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Strategy for Improving Production Performance and Quality of Layer Eggs by Giving Symbiotics (Inulin and L. Fusiformis BIP-211 isolate) Through Feeding

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Abstract **Original Research Article**

Symbiotic is a combination of pre-biotic and pro-biotic. This study aims to evaluate the impact of giving symbiotics through feeding on the performance and quality of layer eggs. This study used 408 Layer 65 weeks old which were divided into 2 groups as treatment. Layer maintenance was carried out for 14 days in a closed house cage with a battery cage system. The treatment in this study was giving symbiotic through feeding (0.1% of feeding) and without symbiotic as a control. The symbiotic used consisted of inulin, mineral mix, and L. Fusiformis BIP-211 bacterial isolates with a cell density of 10^{12}. Parameters observed were production performance [(Feed Intake (FI), Hen Day Production (HDP) and Feed Conversion Ratio (FCR)], Feed digestibility [Dry matter digestibility and organic matter digestibility] and egg quality [(shell thickness, Egg Yolk Index (EYI), Haugh Units (HU), and Egg Yolk Color (EYC)]. The data obtained was analyzed using the T-Test. The results showed that giving symbiotics through feeding had a very significant effect (P-0.000) on HDP and FCR, but not significantly different on FI (P-0.900). The average FI in this study was 102 g/day. The HDP and FCR in the layer that were given the symbiote were 87.6% and 1.8 respectively, while those that without symbiotic were 81.16% and 2.02, respectively. Feed containing symbiotics had a higher level of digestibility of dry matter and organic matter compared to the control (P-0.000). The digestibility of dry matter and organic matter in this feed was 95.5 and 96.07% respectively. Symbiotic administration had a very significant effect (P-0.000) on shell thickness and had no significant effect on EYI, HU, and EYC. The conclusion of this study is that the administration of symbiotics can improve the performance and feed digestibility of layer production and increase the shell thickness without affecting egg quality.

Keywords: Layer, Lysinibacillus Fusiformis BIP-211, Performance, Symbiotic.

INTRODUCTION

Egg is a source of animal protein that is affordable by the public. This is because eggs can be stored at room temperature and have a relatively cheaper price compared to other sources of animal protein. Currently the largest supplier of eggs is purebred chicken. The population of laying hens in 2021 will reach 3.01 billion with an average annual growth of 15.46% (BPS, 2022). This purebred chicken can lay eggs up to 96% at the age of 26-29 weeks (ISA-Brown, 2021). Production performance is influenced by several factors, one of which is the environmental factor. In the laying phase (layer) of purebred chickens, an ambient temperature of around 20-22ºC is required (ISA-Brown, 2021). The same thing was also reported by Hu *et al.*, (2019) that the optimal temperature for poultry farming ranges from 18-20ºC. Meanwhile, the average ambient temperature in Indonesia is ± 31.5ºC (Sumiati *et al.*, 2015).

High ambient temperature will cause heat stress on the layer, and this will trigger a decrease in performance (Hu *et al.*, 2020; Ismail *et al.*, 2022; Lara & Rostagno, 2013; Miao *et al.*, 2020). In addition to heat stress, density that is too high also affects stress which will also trigger a decrease in performance. The density standard for 1 chicken at the age of more than 16 weeks is 750 cm^2/head (ISA-Brown, 2021). In general, laying hens in Indonesia use a density of 500 cm^2/head which is lower than the existing standard, resulting in a decrease in performance.

One way to overcome this problem is by administering prebiotics and probiotics. Prebiotics are fibers that cannot be digested and have the function of stimulating the growth or activity of certain bacteria, while probiotics are live bacteria or yeast that are beneficial to health (Jha *et al.*, 2020). The positive impact of using probiotics in laying hens has been widely reported. Among them are being able to increase egg production and mass (Youssef *et al.*, 2013), reduce FCR and increase shell thickness (Zamanizadeh *et al.*, 2021), increase blood index, blood protein, and antibody titers (ND, IB and EDS) (Al-khalidi *et al.*, 2020).

Inulin is one of the ingredients that can be used as a prebiotic. Inulin can function to balance microorganisms in the digestive tract, increase immunity, metabolize fat, and help absorb minerals (Birmani *et al.*, 2019). Furthermore, one of the bacterial isolates that can be used as probiotics is L. Fusiformis BIP-211 bacteria (Prihartini *et al.*, 2023). These bacteria are able to increase nutrition, crude fiber, organic matter and feed digestibility (Prihartini *et al.*, 2009). The combination of inulin as a prebiotic and L. Fusiformis BIP-211 bacterimatter, lates as a probiotic can become a product called symbiotic. This symbiotic has been used by Prihartini *et al.*, (2021) to increase the in-vitro digestibility of ruminant feed. However, it has never been used in improving the performance of laying hens. Therefore, this study aims to evaluate the increase in production performance and egg quality of laying hens given symbiotic through feeding.

MATERIALS AND METHODS

Materials

The material used in this study was 408 layers of Isa-Brown strain aged 65 weeks. The feed used is commercial feed in the form of a mesh with the following nutritional content: Maximum water content 13%, Protein 17-18%, Crude fat minimum 4%, Crude fiber maximum 6%, Ash maximum 14%, Calcium minimum 3.7%, Phosphorus minimum 0.6%, maximum aflatoxin 50 ppb, and metabolized energy of 2650-2750 Kcal/kg. The symbiotic used consisted of inulin as a carrier medium, mineral mix (2% of inulin) and L. Fusiformis BIP-211 bacterial isolates with a cell density of 10^{12}. Then the symbiotic was formulated in powder form.

Methods

The experimental design used in this study was the T-test. The treatment consisted of giving symbiotics through feeding (0.1% of feeding) and without giving symbiotics as a control. Each treatment consisted of 204 birds distributed in 51 batteries (each battery contained 4 chickens).

Experimental Design

Rearing was carried out for 14 days in a closed house cage. Feed is given in a limited manner, namely 102 g/day which is given two times, morning (40%) and evening (60%). Drinking water is provided with ad-libitum. The temperature of the cage at night was around 20-25°C and during the day it was around 27-31°C. Chickens were reared intensively in a battery cage system with a size of 50 x 40 x 40 cm. Each battery contains 4 chickens.

Data Collecting

The variables observed in this study consisted of production performance [Feed Intake (FI), Hen Day production (HDP) and feed conversion ratio (FCR)], feed digestibility [dry matter digestibility and organic matter digestibility] and egg quality [Shell thickness, Egg Yolk Index (EYI), Haugh Unit (HU), and Egg Yolk Color (EYC)]. Feed Intake is calculated based on the feed consumed daily. HDP is calculated daily based on the percentage of laying hens (%). FCR is calculated daily by means of the total feed consumed divided by the total eggs produced.

Dry matter and organic matter were analyzed using proximate analysis (AOAC, 2005). Feces were collected every day during the rearing period (14 days). The collected feces are then homogenized and 10% was taken to be dried every day. Dry feces collected during the rearing period (14 days) were homogenized and 5% was taken for analysis of dry matter and organic matter. analysis was carried out in Duplo. Dry matter digestibility was calculated using the formula:

$$\frac{\text{Dray matter intake} - \text{Fecal dry matter}}{\text{Dry matter intake}} x\ 100\%$$

Organic matter digestibility was calculated using the formula:

$$\frac{\text{Organic matter intake} - \text{Fecal organic matter}}{\text{Organic matter intake}} x\ 100\%$$

Egg quality was observed by taking one egg from each battery on the 14^{th} day of observation. The shell thickness was calculated by breaking the eggs, then the shells were cleaned and measured using a standard micrometer. EYI is calculated by dividing the height of the yolk by the diameter of the egg. HU was calculated using the Ames Trypot Micrometer. And the EYC is calculated by scoring techniques.

Data Analyses

The collected data were then analyzed for variance using the T test with a significant level of 1%. Data processing was carried out using SPSS software version 21.0 (SPSS, 2012).

RESULTS AND DISCUSSIONS

Results

The average results of giving symbiotics through feeding on production performance, feed digestibility, and egg quality in laying hens are shown in Tables 1, 2 and 3 respectively. Furthermore, daily feed consumption and Hand Day Production (HDP) during laying hens are shown in Figures 1 and 2.

Based on the analysis of variance, the administration of symbiotic through feeding had no significant effect (P>0.05) on the feed consumption of laying hens. The average feed intake (FI) in this study was around 102 g/day (Table 1). Giving symbiotic through feeding was able to increase hen day production (HDP) of laying hens very significantly (P<0.01) with an increase rate of 6.44% (Table 1). The administration of this symbiotic was also able to significantly reduce the feed conversion ratio (FCR) (P<0.01) of 0.15.

Feed digestibility in the study was influenced by the administration of symbiotics (P<0.01) (Table 2). The digestibility of dry matter and organic matter in feed given symbiotic was higher compared to the control. The digestibility of dry matter and organic matter in feed that was given symbiotic was 95.58, 96.07%, respectively. Meanwhile, the digestibility of dry matter and organic matter in feed that was not given symbiotic was 91.58, 74.91%, respectively.

In general, the quality of the eggs produced from this study based on the analysis of variance was not affected by the symbiotic given through feeding. Symbiotic administration only had a very significant effect (P<0.01) on shell thickness. The thickness of the eggshells that were given symbiotic by feeding was 0.7 mm thicker than the control (Table 3). Furthermore, the administration of this symbiotic had no significant effect (P>0.05) on the egg yolk index (EYI), Haugh Unit (HU) and egg yolk color (EYC). The mean values for EYI, HU, and EYC ranged from 0.34-0.35, 54.80-55.42, and 5.80-6.20 respectively.

Daily feed intake during rearing (14 days) ranged from 97-106 g (Figure 1). In the quantitative date, the feed intake is sometimes higher in laying hens that were given symbiotic through feeding and sometimes higher in laying hens that are not given symbiotic (control). The data generated in this study are normally distributed close to the mean.

Hen day production (HDP) produced in this study was consistently higher in laying hens given symbiotic by feeding. Only on the 3rd day, the HDP of laying hens that were not given symbiotic was higher than the HDP of laying hens that were given symbiotic through feeding. In numbers, the HDP on the first day did not differ, which was around 83%, then on day 2 the HDP of laying hens given symbiotic through feeding increased, while the HDP of laying hens that were not given symbiotic decreased. The increase in HDP was also consistent from day 4 to day 14 that the HDP of laying hens given symbiotic through feeding was higher than HDP of laying hens that were not given symbiotic.

Table 1: The effect of giving symbiotic through feeding on the production performance of laying hens

No	Parameter	Treatments		Standard Error (SE)	P-Value
		Symbiotic	Non-Symbiotic		
1	Feed Intake (g/day)	102.31	102.43	0.960	0.900
2	Hen Day Production (HDP) (%)	87.60 [a]	81.16[b]	1.175	0.000
3	Feed Conversion Ratio (FCR)	1.87[a]	2.02[b]	0.024	0.000

Note: Different superscripts in the same line indicate a very significant difference (P<0.01)

Table 2: The effect of giving symbiotic through feeding on feed digestibility

No	Parameter	Treatments		Standard Error (SE)	P-Value
		Symbiotic	Non-Symbiotic		
1	Dry matter digestibility (%)	95.58a	91.58b	0.477	0.000
2	Organic matter digestibility (%)	96.07a	74.91	0.378	0.000

Note: Different superscripts in the same line indicate a very significant difference (P<0.01)

Table 3: The effect of giving symbiotic through feeding on egg quality

No	Parameter	Treatments		Standard Error (SE)	P-Value
		Symbiotic	Non-Symbiotic		
1	Shell thickness (mm)	0.32a	0.25b	0.917	0.000
2	Egg Yolk Index (EYI)	0.35	0.34	0.008	0.113
3	Haugh Unit (HU)	55.42	54.80	2.651	0.815
4	Egg Yolk Color (EYC)	6.20	5.80	0.405	0.335

Note: Different superscripts in the same line indicate a very significant difference (P<0.01)

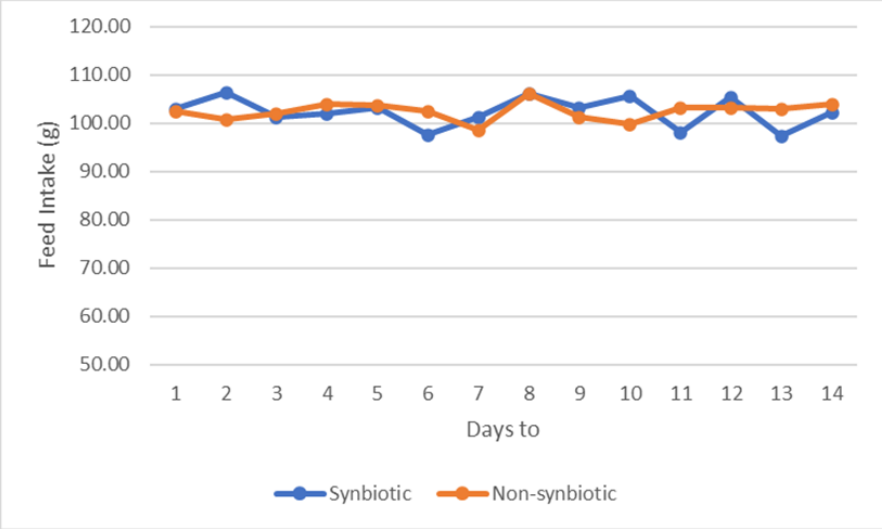

Figure 1: Daily feed consumption for laying hens during rearing

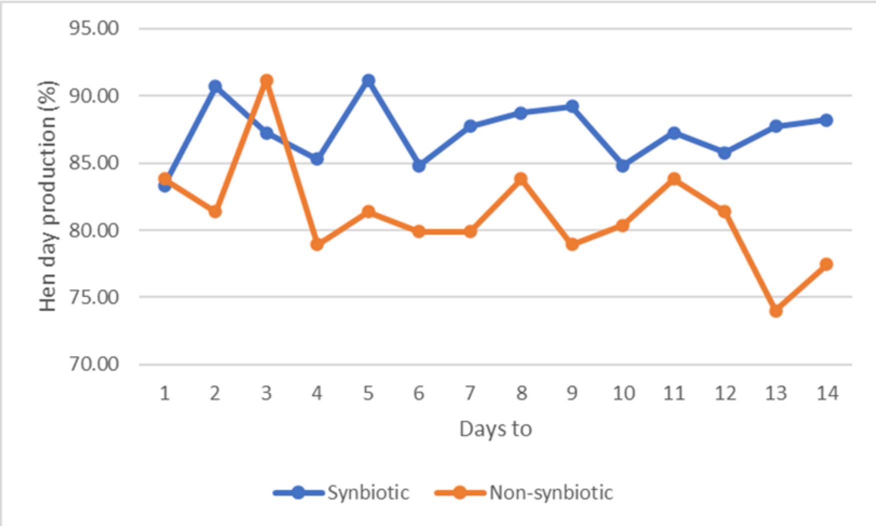

Figure 2: Daily Hen Day Production (HDP) during rearing

DISCUSSIONS

Production Performance of Laying Hens

Giving symbiotics through feeding in this study did not significantly affect feed intake compared to control. This is because the feed given in the maintenance process is limited to around 102g/day. The feed given is lower than the standard provided by ISA-Brown, namely at the age of 65 weeks the consumption of feed for laying hens is 115g/day (ISA-Brown, 2021). The same thing was also reported by Ghanima *et al.*, (2020) that at the age of 60-68 weeks the consumption of feed for laying hens (layers) reared in a battery cage system is 121.06 g/day. Because the feed given in this study was lower than the standard, the feed given was consumed all by laying hens. This is why feed intake in this study was not significantly different.

Giving symbiotics through feeding in this study can increase Hen Day Production (HDP) by 6.44%. This is because the symbiotics used in this study contain inulin and L. Fusiformis BIP-211 bacterial isolates. Inulin functions as a prebiotic to balance microorganisms in the digestive tract, increase immunity, fat metabolism and help absorb minerals (Birmani *et al.*, 2019). Furthermore, Jha *et al.*, (2020) explained that prebiotics can also increase mineral absorption and enhance the body's immune function. In addition, the symbiotic also contains L. Fusiformis BIP-211 bacterial isolates. These bacteria can increase nutrition, crude fiber, organic matter, and feed digestibility (Prihartini *et al.*, 2009). This can also be seen from the increased digestibility of dry matter and organic matter compared to the control (Table 2). On the other hand, egg production will occur if basic nutritional needs have been met. By increasing and absorbing feed nutrients and improving the health of laying hens given symbiotic, HDP was therefore higher in this treatment compared to the control. The results of this study are also in accordance with what was reported by (Alaqil *et al.*, 2020; Jha *et al.*, 2020) that probiotics and prebiotics can increase HDP. The HDP produced from laying hens given symbiotic through feeding was also higher than the HDP standardized by Isa-Brown, namely at the age of 65 weeks the HDP of laying hens is 81% (ISA-Brown, 2021), whereas in this study, the addition of symbiotic through feeding produces HDP up to 87.6%. This result is also higher than that reported by Ghanima *et al.*, (2020) that laying hens reared with a battery system at the age of 60-68 weeks is 71.99%. and that reported by Sharma *et al.*, (2020) that the HDP of laying hens aged 65 weeks is 65%.

Feed conversion ratio (FCR) of laying hens is the ratio between the total weight of the eggs produced and the total feed consumed. The heavier and higher the HDP of a laying hen, the lower the resulting FCR. In this study, the consumption of feed produced between laying hens that were given symbiotic by feeding was the same as laying hens that were not given symbiotic. Meanwhile, the HDP produced was higher in laying hens given symbiotic as described above. This is why the FCR in this study was lower in laying hens given symbiotic compared to laying hens without symbiotic. The FCR produced from laying hens with symbiotic is lower than the FCR standardized by Isa-Brown, which is 2.06 (ISA-Brown, 2021). The resulting FCR is also lower than that produced by Ghanima *et al.*, (2020) which is 2.85 in laying hens aged 60-68 weeks which are reared with a battery cage system. The lower the FCR value, the more efficient the laying hens is in converting feed into eggs.

Feed Digestibility

Feed digestibility is seen from the percentage of feed given to feed that is absorbed by the intestine. The results of this study showed that the digestibility of feed, both dry matter and organic matter, was higher in feed given symbiotics compared to feed without symbiotics (control). As explained above, the symbiotic used in this research contains L. Fusiformis BIP-211 bacterial isolates bacteria. This bacterial has the ability to increase the digestibility of dry matter and organic feed materials (Prihartini, *et al.*, 2009). The level of digestibility of dry matter and organic matter has a positive correlation with egg production and FCR. The higher the level of digestibility of dry matter and organic matter, the higher the egg production and also the lower the feed conversion (FCR) (El-Hack, *et al.*, 2019). This is related to the nutritional level of feed that can be utilized by the layer. These results are also in line with the increase in egg production and decrease in feed conversion (FCR) in this study (Table 1).

The Egg Quality

Giving symbiotics by feeding in this study resulted in thicker eggshells compared to the control (without giving symbiotic). Eggshells, one of which is formed by minerals contained in the feed. Therefore, the thickness of the shell is affected by the absorption of minerals in the intestine. Laying hens given symbiotic through feeding had higher eggshells because this symbiotic consisted of probiotics and prebiotics. As explained above by Jha *et al.*, (2020) that one of the functions of prebiotics is to increase the absorption of minerals contained in feed. The results of this study are also in accordance with those reported by Ismoyowati *et al.*, (2022); Mikulski *et al.*, (2020); and Ray *et al.*, (2022) that giving probiotics to laying hens can thicken the shells of the eggs they produce. Furthermore, administration of symbiotic by feeding did not affect the Egg Yolk Index (EYI), Haugh units (HU) and the resulting Egg Yolk Color (EYC). IKT and HU are influenced by the protein content in the feed. The feed used in this study was the same, so the protein content was the same. This is why EYI and HU in this study are no different. Like EYI and HU, the color of the yolk is also influenced by the feed. Feed composed of feed ingredients with high orange pigment, the resulting egg yolk will follow the orange color. In this study, the feed ingredients used were the same, so the egg yolks produced were no different.

CONCLUSION

Giving a symbiotic that contain inulin and lignolytic bacterium isolate of 0.1% of the feed given in this study can improve the production performance and feed digestibility of laying hens and also the thickness of the eggshells significantly affects egg quality (egg yolk index, Haugh Unit and egg yolk color).

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