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The effect of feeding a mixture of shellfish meal and fish oil on egg production and egg storability of Lohmann Brown laying hens

I Dewa Gede Agung Angga Diningrat [1], I Putu Ari Astawa [1,*], Ni Wayan Siti [1], I Made Suasta [1] and I Gusti Nyoman Gde Bidura [1]

[1] *Master's Program, Faculty of Animal Husbandry, Udayana University, Denpasar, Indonesia.*
[2] *Faculty of Animal Husbandry, Udayana University, Denpasar, Indonesia.*

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Abstract

The aim of the research was to determine the effect of feeding a mixture of shellfish (SF) and fish oil (FO) on egg production performance and storability of Lohmann Brown hen eggs. The study used a completely randomized design consisting of 4 treatments and 4 replications, and each replication consisted of 40 Lohman Brown hens with the same laying age (45 weeks of age). The four treatments were mixed levels of shellfish flour with fish oil in feed, namely 0%, 1%, 2%, and 3%, as treatments P0, P1, P2, and P3. Egg samples were taken at the end of the study, then stored and observed for 4 weeks. The results showed that egg pH and haugh units (HU) in the P2 and P3 hen groups significantly ($P<0.05$) increased. Meanwhile, egg shell weight and egg yolk color did not show significant differences ($P>005$). Feeding SFFO to P2 and P3 hen groups increased ($P<0.05$) egg weight, hen-day-production and feed efficiency (feed consumption/egg weight). It can be concluded that SFFO can be used as an ingredient in laying hens with an inclusion level of 20-30g/kg and can be used in chicken feed during the finishing phase. SFFO may affect the storability of Lohmann Brown hen eggs.

Keywords: Fish oil; Hen-day-production; Shellfish; Storability

1. Introduction

Eggs are a producer of animal protein that is popular with the public, because they have high nutritional content and are relatively cheap when compared to other sources of animal protein. The laying hen industry is experiencing rapid development due to the large demand for eggs from the public. Various groups consume eggs from the lower class, middle class, to the upper class, which causes the population of laying hens to increase every year [1]. Maximizing egg production in laying hens is by meeting their energy needs, as well as other nutritional elements such as protein, minerals and vitamins [2].

The egg shell is the outer layer of the egg that protects the egg from deterioration in quality, whether caused by microbial contamination, physical damage or evaporation [3]. To prevent a decrease in the shelf life of eggs, this can be done by adding a mixture of calcium and fish oil to the ration. According to [2], to maximize egg production in laying hens is to meet their energy needs and other nutritional elements such as protein, minerals and vitamins.

Shellfish flour contains the element $CaC0_3$ of 99.4% and pure calcium reaching 39.5% [4]. Providing 2-3% shellfish meal as a source of calcium can increase egg weight, but has no effect on daily egg production in 95 week old Isa Brown laying hens [5]. Supartini [4] reported that providing 2-3% shellfish meal in feed was able to improve egg quality, namely the egg yolk index and eggshell weight. Shellfish meal contains 30-40% calcium, 1% phosphorus and 3-4% protein [6]. Shellfish meal is also often used as an ingredient in livestock rations, because it has a very high calcium and phosphorus

*Corresponding author: I Putu Ari Astawa

content, so it can help livestock growth. Shellfish meal is the same as bone meal, which also has great potential in the growth and production process. Calcium is needed for the process of forming egg shells. Laying hens aged 20 weeks until the culling phase require 3.25-4.25% calcium [7]. If there is a lack of calcium in feed intake, the egg shells formed will be thin and can cause paralysis in chickens.

Fish oil contains around 25% saturated fatty acids and 75% unsaturated fatty acids [8]. Some of the ingredients contained in fish oil are omega-3, omega-6, squalene, vitamin A, vitamin D, vitamin E and vitamin K [9]. The purpose of providing fish oil is as an energy source in preparing rations and also to obtain livestock products that are high in omega-3 fatty acids [10]. The use of 3% fish oil in feed and 6% fish oil in broiler chickens in feed does not have a negative impact on its use, so it can be used as an energy source in feed [11]. The balance between Mineral Ca and P in feed has a very significant effect on egg shell thickness [12]. Meanwhile, the inclusion of animal and vegetable oils in feed will have an impact on yolk quality [13].

The aim of the research was to determine the effect of feeding a mixture of shellfish and fish oil on egg production performance and storability of Lohmann Brown chicken eggs.

2. Material and methods

2.1. Animal treatments

This research used 45 week old Lohman Brown hens, a total of 160 hens produced by Tubagus Oky Farm, Bali, Indonesia. This research took place for 8 weeks in a commercial laying hen cage located on Jl. Nagasari, Banjar Pohmanis, Penatih Dangin Puri Village, East Denpasar, Denpasar City, Bali, Indonesia. All laying hens were kept in 160 cages with a permanent battery system made of wire. Each plot measures 35cm long, 30cm wide, front height 37cm, and back height 30cm. All cage plots were located in a cage building with controlled ventilation. Each row of the cage was equipped with a feeder made of paralon pipe and an automatic drinking water dispenser (nipple). The feed provided was special commercial feed for laying hens produced by PT. Japfa Comfeed Indonesia, Tbk., Indonesia.

The shellfish meal (SF) used in this research was local shellfish meal that was sold commercially and was obtained from the local Poultry Shop. The fish oil (FO) used as a mixture of SFFO is a commercial Scott's emulsion fish oil product which can be purchased at pharmacies and other drug stores, around Denpasar, Bali, Indonesia.

2.2. Experimental design

The study used a completely randomized design, with 4 treatments and 4 replications and each replication used 40 laying hens aged 45 weeks of the Lohman Brown strain, totaling 160 hens. Research eggs were taken at the end of the research, then stored and observed every week for 4 weeks. The treatments given in this study were commercial feed without the addition of SFFO as control (P0), commercial feed with the addition of 1% SF+0.2% FO (P1); commercial feed with the addition of 2% SF+0.2% FO (P2); and commercial feed with the addition of 3% SF+0.2% FO (P3).

2.3. Research tools

The tools and materials used in this research were egg trays, 0.001g sensitivity digital scales, pH meter, plastic, glass table, vernier caliper, Roche yolk color fan, glass mat, and ruler.

2.4. Observed variables

Feed consumption was measured by calculating the amount of feed given each day and then subtracting the remaining feed. Hen day production: compares the egg production obtained with the number of living chickens. Feed conversion was a comparison between the amount of feed consumed (kg) and the weight of eggs (kg). Kartasudjana and Suprijatna [14] state that feed conversion is the amount of feed used to produce each kilogram of egg production. Egg yolk color was measured using the Roche Yolk Color Fan egg yolk standard with a range between 1-15. The color of the egg yolk was adjusted to a standard color that is close to the standard. To obtain the Haugh unit (HU), the egg was first weighed to determine its weight, then broken and placed in a glass. Egg white height (mm) was measured with a caliper. The white part of the egg measured was 1 cm from the edge of the yolk [15]. Haugh Unit was calculated using the formula: HU =100 Log (H+7.57-1.7 W 0.37); H= high viscosity of egg white; and W= egg weight. Egg pH can be obtained by mixing egg white and egg yolk until homogeneous and measured using pH paper or a digital pH meter.

2.5. Statistic analysis

The data obtained were analyzed using a one-way variance test, if there were significant differences between treatments (P<0.05), then continued with Duncan's multiple range test [16].

3. Results and discussion

3.1. Production performance

The results of the research on feed consumption, hen day production, feed conversion (feed consumption/egg weight), total egg weight, and average egg weight in Lohman brown laying hens given SFFO in conventional rations can be seen in Table 1.

Table 1 Egg production performance of Lohman Brown laying hens given SFFO in feed

Variable	SFFO level in feed (%)				SE
	0	1.2	2.2	3.2	
Feed consumption, g/head/day	118.5^{a}	117.5^{a}	116.5^{a}	117.50^{a}	1.25
Hen day production, %	85.43^{a}	88.61^{ab}	90.29^{c}	89.06^{bc}	0.64
Feed conversio	2.12^{c}	2.02^{bc}	1.83^{a}	1.97^{b}	0.06
Total egg weight, g	223.48^{a}	231.67^{ab}	246.65^{bc}	237.92^{c}	1.01
Average egg weight, g	55.87^{a}	57.91^{ab}	61.66^{bc}	59.48^{c}	1.01

Values with different letters on the same row are significantly different (P<0.05).

Feeding SFFO at a level of 1-3.2% did not cause a significant difference (P>0.05) in feed consumption. This lack of difference is due to the fact that the metabolizable energy content in fish oil is quite high, reaching 3,691 kcal/g [10], so that the greater the amount of fish oil provided, the more energy supply can be met. Suprijatna et al. [17] explained that the amount of feed consumed by livestock also depends on the quality of the feed ingredients used to prepare the ration, the compatibility of the feed composition, its nutritional value in accordance with the needs for optimal growth and production, and maintained in the same conditions. According to [10], the addition of fish oil can cause the palatability of the ration to decrease, resulting in decreased feed consumption. Apart from that, other factors that influence daily feed consumption are the calorie content of the ration, environmental temperature, body weight, egg weight, and chicken activity [18].

In Table 2, hen day production in the P2 and P3 hen groups is significantly (P<0.05) higher than the control hen group (P0).According to [19], rations containing omega-3 produce good production performance in laying hens. This omega-3 content can be found in fish oil [9]. Providing good feed will of course affect egg production, feed consumption, and also the conversion rate of the feed given. So, with the right balance between energy and protein, the production performance of chickens will be optimal [20].

Feeding SFFO as much as 0.2% in the ration was able to increase (P<0.05) feed efficiency. This increase was due to differences in energy and protein levels in the rations. The lower the energy and protein given, the higher the feed consumption, because laying hens will continue to consume until their energy is met. Feed efficiency is interrelated with feed consumption and egg weight.However, high feed consumption is not always accompanied by high feed efficiency. Feed efficiency is the ability of feed consumed in a certain unit of time to produce egg weight in the same time [21]. The smaller the feed conversion value, the better the feed efficiency, while the greater the feed conversion value, the smaller the feed efficiency. Feed conversion can be used as an illustration of production efficiency. A small feed conversion rate means that the amount of feed used to produce one kilogram of eggs is less [14].

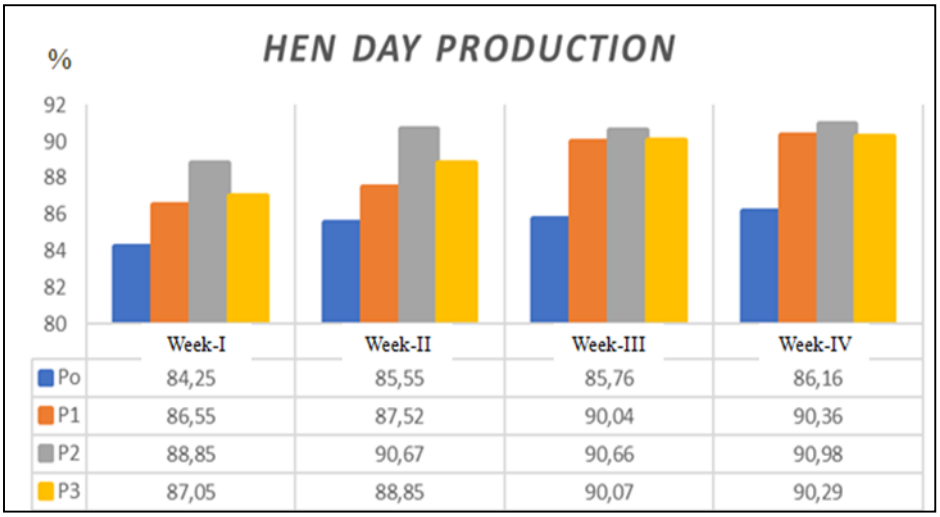

Figure 1 Hen day production of Lohman Brown chickens for 4 weeks given SFFO feed

The average total egg weight in the P1, P2 and P3 hen groups was 57.91g;61.66g and 59.48g were significantly (P<0.05) higher compared with the P0 hen group. The effect of feeding SFFO at the 0.4% level can generally increase total egg weight and average egg weight. This increase is due to SFFO feed not only being a source of energy for egg production but also being a source of fat-soluble vitamins, namely vitamins A, D, E and K. Fish oil as linoleic fatty acid [22]. Linoleic fatty acid is needed as a constituent of lipoprotein complexes, is synthesized in the liver by estrogen stimulation and then transferred to follicle formation and directly controls egg weight [23].

3.2. Storability

In Table 2, the shell weight, yolk color, haugh unit, and egg pH of Lohman Brown laying hens fed SFFO in a commercial diet are presented.

Table 2 Effect of SFFO feeding on the shelf life of Lohman brown eggs for 4 weeks

Variable	SFFO level in feed (%)				SE
	0	1.2	2.2	3.2	
Weight ofegg shell, g	7.20^{a}	7.10^{a}	7.40^{a}	7.20^{a}	0.430
Yolk color, 1-15	6.25^{a}	6.50^{a}	7.25^{a}	7.00^{a}	1.04
Haugh unit	74^{a}	79^{ab}	87^{b}	85^{b}	0.027
pH	6.37^{a}	7.50^{b}	8.36^{c}	8.28^{c}	0.046

Values with different letters on the same row are significantly different (P<0.05).

The egg shell weight in the P2 hen group was not significantly (P>0.05) higher than all treatments. Calcium is one of the main nutrients needed for optimal egg shell production and quality in laying hens [24]. There was a linear increase in egg shell weight along with increasing Ca levels in the diet. The yolk color in the P2 hen group was higher (P>0.05) than the P0 hen group. Yolk brightness is an indicator that can be used to determine egg quality, based on the Roche yolk color fan [15].

Haugh units of egg in the P2 and P3 hen groups were significantly (P<0.05) higher than those in the control hen group. This increase was caused by nutrient consumption in the P2 and P3 hen groups due to the presence of SFFO feed supplements in commercial rations. The factor causing the value (HU) is closely related to the depleting ovomucin content in eggs [24]. Based on the indicators that determine the HU value in laying hens, they are shelf life, age, feed nutrients, egg storage location, strain, disease, vitamin C and E supplementation, molting and storage time [25].

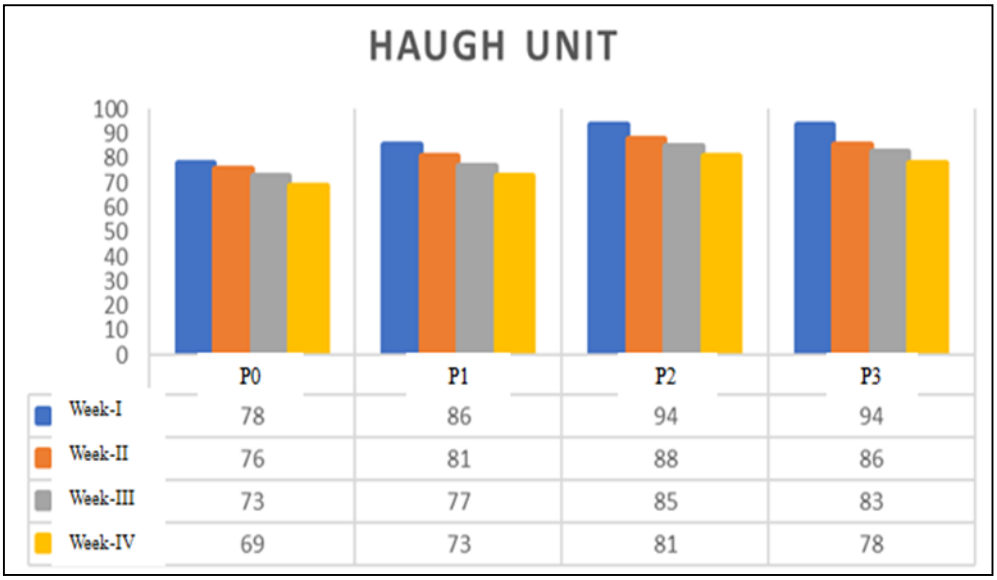

Figure 2 HU of eggs in Lohman Brown laying hens for 4 weeks given SFFO feed

Feeding SFFO at a level of 1.2-3.2% in the ration significantly ($P<0.05$) increased the egg pH of Lohman Brown laying hens (Table 2). The longer the egg is stored, the more the pH value will increase, because the mesh-shaped ovomucin will be damaged and broken, so that the liquid from the egg white becomes wider. The egg yolk also experiences dilution and will mix with the egg white, causing the pH value to increase. This is supported by the high temperature and humidity in the storage room which results in CO_2 evaporation. Kurtini et al. [26] stated that the concentration of bicarbonate and carbonate ions is influenced by CO_2. The large amount of CO_2 lost through the pores of the eggshell causes the concentration of bicarbonate ions in albumin to decrease and damages the buffer system. This makes the egg white and egg yolk alkaline, resulting in an increase in the pH of the egg. Eggs will experience changes along with the length of storage. The longer the storage time will result in more evaporation of liquid and gas in the eggs. Evaporation of water and CO_2 can cause the white and yolk to become diluted, so that the pH value will become more alkaline [27].

4. Conclusion

It can be concluded that a mixed feed supplement of shellfish meal and fish oil (SFFO) can be used as an ingredient in laying hens with an inclusion level of 20-30g/kg and can be used in chicken feed at the finishing stage. SFFO can affect the shelf life of Lohmann Brown chicken eggs.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest is to be disclosed

Statement of ethical approval

The procedures for using test animals have been approved by the Animal Ethics Commission, Faculty of Veterinary Medicine, Udayana University, Denpasar, Indonesia.

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