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Utilization Effect of *Sardinella lemuru Fish* Oil and Sprouted Mung Bean *(Vigna radiata)* on Broiler Performance and Income Over Feed Cost

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Abstract. *The research was aimed to evaluate the effect of addition Sardinella lemuru oil* (SLO) *and sprouted mung bean* (SMB) *supplementation on performance broiler and IOFC. The material used in this research were 160 unsexed Cobb Strain DOC broiler. The method used Completely Randomized Design with 4 treatments and 5 replications, and the experiment tested* T_0 *(basal feed) as a control,* T_1*(basal feed + SMB 0.5% + SLO 1.5%),* T_2 *(basal feed +SMB 0.5% + SLO 3%),* T_3 *(basal feed + SMB 0.5% + SLO 4.5%) as feed given. Variable measured were feed consumption, body weight gain, feed conversion, index of production, and income over feed cost. The data collected and analysed using Variance analysis and the Duncan Multiple Range Test further tested any significant difference. The results were showed that the addition of Sardinella lemuru oil 4.5% and sprouted mung bean 0.5% highly significant (P<0.01) affected feed consumption, feed conversion, body weight gain, income over feed cost and no significant effected on the index of production.*

Keywords: *Income, Performance, Sardinella lemuru oil, Sprouted mung bean*

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INTRODUCTION

Livestock production, especially in the broiler can be improved through the fulfillment of energy needs. A nutrient source of energy that has the highest calorie can be obtained from fat. Feed ingredients with high-fat content can be found in the supplementary feed materials such as oil. Besides to meet the energy needs, the addition of oil in broiler feed is used to improve the palatability. The added oil in the feed material plays a role in the process of absorption of fat-soluble vitamins and reduces the dusty nature of the feed (Heldini, 2015). Oil of *Sardinella lemuru* is a by product of *Sardinella lemuru* canning and flouring process. *Sardinella lemuru* oil still contains polyunsaturated fatty acids such as omega-3, so that they can be used for additional feed of broilers (Rusmana, *et al*, 2008). *Sardinella lemuru* oil obtained from Banyuwangi Muncar regional water contain unsaturated fatty acids omega-3 in the form of 6.89% α-linolenic acid, 3.62% Eicosa pentaenoic acid and 3.56% Diocosa hexanoic acid (Istiqomah, *et al*, 2017). The omega 3 poly unsaturated fatty acid caused oil to be easier oxidized, and increase the risk of disruption metabolism and destroy the cells of the body tissue due to the oxidation process that takes place produces free radicals that would destroy the antioxidant produced by the body, therefore it makes the addition of antioxidants that can be added to the feed.

Antioxidants can enhance the immune response; one of the commonly used antioxidants is vitamin E (Rusmana *et al*., 2008). Vitamin E acts as an antioxidant works by binding free radical molecules agent (Fauziah, *et al*., 2013). Green bean is one of the plants that contain vitamin E. Green bean has high nutritional content. However, it is still in an inactive form, which will further heighten nutritional value after undergoing a process of germination. Vitamin E will increase after the green bean experiences germination for 48 hours (Maruliyananda, *et al*., 2010).

Based on these problems, it needs to conduct further study on the effect of *Sardinella lemuru* oil use and green bean sprouts on broiler performance. Oil and green bean sprout added in the feed are expected to have complementary functions that can spur the growth of livestock to increase production shown in the performance of broiler.

LITERATURE REVIEW

Broiler production can be improved by the fulfillment of nutrients needs containg energy, protein, lipid and micronutrients. A nutrient source of energy that has the highest calorie can be obtained from fat. Feed ingredients with high-fat content can be found in the supplementary

feed materials such as oil. Broiler feed with addition of oil also have better palatability. The added oil in the feed material plays a role in the process of absorption of fat-soluble vitamins and reduces the dusty nature of the feed (Heldini, 2015). *Sardinella lemuru* oil is a by product of *Sardinella lemuru* canning and flouring process.

Rresearch of usmana (2007) found that use of *Sardinella lemuru* oil and vitamin E led to a decline in consumption and feed conversion, cause of oil has a high energy content contained in the fatty acid so that it was sufficient energy for livestock requirement. Feed with lower energy content will spur broiler to consume additional energy. Qurniawan *et al*., (2016) describe different metabolic energy requirements that can cause feed consumption differences. Metabolism energy required by broiler is different based on age, temperature, and gender. Metabolism energy is used for the growth of body tissues, production, physical activity, and maintaining body temperature.

Sardinella lemuru oil still contains polyunsaturated fatty acids such as omega-3, so that they can be used for additional feed of broilers (Rusmana, *et al*, 2008), contain unsaturated fatty acids omega-3 in the form of 6.89% α-linolenic acid, 3.62% Eicosa pentaenoic acid and 3.56% Diocosa hexanoic acid (Istiqomah, *et al*, 2017). The omega 3 poly unsaturated fatty acid caused oil to be easier oxidized, and increase the risk of disruption metabolism and destroy the cells of the body tissue due to the oxidation process that takes place produces free radicals that would destroy the antioxidant produced by the body, therefore it makes the addition of antioxidants that can be added to the feed.

Antioxidants will be prevent oxidation process and enhance the immune response; antioxidants usually provide by tokoferol / vitamine E (Rusmana *et al*., 2008). Its acts as an antioxidant by binding free radical molecules agent (Fauziah, *et al*., 2013). Green bean contain vitamine E and other nutrients , and will be more active after a germination /sprouted. Vitamine E will increase after the green bean experiences germination for 48 hours (Maruliyananda, *et al*., 2010). Its interesting to evaluate the effect of *Sardinella lemuru* oil use and green bean sprouts on broiler performance. Oil and green bean sprout added in the feed are expected to have complementary functions that can spur the growth of livestock to increase production shown in the performance of broiler.

Feed containing high-fat feed will increase the retention time in the intestine or extend a flow rate so that the process of digestion and absorption becomes increased. Ryla ,*et al*. (2017) explains that chickens which have proper metabolism to be more efficient in absorbing nutrients intake level of feed consumed. The efficiency level showed how much the influence

of the role of feed to the digest health. Besides, the addition of green bean sprouts also supported the addition of the nutritional value of feed. Asrullah (2015) explains that the process of germination of green beans will improve the functional characteristics and nutritional value of the protein and vitamins in the catabolic reaction so that it becomes a simple compound that is easily digested.

RESEARCH METHODS

The research was conducted for 4 months on October = November. Proximate analysis of feedstuffs was carried out in Laboratory Testing Quality and Food Safety, Faculty of Agriculture, University of Brawijaya.

Research Material

The study used 160 Day Old Chickens (DOC) Cobb broiler strains, which were not differentiated by their sex (unsexed). The average body weight of DOC used was 44.96 ± 3.728 g/tail, with a variant coefficient of 8.257%. Cage used in this study was a terraced semi-closed house, use for research on a lower floor, with the placement of the research cage enclosure as many as 20 plots with each plot measuring 125x100x60 cm.

The materials used for research feed, such as *Sardinella lemuru* oil, were obtained from a byproduct of *Sardinella lemuru* processing located in Muncar, East Java. Green bean sprouts were obtained from the germination process of green beans seed for two days and dried. The basal feed used was the commercial feed corresponding to the phase of growth; the starter feed was crumble form, and finisher feed was pellet form.

Table 1. Nutrition of *Sardinella lemuru* oil (SLO)

No.	Nutrition	Contents
1	Crude protein(%)	3.74
2	Metabolic energy (Kcal / kg)	8280
3	Crude Fiber (%)	0.75
4	Crude fat (%)	70.4
5	Dry matter(%)	91.19
6	Ash (%)	-
7	Without Extra ingredients Nitrogen (%)	16.61
8	Water (%)	8.81

Source: Istiqomah *et al*. (2017)

Table 2. Nutrition of dried mung bean sprouts (SMB)

No.	Nutrition	Contents
1	Protein (%)	19.51
2	Metabolic energy (Kcal / kg)	3540
2	Fat (%)	3.44
3	Water (%)	11.83
4	Ash (%)	3.62
5	Carbohydrates (%)	61.60
6	Antioxidants (mg / ml)	187.25

Source: The results of the proximate analysis, Laboratory Testing Quality and Food Safety, Faculty of Agriculture, University of Brawijaya (2018).

Research Methods

The method used in this research was a field experiment using a completely randomized design (CRD), with 4 treatments (combination of sprouted mung bean (SMB) and Sardine lemuru oil (SLO), and 5 replications,. Each one unit experiment used 8 broiler chicks. Treatment given were as follows:

T_0: Basal feed

T_1: Basal feed + 0.5% SMB + 1.5% SLO

T_2: Basal feed + 0.5% SMB + 3.0% SLO

T_3: Basal feed + 0.5% SMB + 4.5% SLO

Research Procedure

The preparation phase had been done two weeks before DOC arrival. Activities undertaken included preparing the cage brooding, sterilizing, the labeling of the treatment on the plot cage, preparing feed, making food and drink equipment. Broiler with 1-14 days of age was kept in one cage brooding. Broiler gave basal feed through chick feeder. Drinking water had been provided in ad libitum. Brooding cage temperature was maintained using gasolec that serves as a heater and lit for 24 hours.

Broilers with 15 days of age were grouped in the treatment cage. Broiler was placed on a research cage through randomization by way of lottery and began to be given feed treatment in proportion to the addition of *Sardinella lemuru* oil and green bean sprouts on each treatment. The feed given twice a day at 08.00 am, and at 15:00, the feed treatment was given until harvest time.

Data collection of the research on body weight and feed intake was done every week. Weighing body weight was conducted to determine weight gain. Feed intake data retrieval was done by weighing the feed every time would be given, further weighing leftover feed every weekend, the feeding data were reduced by the rest of the feed. Data body weight and feed

intake had been gained during the maintenance were used to calculate the value of feed conversion, performance index, and IOFC.

Research Variable

The variables measured in this study were:

a) Feed consumption

Feed intake was calculated by counting the number of the ration with the rest of the feed.

Feed intake = Feed given – wasting Feed

b) Body Weight Gain (BWG)

Weight growth was calculated by body weight when weighing reduced by prior body weight.

c) Feed conversion

Feed conversion is the ratio between the feed consumption with weight gain obtained within a certain period. Feed conversion can be used in measuring feed efficiency to increase production, feed conversion calculating formula is as follows:

Feed conversion = $\frac{\text{Feed Intake}}{\text{Body Weight Increase}}$

d) Performance Index

Performance index calculation formula is as follows:

: x100$\frac{(100-\%mortality)x\ harvest\ weight\ (Kg)}{FCR\ x\ age}$

e) IOFC (Income Over Feed Cost)

IOFC is a way to calculate the income derived from the performance measurement of the feeding program. The formula to calculate the feed conversion is:

Body Weight $\times$ broiler price) $-$ $\sum$ feed intake $\times$ feed cost

Data analysis

Data of the research results recorded and statistically analyzed using analysis of variance (ANOVA) on the Complete Random Design (RAL) Unidirectional Pattern. If there is a real difference, then it will be continued with mathematical Duncan's. Model Multiple Range Test of completely randomized design is as follows (Razak, Kiramang and Hidayat, 2016).

$Y_{ij} = \mu + \pi_i + \beta_{ij}$

Information :

Y_{ij} = Observations on the treatment of the i-th repetition j-th

μ = The general median

τ_i = Effect of treatment 1-th (1,2,3,4)

ε_{ij} = Effect of error treatment of the i-th repetition j-th

i = 1,2,3,4

j = 1,2,3,4,5

RESULTS AND DISCUSSION

The result of the research on the effects of the *Sardinella lemuru* oil addition and green bean sprouts on the performance of broiler can be seen in Table 3.

Table 3. The research result of the production performance of each treatment.

Variables	Treatment			
	T_0	T_1	T_2	T_3
Feed intake (g/bird)	3347±0.98^{ab}	3380±3.91^{b}	3251±52.69^{a}	3218±73.86^{a}
Energy consumption (Kcal/bird/day)	1501±0.54^{a}	1574±1.85^{b}	1561±25.93^{b}	1592±37.58^{b}
BWG(g /bird)	2091±4.65^{a}	2104±16.55^{a}	2118±3.86^{ab}	2122±9.17^{b}
feed conversion	1,566±0.004^{c}	1,573±0.012^{c}	1,503±0.024^{b}	1,485±0.034^{a}
Performance index	389.72±2.06	390.21±5.96	317.32±100.51	384.94±39.00
IOFC (Rp/bird)	15852±107.0^{c}	13997±316.4^{c}	1338±467.9^{b}	12 742±665.3^{a}

Different superscript on the same lines showed a highly significant effect (P<0.01).

Feed consumption

The lowest feed consumption was in T_3 treatment; this result was not different from the result in T_2 treatment, which indicated the same notation, but the significant difference in T_1 treatment. The effect of varying feed consumption results for each feed treatment allegedly had different metabolic energy content.

The level of energy consumed showed that the addition of *Sardinella lemuru* oil and green bean sprouts provided a highly significant difference ($P < 0.01$) to the level of energy consumption. Energy consumption in feed treatments, which was added *Sardinella lemuru* oil and green bean sprouts, indicated the level of energy consumption that was significantly different from the feed control; it was influenced by the amount of feed consumed and metabolizable energy content in the feed. The high energy content produced a lower feed intake but also with a specific dose made the increased palatability of feed as in the result of T_1 treatment by Rusmana (2007) statement in his research that the use of *Sardinella lemuru* oil and vitamin E led to a decline in consumption and feed conversion. The decrease was due to *Sardinella lemuru* oil has a high energy content contained in the fatty acid so that it was sufficient energy for livestock requirement, while the use of vitamin E can improve the degree of oxidation caused by the high content of fatty acids. Feed with lower energy content will spur broiler to consume additional energy needs, and vice versa. Qurniawan *et al*., (2016) describe different metabolic energy requirements that can cause feed consumption differences. Metabolism energy required by broiler is different based on age, temperature, and gender. Metabolism energy is used for the growth of body tissues, production, physical activity, and maintaining body temperature.

The addition of *Sardinella lemuru* oil to the basal feed appropriate to the level of treatment provides different discoloration and smell on a basal feed by the treatment so that it can affect the different palatability on each treatment feed. T_1 treatment showed the highest consumption levels of $3380 \pm 3{,}9191$ g/tail. T_1 Treatment with the addition of *Sardinella lemuru* oil by 1.5 and 0.5% of green bean sprouts could be expected to improve the palatability of the treatment so that T_1 obtained a high level of consumption. Heldini (2015) explains that the palatability of feed affects consumption to appeal that raises appetite, such as smell, taste, and color of feedstuffs. The addition of tuna oil on his research at a certain level changed the feed color to dark brown thereby reducing the

consumption of broiler feed, and this is because the broiler has a sensitivity to color as a result of the stimulus received by the eye's retina, thereby increasing different sensitivity.

Body Weight Gain

Bodyweight gain in Table 3 shows the highest achievements of body weight gain in P3 treatment, this result did not differ significantly to the T_2 treatment, but shows a highly significant difference to the T_0 and T_1 treatment, it was presumably because the T_3 and T_2 treatment obtained the nutritional content of food that could be absorbed optimally to meet basic needs and broiler production.

The content of omega-3 in *Sardinella lemuru* oil could be used as additives for broiler feed. *Sardinella lemuru* oil added in the feed as much as 3-6% could have a good influence on the performance of production (Indi *et al*., 2014). The use of materials containing omega-3 and omega-6 can maintain the balance of fatty acids that make the body's metabolic processes take place optimally and produce better growth.

The addition of *Sardinella lemuru* oil that contains unsaturated fatty acids can increase energy efficiency through increased energy density and increase the efficiency of protein synthesis through a stream of nitrogen to the duodenum (Tarigan *et al*., 2016). Weight gain is influenced by the rate of metabolism in the body; proper metabolism makes the feed consumed is absorbed efficiently (Yunilas, 2005).

Feed conversion

Feed conversion in Table 3 showed the result of T_3 treatment was significantly different from any other treatment. The result in the treatment the lowest level compared to other treatments, it was suspected because of the effect of adding *Sardinella lemuru* oil and green bean sprouts at this level could be absorbed well by broiler to the meat establishment. Heldini (2015) explains that feed containing high-fat feed will increase the retention time in the intestine or extend a flow rate so that the process of digestion and absorption becomes increased. Ryla ,*et al*. (2017) explains that chickens which have proper metabolism to be more efficient in absorbing nutrients intake level of feed consumed. The efficiency level showed how much the influence of the role of feed to the digest health. Besides, the addition of green bean sprouts also supported the addition of the nutritional value of feed. Asrullah (2015) explains that the process of germination of green beans will improve the functional characteristics and nutritional value of the protein

and vitamins in the catabolic reaction so that it becomes a simple compound that is easily digested.

Feed conversion is an indicator of the broiler production performance obtained by dividing the amount of feed consumed and the achievements of body weight. Budiarta, *et al*. (2011) explain that the feed conversion rate is used to determine the level of efficiency of the use of feed. Feed conversion is calculated through a comparison between the amount of feed consumed to the body weight gain in a certain period. Feed conversion value shows the efficiency of feed use in meat formation.

Feed conversion is influenced by nutrition absorption and animal behavior. Dharmawan *et al*., (2017) explains that the feed conversion is also influenced by several factors such as excessive feeding, the feed which is not according to standards, feed much scattered, disease, gas content, the temperature of the enclosure, and quality of feed.

Index Performances

Research results in Table 3 show that the addition of *Sardinella lemuru* oil and green bean sprouts in the addition of T_1, T_2, and T_3 treatment had no significant effect on the P0 control treatments on the broiler performance index. The high production value could indicate improvements in the value of broiler achievement of the efficient use of feed. T_2 and T_3 treatment although in the feed intake, feed conversion and weight gain gave good results but the performance index T_2 and T_3 show lower results than T_0 and T_1 treatment, it was presumably because the treatment of T_2 and T_3 showed the presence of death was caused by many factors, particularly the mismanagement during maintenance, thus lowering the value of performance index.

The addition of *Sardinella lemuru* oil in each treatment should be balanced by the addition of green bean sprouts in a certain percentage. It is intended to support the broiler health factor. Tarigan, *et al*., (2016) explain that the use of oil that is too high in the feed can increase fat peroxidation in plasma and decrease of vitamin E because polyunsaturated fatty acids are very easily oxidized and facilitate the entry of free radicals enter the cell so that it can trigger oxidative stress. Asrullah (2015) explains that the amount of vitamin E on green bean sprouts is potential as a source antioxidant.Vitamin E is capable of protecting against lipid peroxidation by breaking the chain of propagation of lipid peroxidation through a donation of hydrogen atoms on ROS. Mortality in broiler apart because of imbalance of antioxidants that is given, it is also influenced by many

factors such as disease, environment, poor maintenance management, and any other. Placement of research cage on the lower floor is presumed to affect the health of broilers. According to Kusnadi, *et al*. (2006) explain that the multilevel cage ventilated substandard causes a lack of oxygen that goes into the cage and other gases such as H2S, NH3, and CO2 difficult to remove.

Achievements of performance index in each treatment obtain the results in T_0 treatment with the value of 389.72 was in the excellent category, in the T_1 treatment with a value of 390.21 was in an outstanding category, with a value of 317.32 in T_2 treatment was in the category enough and in T_3 treatment with a value of 384.94 was in the excellent category. The classification of performance index categories described by Maharatih (2017) that the performance index is a parameter of assessing the success of the farm with the assessment divided into five categories. The performance index that has a value of less than 300 it belongs to the less category, the performance index with value 301-325 belongs to the enough category, the performance index values 326-350 belongs to the good category, the performance index with value 351 -400 belongs to the very good category and if the performance index with value over 400 belongs to the excellent category.

IOFC (Income Over Feed Cost)

IOFC sequentially, during the study in Table 3 showed that the addition of *Sardinella lemuru* oil and green bean sprouts provided a highly significant difference ($P < 0.01$) on IOFC. Low IOFC in T_3 treatment which showed a significant difference to P0 allegedly due to the addition of *Sardinella lemuru* oil at a high enough level so that added to the cost for feed, although in T_3 treatment generating very good performance of broiler with the support of feed consumption factor, feed conversion, performance index and the achievement of the final body weight, but had not been able to be a solution to increase the IOFC value. According to Anggitasari *et al*. (2016), different IOFC values can be caused by the price and content of a different feed. IOFC value is influenced by the final weight, feed intake, feed prices, and the selling price of chicken. Suprayogi *et al*., (2017) explains that the excellent growth does not necessarily guarantee the maximum profit, but good growth and conversion with minimal feed costs will get the maximum benefit.

IOFC is often used as a benchmark to see the magnitude of the benefits of the use of feed because feed spent the highest cost in maintenance management. Supplementation

of the feed is a way that is often used to cover costs incurred during production. According to Prasetiyono, *et al*.(2008) state that IOFC is a concept to determine the economic analysis as an early indicator of fattening beef cattle activity in the short term, the calculation aims to assess the effort of replacement or addition of feed to the IOFC influence in determining economical feed and farmer incomes. Munira *et al*. (2016) explain that feed is the most significant component of the production cost. The production cost is strived to a minimum without compromising the optimum production, which can be done by replacing or substituting the feed material that has a relatively low price.

CONCLUSION

The addition of *Sardinella lemuru* oil as much as 4.5% and green bean sprouts as much as 0.5% could lower the feed with the lowest achievements of 3218 g/tail, bodyweight gain with the highest performance of 2122 g/tail, feed conversion with the lowest performance of 1485, the performance index amounts to 384.94, but this treatment caused a decrease IOFC with the lowest performance Rp 12742 /tail thereby reducing the advantage of income. Based on the research that has been done, the authors suggest:

1. To use *Sardinella lemuru* oil as much as 4.5% and green bean sprouts as much as 0.5% as an additional feed to achieve excellent performance of broiler.
2. To continue the research on examining the content of unsaturated fatty acids in the meat.

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