of the ration was changed, the protein content of the ration was changed according to the proportion of changes in the energy content. If energy needs were met, chickens would stop consuming rations, otherwise, ration consumption increased if energy needs were met. If the protein in the ration was high, the energy in the ration must be increased.

If there is a decrease in consumption due to energy in the ration that exceeds the provisions or is high, then the protein in the ration must be balanced (Harms et al., 2000). The total energy content of research eggs could be used to fulfill the nutritional needs of toddlers. The energy needs that must be supplied by toddlers in Indonesia had been determined for 0-6 months as much as 550 Kcal, 7-11 as much as 725 Kcal, 1-3 years as much as 1125 Kcal, 4-6 years as much as 1600 Kcal (Rahayu et al., 2018).

Based on Table 2, the value of egg cholesterol was 267.04-365.68 mg/100g egg. From the results of the data analysis, the addition of sardine fish oil waste had a highly significant effect on egg cholesterol. The more concentration of fish oil the lower the egg cholesterol content. The addition of waste sardine oil at a concentration of 5-10% had the same cholesterol content. The best addition of waste sardine oil was 5%, to production costs efficient. The egg cholesterol content decreased with the increasing concentration of sardine fish oil waste into the diet because the sardine fish oil waste was a source of omega-3 which could inhibit the occurrence of cholesterol biosynthesis and reduce cholesterol. Fish oil was a source of omega-3 polyunsaturated fatty acids (PUFA) which could reduce triglycerides in chicken eggs when compared to the provision of feed containing saturated fatty acids (SFA) (Basudewa et al., 2022). Kang et al. (2001), cholesterol reduction by dietary fish oil waste was suggested mainly from the inhibition of hepatic VLDL production. Novak and Scheideler (2001) the decrease of egg yolk may decrease the amount of cholesterol content per egg.
consumed. When laying hens were fed with a diet supplemented with 5% fish oil, 5% palm oil, and 5% soybean oil, the cholesterol level in the yolk of the fish oil group was lower than in palm oil. The results showed that fish oil could decrease the egg cholesterol content (Ouyang et al. 2004). The laying hens were fed three diets supplemented with flax oil and fish oil, and egg cholesterol content significantly decreased in the group with supplementation of flax and fish oil (11.98 and 11.79 mg/g) (Vasko et al. 2005).

CONCLUSION

The sardines fish oil waste into the diets did not affect on the protein, fat, moisture, and carbohydrate content of laying hen eggs, and significant effect on energy total and cholesterol content of laying hen egg. The chemical quality of laying hen egg consist of a protein content was 12.18-12.47%, fat content was 7.79-8.89%, moisture content was 76.45-77.58%, carbohydrate content was 0.93-1.44%, ash content eggs was 0.88-0.94%, the energy total was 125.75-134.54 Kcal/100 gram, and egg cholesterol content was 267.04-365.68 mg/100g egg. Based on the results of this research, the best addition of waste sardine fish oil was 5% to production costs efficient to produce functional eggs in UD Sumber Rejeki for stunting sufferers, especially in the Lamongan District.

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136


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