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Evaluation and Analysis of the Effects of Feed Supplements, Including both Organic and Inorganic Selenium, on the Production of Layer Eggs

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ABSTRACT: This research aims to evaluate and analyze the provision of additional feed in the form of selenium (Se) on the performance of egg production produced by layers. This research took the main object in the form of 60 weeks old laying hens with the *Isa Brown strain*. The research was carried out using a Completely Randomized Design (CRD) method with Duncan's advanced test. The results of this study explain that providing additional feed in the form of selenium (Se) in several doses has a very real influence on egg production performance (egg weight, feed intake, mortality, daily egg production, and FCR). The best dose of selenium was shown in treatment three (commercial feed + organic selenium dose of 150 grams/ton of inorganic selenium feed + vitamin E dose of 1000 grams/ton of feed). The presence of selenium and vitamin E given as additional feed for laying hens can increase egg weight, egg production, minimize mortality rates, and increase appetite.

KEYWORDS: Egg weight, FCR, Feed intake, Mortality, Layer, Selenium

INTRODUCTION

The livestock sub-sector in Indonesia which has very good prospects for development is poultry farming. As time goes by, the development of poultry farming, especially layers in Indonesia very fast compared to other livestock. Layer chicken farming is generally commercial and there are many benefits to be gained from this business. The main aim of raising layer chickens is to increase egg production quickly, economically, and produce highly nutritious eggs to meet public demand. The layer farming business definitely has a big risk of being susceptible to disease. Some problems in the field that can become obstacles and have a negative impact are low egg productivity, poor production performance including decreased feed consumption, decreased body weight, feed efficiency and high mortality rates, high levels of stress which cause chickens not to lay eggs regularly, disease outbreaks, too many eggs. With damaged shells, and chickens have not reached the expected peak production at a certain age. This can cause losses to farmers. The success of a livestock business is influenced by several factors including feed, seeds, environment and management. Problems related to efforts to increase egg productivity and quality can be addressed by improving management and the quality of nutrients in the ration. Providing micronutrients as additional vitamins and minerals in feed also has an effect even though the amounts needed are only small.

Livestock growth and production will be disrupted if there is a lack of vitamins and minerals, because these substances are needed to help the process of forming or breaking down other nutrients in the body. Selenium is a micromineral needed by livestock. Poultry needs selenium in the body, so the selenium premix given is 0.2-0.3 kg/kg commercial feed. Selenium is a mineral that is important for protein synthesis and the activity of the enzyme glutathione peroxidase (GSH-PX). Selenium in glutathione peroxidase has a role as a catalyst in breaking down peroxide formed in the body into non-toxic bonds. Peroxide can turn into free radicals which can oxidize unsaturated fatty acids in cell membranes, thereby damaging cell membranes. Selenium collaborates with vitamin E and acts as an antioxidant. This collaboration occurs because vitamin E protects cell membranes from free radicals by releasing hydrogen ions, while selenium plays a role in breaking down peroxide into non-reactive bonds so that it does not damage the unsaturated fatty acids that are abundant in membranes, helps maintain membrane integrity and protects DNA from damage. (Brown and Arthur, 2010). Selenium in combination with vitamin E can improve *stress* and resistance to disease, as a result production and reproductive performance increases. The work of selenium is closely related to other antioxidants, especially vitamin E. Vitamin E prevents the formation of free peroxides while selenium works to reduce peroxides that have already been formed (Siswanto *et al*, 2013). According to (Lubis *et al*, 2015) they argue that vitamin E and the mineral selenium are not effective when given alone,

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because vitamin E and selenium have synergistic activities in the body. It is further known that vitamin E is very effective in breaking fat chains which can be dissolved by antioxidants in membranes, while selenium is essential as a cofactor of glutathione peroxidase. The mechanism of inhibiting lipid peroxidation by vitamin E begins when lipids lose one hydrogen and become radical products), which react with free oxygen to produce peroxyl radicals. With the peroxyl radical reaction, a chain reaction will then follow, this often occurs, for example in cell membranes, which can disrupt the structural integrity of the membrane.

Vitamin E can disrupt chain reactions by interacting with peroxyl lipids to form hydroperoxide radicals, thereby neutralizing free radicals (Shinde *et al*, 2007). The influence that Vitamin E and Selenium have on the chicken's body is to help transport amino acids and lipids in digestion, be involved in iron metabolism, steroidogenesis, and stimulate cellular and humoral immunity against infectious agents. Lack of Vitamin E and Selenium can cause a decrease in cell membrane function resulting in decreased cell immunity, hemolysis of blood cells, a decrease in oxygen binding, resulting in decreased egg production and embryo death in chickens (Brown and Arthur, 2010). This can affect the quality of egg albumin and affect egg weight. Based on the background description above, this research aims to evaluate and analyze the comparison of giving organic and inorganic selenium in additional feed on the performance of egg production.

MATERIALS AND METHODS

Research Materials

A. Laying Hens

The laying hens used were 60 weeks old with *the Isa Brown strain.* Initial maintenance starts from the pullet and is obtained from the Malang Pullet Cage.

B. Material

The materials used in the first stage of research were organic selenium with the trademark SELEN-OYE and inorganic selenium with the trademark Introvit E Selen-WS produced by PT. Mandiri Citra's Determination. Basal feed produced by PT. Malindo Feedmill. Tbk, code 7605 with the content on the feed label (min protein 16%, fiber max 7%, water max 7%, ash max 14%).

C. Tools

The equipment used in the first stage of research was a battery cage measuring 56 x 60 cm complete with feed and drink containers, 1 ml syringe, EDTA tube, writing instruments, surgical scissors, digital scales and hematology machine.

Research Methods

The research method used a Completely Randomized Design (CRD) with four treatments and six replications, as follows:

P0 : Commercial feed
P1 : Commercial feed + organic selenium dose of 150 grams/ton of feed
P2 : Commercial feed + inorganic selenium + vitamin E dose of 1000 grams/ton of feed
P3 : Commercial feed + organic selenium dose of 150 grams/ton of inorganic selenium feed + vitamin E dose of 1000 grams/ton of feed.

DATA ANALYST

In this study, the data obtained were analyzed using *analysis of variance* (ANOVA) with a test level of 5%. Data processing uses Microsoft Excel version 2021. If the treatment shows a significant effect ($P<0.05$) or very significant ($P<0.01$), then proceed with the Distance test *Duncan* Doubles.

RESULTS AND DISCUSSIONS

Combined Analysis of Organic and Inorganic Selenium Feeding on Production Performance of Laying Hens

This research aims to analyze the production performance of laying hens after being given the best treatment from phase one research, namely a combination of organic and inorganic selenium. Data from research on feed consumption levels, *hen day production* (HDP), egg weight, mortality and feed conversion (FCR) are presented in Table 1.

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Table 1. Effect of Treatment on Production Performance of Laying Hens

Variable	Control (-)	Selenium Administration Treatment		
	P0	P1	P2	P3
Feed Consumption (g/ tail)	108.08 ± 1.22^a	110.14 ± 1.09^b	112.31 ± 0.33^c	112.23 ± 0.81^c
HDP (%)	75.30 ± 2.61^a	86.00 ± 16.38^b	87.50 ± 5.15^b	91.66 ± 3.80^c
Egg Weight (g/head)	60.23 ± 0.56^a	62.56 ± 0.75^b	63.23 ± 1.87^b	64.78 ± 2.02^c
Feed Conversion	1.79 ± 0.06^a	1.55 ± 0.12^b	1.54 ± 0.08^b	1.47 ± 0.06^c

Effect of Treatment on Feed Consumption of Laying Hens

Based on the results of statistical analysis in Table 1. showed that the treatment made a significant difference (P<0.05) to the feed consumption of laying hens. This is thought to be because providing selenium increases the percentage of crude protein and energy in the feed. The average values of feed consumption for laying hens during the study from lowest to highest in sequence were P0/control (–) (108.08 ± 1.22), P1 (110 ± 1.09), P2 (112.31 ± 0.33), and P3 (112.23 ± 0.81). (grams/head/day).

Laying chickens that are nutritionally adequate will grow optimally with maximum egg production. The need for protein is one of them. Fulfilling good protein needs will have a good impact on chicken growth and productivity. The need for crude protein in feed according to SNI 01-3929-2006 standards is a minimum of 16%. Protein in laying hens affects the health of chickens, as previously known, protein is beneficial for growth, egg production and energy. Factors that can influence ration consumption and protein requirements in laying hens include size and breed, environmental temperature, production phase, housing system (battery or floor system), feeding space per bird, whether or not the beak is cut, chicken density, availability of drinking water, health and energy content in the ration.

The highest average feed consumption was obtained in treatment P3. This was due to the addition of high levels of vitamin E and selenium to the feed. Addition of vitamin E and selenium can reduce stress levels in artificially inseminated chickens. Factors that influence feed consumption are age, feed palatability, feed energy, production level, feed quantity, feed quality, crude fiber, feed density, crude fat, chicken breed, body weight, egg weight, feather cover, degree of stress and chicken activity .

The contents of organic selenium and vitamin E play a role in increasing poultry feed consumption. This is comparable to the statement (Lubis *et al*. 2015) which explains that adding organic selenium and vitamin E supplements with a combination of 0.2 ppm selenium and 50 ppm vitamin E can increase feed consumption for female ducks. The function of selenium and vitamin E is to increase the body's immune system and be able to suppress *heat stress*. This is influenced by the temperature inside the drum which is quite hot, 31º - 33ºC, so the addition of selenium and vitamin E can help during heat stress conditions which cause chickens to enter the culling phase and feed consumption will decrease and can result in a decrease in egg production. According to (Mashaly *et al*. 2004) explained that the negative impact of high temperatures in the environment for raising layer chickens (23.9º - 35ºC) can affect production performance, decreased feed consumption, and high mortality rates.

Effect of Treatment on *Hen Day Production* of Laying Hens

Based on the results of statistical analysis in Table 1. Showed that the treatment made a significant difference (P<0.05) to the HDP of laying hens. This is because selenium and vitamin E are anti-oxidants in the body, where vitamin E will maintain the mineral Selenium in the body so that the body does not have a Selenium deficiency and also prevents the occurrence of reactive auto-oxidation chains in lipid membranes so that there is a synergistic combination between Selenium and Vitamins E can act and protect tissue against oxidative damage where Selenium and vitamin E have been shown to increase the immune response (Shinde et. al., 2007)

The average HDP values of laying hens during the study from lowest to highest in sequence were P0/control (–) (75.30 ± 2.61), P1 (86.00 ± 6.38), P2 (87.50 ± 5.15), and P3 (91.66 ± 3.80) (%). *Hen Day Production* (HDP) is wrong one parameter of the success of a livestock business. P addition of vitamin E-selenium in feed had a very real influence (P>0.05). The highest mean HDP was obtained in treatment P3, namely 91.66 %. Factors that influence the amount of egg production include seeds, protein in feed, phosphorus, maturity level, medicine, livestock health, feed nutrition that suits livestock needs, environment and rearing patterns. Environmental factors include stress caused by artificial insemination activities. The addition of high levels of vitamin E and selenium in the P3 treatment can reduce the level of stress caused by artificial insemination inga has the highest average HDP. This

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is in line with research conducted by Lubis *et al* (2015) where adding vitamin E and organic selenium to the feed of gotu kola ducks can increase egg production.

The contents of organic selenium and vitamin E play a role in producing eggs and the eggs produced have high protein. This is comparable to the statement (Brand *et al*. 2003) which states that one of the factors that influences productivity is rations. The rations consumed contain energy and protein which play a role in egg production. This is caused by the large consumption of energy and protein rations to form eggs. In this research, it was explained that giving 0.2 ppm of selenium and 50 ppm of vitamin E could result in egg production of 1898.5 g/head. The addition of selenium shows an increase in egg production, egg weight, and other components of eggs (yellow shell and egg white).

Effect of Treatment on Egg Weight of Laying Hens

Based on the results of statistical analysis in Table 1. Showed that the treatment made a significant difference (P<0.05) to the egg weight of laying hens. This is thought to be because the nutritional content in feed that is added with selenium will increase the crude protein, mineral and calcium content so that it also plays a role in increasing the strength and weight of the shell. The nutritional content of feed that determines egg weight is food energy, feed protein content, minerals, especially calcium and phosphorus. Egg weight is influenced by the calcium, protein and energy content in the feed and the age of the chicken. Each breed of chicken has varying egg weights. This difference is related to egg components, such as egg white, egg yolk and egg shell (Sulistyaningrum *et al*. 2019).

The results of the research showed that the treatments had a very significant effect on egg weight in laying hens. The average egg weight values of laying hens during the study from lowest to highest in sequence were P0/control (–) (60.23 ± 0.56), P1 (62.56 ± 0.75), P2 (63.23 ± 1.87), and P3 (64.78 ± 2.02) gram/head. The Indonesian National Standard (1995) states that the criteria and weight of purebred chicken eggs for consumption eggs are oversized (more than 60 g), large (55-60 g), medium (51-55 g), small (46-50 g) and extra small (less than 45 g).

Providing rations at the level of 0.38; 0.46 and 0.53% indicate that an increase in egg weight occurred at a higher level of methionine fertilization. Chickens will produce eggs with increasing size and weight as the chicken ages because the size of the egg yolk increases.

This research is comparable to the statement (Brand *et al.* 2003) which states that one of the factors that influences productivity is rations. The rations consumed contain energy and protein which play a role in egg production. This is caused by the large consumption of energy and protein rations to form eggs. In this research, it was explained that giving 0.2 ppm of selenium and 50 ppm of vitamin E could result in egg production of 1898.5 g/head. The addition of selenium shows an increase in egg production, egg weight, and other components of eggs (yellow shell and egg white). Good quality feed, in this case the content of protein, amino acids and linoleic acid, will affect egg weight, because good quality feed will produce large eggs. Amino acid deficiency can resulting in a decrease in egg production and size.

Meanwhile, research conducted by (Dwiyanjono *et al*. 2023) explained that giving sodium selenite supplements to the rations of laying hens by giving 0.6 mg/kg feed was not able to increase albumen weight, egg yolk weight, or the ratio of egg yolk to albumen weight, however gave values that were more or less the same as the control treatment. According to Ambarwati and Saidah (2017), as chickens get older, the size and weight of their eggs increases due to the growth of the egg yolk. Selenium works by protecting the magnum cellular membrane so that the glandular duct cell secretions function more effectively which results in more protein being secreted into the magnum lumen and producing more egg white (Said and Sulmiyati. 2020). This can affect the quality of egg albumin and affect egg weight.

Effect of Treatment on Feed Conversion (FCR) of Laying Hens

Based on the results of statistical analysis in Table 1. Showed that the treatment made a significant difference (P<0.05) to the feed conversion of laying hens. This is thought to be because the conversion rate is influenced by the egg production produced and the significantly different results are caused by the amount of feed consumed and how many eggs are produced, because these two things influence the conversion value. Ration conversion is a measure of efficiency in the use of rations.

The results of the study showed that the selenium treatment had a very significant effect on the FCR of laying hens. The average FCR values of laying hens during the study from lowest to highest were sequentially P0/control (1.79 ± 0.06), P1 (1.55 ± 0.12), P2 (1.54 ± 0.08), and P3 (1.47 ± 0.06). The addition of vitamin E-selenium in feed has a very significant effect (P > 0.05) on

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the Feed Conversion Ratio (FCR). The smallest average FCR is found at P3 , namely 1.47 . This is closely related to HDP where the largest HDP was obtained in the P3 treatment. Feed becomes uneconomical if the conversion value is more than two. The feed conversion rate is one of the selection criteria for improving the genetic quality of chickens. Factors that influence feed conversion are the physical form of feed, chicken body weight, rearing environment, stress, gender. FCR can be used to describe the size of feed efficiency in a livestock business.

The lower the ration conversion value, the more efficient the use of the ration, because the smaller the amount of ration needed to produce eggs in a certain period of time. The FCR value can also be used as a basis for calculating the *Break Event Point* (BEP) value of egg prices, thus the FCR value can be used as a basis for estimating profits (Haryuni *et al*., 2017). Another research conducted by Suyasa and Parwati (2018) stated that giving fermented cocoa waste as a substitute for bran was able to reduce FCR so that it could have an effect on input. Providing feed in wet form can reduce wasted feed. Feed is given according to the chicken's needs for maximum productivity without reducing the amount of feed consumed.

CONCLUSIONS

Adding selenium to diet yields similar blood profile discoveries within the normal range. Besides that, giving organic selenium both single and mixed gives the best results compared to organic. Giving a mixture of inorganic selenium at a dose of 2500 grams/ton of feed and organic at a dose of 375 grams/ton of feed gave the best results on the blood profile including erythrocytes, leukocytes, hemoglobin and hematocrit as well as production performance including feed consumption, *hen day production*, feed conversion and egg weight.

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