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Comparison with and without P12 Nutraceutical Supplementation in Feed on Egg Productivity and Quality of Laying Hens

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ABSTRACT. The egg production and quality are crucial indicators in the layer chicken industry. Optimal productivity in layer chicken farming requires the use of nutraceutical-based feed comprising probiotics, herbs, amino acids, and vitamin A. This study aims to assess the effects of nutraceutical feed on two primary parameters: productivity and egg quality. The study was carried out over four weeks at the Peternakan Rakyat Tepus in Mojogedang, Karanganyar with a chicken population of 1.206. This study was a designed in a Completely Randomized Design (CRD) with two treatments: feed without supplementation (T0) and feed with supplement contains probiotics, herbs, amino acids, and vitamin. The study findings indicated that adding the nutraceuticals PR12 at 4 kg/ton in the feed did not exhibit a significant difference (P>0.05) in daily feed consumption. However, feed conversion ratio (FCR), hen day production (HDP), egg weight, egg mass, yolk index, and Haugh unit were significantly different (P<0.05). The incorporation of nutraceuticals (PR12) into the feed can enhance HDP, egg weight, and egg mass, and improve FCR. In conclusion, adding PR12 nutraceuticals, composting of probiotics, herbs, amino acids, and vitamin A at a dosage of 4 kg/ton in the feed can enhance the productivity of laying hens by 16.39%, resulting in eggs classified within the AA quality category.

Keywords: egg quality, herbs, laying hens, probiotics, productivity

INTRODUCTION

The laying chicken industry has become a crucial sector in guaranteeing food availability for human needs. A report by the Central Bureau of Statistics Indonesia (BPS) in January 2024 indicated that the average egg intake per capita per week was 38,631 eggs (Badan Pusat Statistik Indonesia, 2024). This highlights the importance of eggs as primary source of animal protein. The productivity of laying hens is the crucial determinant in satisfying the ever-growing market demand for eggs. Egg quality influences customer acceptance and its economic value. However, in meeting the ever-increasing demand for eggs, small-scale layer farmers continue to face various challenges. One of these is a decrease in egg production during extreme weather and low feed efficiency (Syahila et al., 2025).

The decline in egg production can be affected by a farmer's limited understanding of the nutritional needs of the egg-laying chicken (Hajariah et al., 2025). The farmer has not understood the nutritional value of the feed and has not understood the array of rations according to the nutritional needs of the egg-laying chickens. The challenges of the chicken industry are compounded by fluctuations in the price of feed and a breakdown in the supply chain. The cost of commercial feed yields 60-70% of the total cost of production of animal layer farms in Indonesia (Rehan et al., 2025). As a result, this economic pressure causes low egg production and reduced farmer income. This issue is important because it can affect egg production, given the ever-increasing demand for chicken eggs.

The quality and quantity of the feed affect the productivity of egg-laying chickens (Gautron et al., 2022). Feed quality can be enhanced by adding nutraceuticals to the ration. The addition of nutraceuticals to natural feed not only enhances basic nutrition but also improves feed efficiency and the quality of the final product(El-Sabrout et al., 2023) . These complexes contain amino acids, minerals, vitamins, fatty acids, enzymes, prebiotics, probiotics, symbiotic, pigments, medicinal plants, organic acids, antioxidants, flavouring agents, plant extracts, and additional components. The importance of nutraceuticals is to prevent various diseases, exhibit immunomodulatory effects, confer health advantages, and increase productivity (Helal et al., 2019).

Feed supplementation with various additions, such as probiotics, herbs, amino acids, and vitamin A, has great potential to improve the performance of laying hens and egg quality. Nutraceuticals commonly serve as probiotics. Recent studies indicate that probiotics enhance productivity and egg quality (Afikasari et al., 2020; Mas'ad et al., 2020; Mikulski et al., 2020; Tresnitskiy et al., 2023). The use of *Bifidobacterium spp.* and *Lactobacillus sp.*

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Probiotics in the feed improved egg productivity and daily feed intake, and decreased the feed conversion ratio (Lokapirnasari et al., 2019). The addition of *Bacillus coagulans* and *Bacillus subtilis* can be an effective strategy to increase feed consumption and reduce feed conversion (Jannah et al., 2022; Wardiana et al., 2021). Another probiotic, such as the *Saccharomyces cerevisiae*, increased the immune system and overall health of laying hens (Alaqil et al., 2020).

Nutraceuticals also provide herbs. A study reported by Suryani et al. (2023) showed that incorporating herbs such as turmeric and ginger into chicken feed improved the performance of laying hens, egg weight, and feed conversion. Dilawar et al. (2021) reported that supplying Mentha arvensis and Geranium thunbergia extracts into the drinking water of laying hens effectively enhanced hen productivity, egg quality, immunity, and decreased cholesterol levels in the egg yolks. Supplementing livestock with a mixture of turmeric powder and sambiloto can improve egg production and feed conversion (Suwarta et al., 2021). The use of herbal ingredients in livestock can boost immunity, promote growth, and supress the growth of harmful bacteria. The efficacy of herbs in enhancing birds' health and their performances in egg production and quality is attributed to the active chemical composites within the herbs (Liu et al., 2023). According to Gan et al. (2020), the herbs can aid in maintaining the balance of intestinal microbiota.

It is essential to enrich laying hen feed with lysine, methionine, and vitamin A to achieve a good performance of laying hens and ensure the superior, stable, and sustainable egg quality. These nutrients are mostly found in nutraceuticals. Amino acids and vitamin A are widely known to maintain the performance of laying hens and their egg quality (Alagawany et al., 2021) . The inclusion of these vitamins can serve as advantageous antioxidants in bolstering the immunity of laying hens against illnesses. The administration of nutraceuticals with a high amino acid content as a feed additive can have a sexual stimulant effect and produce high-quality livestock products (El-Sabrout et al., 2023).

The sole impacts of nutraceutical supplementation, including probiotics, herbs, amino acids, and vitamin A, have been thoroughly investigated by previous research. However, the synergistic effects of combining the nutraceuticals on egg production and quality when administered in the feed was unexplored. Research is needed to prove the real impact of administering nutraceuticals as nutritional supplements in feed for laying hens. The addition of this additive is expected to support the quality and quantity of eggs in order to increase farmer productivity. The purpose of this research was to assess the influences of administering a nutraceutical supplement in laying hen feed on egg production and quality.

MATERIALS AND METHODS

Research Design

This research was carried out at Peternakan Rakyat Tepus, Mojogedang, Karanganyar, Central Java from June to July 2024. This study used 1.204 Hyline Brown laying hens, allocated into two treatments. The data were analyzed by a Completely Randomized Design (CRD) within the experimental study methodology. The trial consisted of two treatments and seven replications. Replication was an experimental unit containing 86 birds/unit. T0= base feed without adding PR12 nutraceuticals and T1= base feed with adding PR12 nutraceuticals at a dosage of 4 kg/ton. Nutraceuticals PR12 composted of multi strain probiotics, herbs, amino acids, and vitamin A. Each treatment has 86 laying hens aged 49.1 to 52.9 weeks, with an average weight of 2.1 to 2.3 kg.

The basal feed utilized in this study was commercial feed for laying hens during the production phase with the market code 324KJ produced PT Charoen Pokphand Indonesia, containing maximum moisture content 13%, crude protein 17%, crude fat 3%, maximum crude fiber 7%, maximum ash 14%, calcium 3.25-4.24%, and minimum total phosphorus 0.45% (BSN, 2008). Table 1 present the composition of the PR12 Nutraceutical supplement.

Parameters

Egg Production

The parameters of egg production observed in this study include daily feed consumption, hen-day, egg weight, egg mass, and feed conversion ratio (FCR) which measured as follows.

a. Daily Feed Consumption

This parameter is determined through the calculation of the difference between the amount of feed (g) given and the leftover feed (g) in one day, then divided by the number of chickens (heads) (Sulaiman et al., 2019).

$$\text{Daily feed consumption} = \frac{\text{(the feed provided-leftover feed)}}{\text{number of chicken}}$$

b. Hen day production (HDP)

HDP denotes the total number of eggs produced by hens in one day. Hen-day production (HDP) is calculated by dividing the daily egg yield (units) by the total number of chickens (individuals).

$$\text{HDP} = \frac{\text{Egg production}}{\text{number of chicken}} \times 100\%$$

c. Egg weight (EW)

The egg weight refers to the mean weight of an egg within a single cage (g).

d. Egg mass (EM)

Egg mass is the product of the percentage of egg production and the average egg weight.

$$\text{Egg mass (g/chickens)} = \text{HDP\%} \times \text{Egg weight (g)}$$

e. Feed conversion ratio (FCR)

FCR is the ratio of the amount of feed consumed by to the chickens to egg production over the same period and unit.

$$\text{HDP} = \frac{\text{The amount of feed consumed for egg production}}{\text{Egg mass}}$$

Egg Quality

The parameters of egg quality observed in this study included yolk index and haugh unit.

a. Yolk Index (YI)

Yolk index was obtained by comparing the yolk height by the yolk diameter.

$$\text{YI} = \frac{\text{yolk height}}{\text{yolk diameter}}$$

b. Haugh Unit (HU)

HU is a measurement of albumen height with egg weight. The calculation of HU refers to the Raymond Haugh formula (Khaleel, 2019) .

$$\text{HU} = 100 \log (\text{H} + 7.57 - 1.7\text{W}^{0.37})$$

HU : Haugh unit
H : High albumen (mm)
W : Egg weight (g)

Data Analysis

The data obtained were analysed using analysis of variance (ANOVA) based on a completely randomized design and followed by Duncan's multiple range test to see the differences.

Table 1. PR12 supplement composition (in 1 Kg)

Components	Content	Components	Content
Bacteria		Vitamin D3	12000 iu
Lactobacillus bulgaricus	$\geq 1\times10^8$ CFU/gr	Vitamin E	82 iu
Bifidobacterium bifidum	$\geq 1\times10^8$ CFU/gr	Vitamin B12	103 mg
Bifidobacterium longum	$\geq 1\times10^8$ CFU/gr	Minerals	
Saccharomyces cerevisiae	$\geq 1\times10^8$ CFU/gr	Ca	32%
Herbs		P	2.70%
Curcuma xanthorriza	3.75 gr	Mg	3383 ppm
Curcuma domestica	3.75 gr	Mn	828 ppm
Amino Acid		K	12 ppm
Lisin	10000 ppm	I	50 ppm
Metionin	10000 ppm	Cu	119 ppm
Vitamins		Fe	340 ppm
Vitamin A	62000 iu	Zn	850 ppm

RESULTS AND DISCUSSION

Egg Production

The egg production performances of laying hens fed the feeds with and without adding the PR12 nutraceuticals are presented in Table 2. The productivity of laying hens could be signaled by the daily egg production percentage and egg weight (Ilham et al., 2022). Adding the PR12 nutraceuticals to the feed significantly ($P<0.05$) increased egg production (HDP) and egg weight of laying hens. The increased egg productions were not assumed to be high due to the increased feed intake. The result of the t-test did not indicate a significant difference ($P>0.05$) in feed intake between T0 and T1. The PR12 supplement was composted of the probiotics. According to Lokapirnasari et al. (2019) and Lipiński et al. (2021), probiotics contain *Lactobacillus sp.*, *Bifidobacterium spp.*, and *S. cerevisiae* that can enhance daily feed intake. Giving probiotics to chickens can increase their appetite because it helps improve nutrient absorption in their feed. In line with Huda et al. (2019) research, increased nutrient availability in the digestive tract will promote more efficient consumption because livestock nutrients are adequately supplied. In the present study, statistically, there was no significant difference in daily feed intake. However, the chickens fed the feed containing the PR12 supplement tended to consume more feed than those fed the feed without this supplement. The insignificant difference between feed consumption with or without

probiotics may be due to the probiotics used not yet functioning optimally (Widiawati et al., 2018). Feed consumption can be influenced by factors other than the addition of probiotics, such as chicken breed, environmental temperature, and housing system (Purnamasari et al., 2024). Therefore, feed consumption that does not differ significantly may be due to factors other than the addition of probiotics.

Table 2. Egg production performances of the hens fed the rations without and with PR12 supplementation

Egg production performance	Treatment		Percentage Increase (%)
	T0	T1	
Feed consumption (gr/head/day)	120.90 ±0.00	121.90 ± 0.01	0.83
Hen day production (%)	72.79 ±2.53 [a]	84.72 ± 3.68 [b]	16.39
Egg weight (g/egg)	44.10 ±1.65 [a]	52.23 ± 2.33 [b]	18.44
Egg mass (g/head)	32.12 ±2.21 [a]	44.25 ± 2.57 [b]	37.76
Feed conversion (FCR)	2.74 ±0.03 [b]	2.32 ± 0.01 [a]	15.43

Notes: [a,b] Different superscript in the same row is significantly different ($p<0.05$), T0= base feed without adding PR12 nutraceuticals and T1= base feed with adding PR12 nutraceuticals at a dosage of 4 kg/ton.

Increasing egg productivity in the laying hens under the PR12 supplement treatment was highly expected due to the increased feed quality and chicken health, rather than the increased daily feed intake. The probiotics in the PR12 nutraceuticals were considered to play a pivotal role in feed digestibility. According to Saputro et al. (2013), the administration of probiotic-based feed augmented the composition of the digestive environment, thereby optimizing nutrient absorption and the digestive processes. The nutrients support egg formation and subsequently increase the HDP. The PR12 nutraceuticals are also made from several herbs. Hanif et al. (2024) demonstrated that the supplementation of chicken feed with herbs positively influences egg production and egg weight. Stats show that adding PR12, which has curcumin, to feed makes a real difference in chicken egg production. Curcumin is a secondary metabolite compound in herbal plants that can stimulate the gallbladder wall to work optimally, thereby increasing egg production in laying hens (Nawab et al., 2019). Supplementing turmeric at a level of 4% and probiotics at 2% in feed can increase egg production in local chickens (Suryani et al., 2023).

The increase in egg production was considerably less associated with feed intake, but highly nutrients absorbed were more likely to explain the tendency of egg productivity. A significant increase in HDP and egg weight resulted in a significant increase in egg mass. The results of the t-test showed that the hens under the treatment of PR12 supplementation produced egg mass significantly higher ($P<0.05$) than the others. The increase in egg mass in the study occurred due to an increase in HDP and egg weight. Mathematically, egg mass is the product of HDP and egg weight, so its value will be directly proportional (Edi et al., 2018). Several factors that affect egg mass are feed additives, consumption, feed calcium content, egg size, and egg weight (Świątkiewicz et al., 2018).

In the regular feed intake, the hens fed on the feed containing the PR12 nutraceuticals were capable of reaching higher egg mass than those fed with no supplementation of PR12. It meant the hens fed on the PR12-based feed utilized feed efficiently to produce egg mass, thus resulting in better FCR. The result of the t-test showed that the hens fed on the feed with the PR12 supplement had significantly better ($P<0.05$) FCR than those fed on the feed without the PR12 supplement. The lower the FCR value, the better the quality of the feed provided (Sipayung et al., 2024).

The study conducted by Sutarto and Tutik (2020) reported that including herbs, such as turmeric and ginger extracts in the feed, improved FCR in laying hens. The bioactive compounds, particularly essential oils and curcumin, may contribute to the improvement of gastrointestinal function. These chemicals act as antibacterial agents that can impede the proliferation of harmful bacteria in the gastrointestinal system (Mustika et al., 2022). With a low population of bacterial pathogens in the gut, the nutrients will be absorbed optimally for egg formation. Several factors influence FCR values, such as feed physical form, chicken weight, rearing environment, and gender (Purnamasari et al., 2022). Feed content and nutrients can influence feed conversion values in terms of energy and protein balance. Differences in FCR values due to feeding with different feed content and nutrients can be used as a basis for assessing feed quality.

Nutraceuticals play an important role in poultry feed in terms of their benefits for poultry nutrition and health. Nutraceuticals provide disease

prevention and optimize poultry production performance. The components contained in nutraceuticals, such as amino acids, vitamins, minerals, and enzymes, are essential for regulating the immune system of poultry and maintaining physiological balance (Alagawany et al., 2021). By providing balanced nutrition, nutraceuticals help support optimal growth in poultry and reduce dependence on antibiotics. The addition of nutraceuticals to feed is widely chosen because the use of antibiotics as growth promoters in poultry has been restricted in many countries (Rafiq et al., 2022).

Nutraceuticals are an effective solution for improving poultry growth and health without posing risks (Filazi and Yurdakok-Dikmen, 2019). In addition, nutraceuticals play a crucial role in protecting animals from infectious diseases. In this study, in addition to the health benefits obtained in laying hens, it can also increase the productivity value of the eggs produced. In terms of productivity, the quantity of eggs produced increased with the addition of PR12 nutraceuticals. Thus, PR12 nutraceuticals have been proven to be effective in supporting the overall productivity performance of laying hens.

Egg Quality

Egg quality can be evaluated through several important interrelated parameters, namely egg yolk index, albumin quality, and Haugh unit (Lestari, 2024). These three parameters are key indicators that reflect the freshness and nutritional value of eggs. The egg yolk index is one of the important parameters used to assess the internal quality of eggs. The egg yolk index measures the ratio between the height and diameter of the egg. The higher the egg index value, the better the quality of the egg yolk produced. Egg yolks with a high index reflect the good health of laying hens and high-quality feed. The t-test results show that the egg yolk index (EYI) of laying hens under the PR12 nutraceutical is higher than those fed without the supplement.

Table 3. Quality of eggs laid by the chickens fed the rations without and with PR12 supplementation

Egg production performance	Treatment		Percentage Increase (%)
	T0	T1	
Yolk height (mm)	1.348 ±0.217 [a]	1.464 ± 0.264 [a]	8.6053
Yolk diameter (mm)	2.5320 ±0.0113 [a]	3.878 ± 0.247 [b]	9.7961
Yolk index	0.27 ±0.01 [a]	0.39 ± 0.01 [b]	45.31
Haugh unit (HU)	55.26 ± 0.03 [a]	78.04 ±0.02 [b]	41.23

Notes: [a,b] Different superscript in the same row is significantly different ($p<0.05$), T0= base feed without adding PR12 nutraceuticals and T1= base feed with adding PR12 nutraceuticals at a dosage of 4 kg/ton.

According to the National Standardization Agency of Indonesia, egg quality is classified into three primary categories, I, II, and III (BSN, 2008). The distinction is determined by the egg yolk index (EYI) values, which vary from 0.458 to 0.521 for quality I, 0.394 to 0.457 for quality II, and 0.33 to 0.393 for quality III. Based on the results of the study, treatment T1 falls into quality class II, while treatment T0 does not meet the Indonesian National Standard (SNI) for chicken egg quality. The improvement in egg yolk quality is due to the administration of nutraceuticals containing probiotics. Probiotics are considered capable of maximizing nutrient absorption, thereby improving the digestive system of laying hens (Mubarrok et al., 2025). The probiotic bacteria content in nutraceuticals can increase lactic acid production, which reduces harmful bacteria in the digestive tract (Filazi and Yurdakok-Dikmen, 2019). The reduction in these bacteria results in a higher egg yolk index than without the addition of PR12 nutraceuticals.

The correlation between HU value and egg quality is straightforward, thus, an increase in HU value corresponds to an enhancement in egg quality. The HU value ranges from 0 to 130 and is categorized into four classes: AA (≥72), A (71-60), B (59-31), and C (≤30) (Haugh, 1937). According to these standards, the results in Table 3 classify T1 eggs as quality AA, while T0 eggs are categorized as class B. Including the PR12 supplements in the feed enhances egg quality. In this study, the addition of PR12 supplements to the feed improved egg quality. PR12 supplements contain bio probiotics that can help with nutrient absorption, which can increase HU values.

The addition of probiotics derived from bacteria such as *S. cerevisiae* can improve egg quality, ovarian growth, and immune function in laying hens across several laying seasons (Xu et al., 2023). Probiotic supplementation substantially improves egg quality, eggshell integrity, and uterine development and modulates the expression of mineralization genes and ion concentrations in serum and eggshells because probiotics enrich the

uterine and caecal microbiota in laying hens (Lu et al., 2025).

CONCLUSION

The result of this study conducted that adding nutraceuticals of PR12 supplement in the ration enhanced egg production performances and egg quality of laying hens indicated by the increased egg production, egg mass, and egg quality. The PR12 supplement could improve feed conversion of laying hens.

CONFLICT OF INTEREST

The writers of this paper affirm that there are no conflicts of interest with the research undertaken and the article prepared.

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