

## EFFECTS OF INCLUSION OF DRIED SOYBEAN (*Glycine max* L. Merr.) PULP ON EGG PRODUCTION AND EGG QUALITY OF DARAG NATIVE CHICKEN

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### ABSTRACT

The study was conducted to determine the effect of partial inclusion of okara on egg production performance and egg quality of Darag native chickens. With the continuous genetic improvement of the Darag chicken breed, exploring alternative feed ingredients should be considered to support its sustainable production. A total of 36 Darag native chicken layers were randomly allocated to two dietary treatments following a randomized complete block design with age as a blocking factor ( $53.89 \pm 2.35$  weeks). The experiment was conducted for 92 days, during which the hens were fed one of two treatments: (T1) 100% commercial feed as the control group, or (T2) 80% commercial feed + 20% dried okara. The results showed that partial replacement with okara significantly reduced feed intake ( $P=0.0064$ ) and final body weight ( $P=0.0014$ ). No significant differences were observed in hen-day egg production, egg weight, FCR, and most egg quality parameters, but with minor acceptable variations in the overall yolk color ( $P=0.0169$ ) and eggshell thickness ( $P=0.0230$ ) in the first month of feeding. Economically, the inclusion of okara decreased the feed cost and increased the Income over Feed Cost (IOFC) per egg. In conclusion, okara has shown potential as a cost-efficient feed alternative for native layer chickens at 20% inclusion without compromising key egg production and egg quality parameters.

Keywords: Darag Native Chicken; egg production; egg quality; layer hens; okara

### INTRODUCTION

Poultry production plays a significant role in the global food supply, especially in developing countries (Farrell, 2013). In the Philippines, 43.7% of the total chicken inventory for 2022 is native/improved chicken, which are mainly raised by small-hold farmers (PSA, 2022). Over recent years, native chickens have played a crucial role in the Philippine poultry industry and have drawn increased attention due to their adaptability, hardiness, and resistance against common diseases. The demand for their meat and eggs has been increasing because of their unique flavor, tenderness, and leanness. Darag native chicken, being an established breed, is famous for its lean meat and delicious flavor due to its high

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amino acid content. It also produces eggs with a rich, golden yolk, which is a healthy source of protein.

While Darag chickens offer clear advantages for smallholder and free-range farming, feeding expenses create a primary economic bottleneck, accounting for 60 to 70% of overall production costs (Thirumalaisamy *et al.*, 2016). Long-term farm sustainability and profit margins require strict control over feed inputs without compromising dietary quality (Saleh *et al.*, 2020). In rural areas, the diet of poultry is not restricted to purely commercial feeds; supplementation or inclusion of forages and by-products is also being practiced.

Given these considerations, soybean pulp, commonly known as okara, is one agro-industrial by-product that has potential as an alternative feed ingredient for native poultry. Okara is the insoluble residue derived from the processing of soybeans into *taho*, soymilk, tofu, and other soy-based products (van der Riet *et al.*, 1989). During processing, approximately 45% of the raw material is converted into soymilk, whereas the remaining 55% becomes okara, yielding approximately 1.1–1.2 kg of fresh okara (wet basis) for every kilogram of soybean processed (Shinde *et al.*, 2025).

In 2025, global soybean production reached about 429.46 million MT, with the Philippines producing about 1,000 MT and an average yield of 1 MT/ha (USDA-FAS, 2026). These figures suggest that soybean processing generates considerable quantities of okara. In the Philippines, where soybean processing is practiced in many rural and peri-urban communities, much of this by-product remains underutilized despite its potential as a practical and low-cost feed resource for native poultry production.

Beyond its availability, okara exhibits nutritional characteristics that make it a promising feed ingredient. It contains approximately 23% crude protein, 40.2–43.6 g/100 g insoluble fiber, and 12.6–14.6 g/100 g soluble fiber (van der Riet *et al.*, 1989). Okara derived from soymilk processing has likewise been reported to provide 5,105 kcal/kg gross energy (GE) and 3,300 kcal/kg apparent metabolizable energy (AME) on a dry matter basis (Wicaksono and Yamamoto, 2025).

These nutritional characteristics have driven interest in trials across different livestock species. An *in vitro* assessment of tubers and agro-industrial co-products demonstrated that okara has relatively high dry matter digestibility as well as favorable digestible and net energy values, supporting its potential as a partial substitute for conventional feedstuffs in pigs (Tiwara & Jha, 2016). Similarly, replacing soybean meal with okara in dairy cattle diets did not adversely affect milk production, protein synthesis, or milk quality (Zang *et al.*, 2021). More broadly, soybean-derived feed ingredients have also demonstrated value in poultry nutrition. A meta-analysis by Irawan (2022) reported that substituting conventional soybean meal with fermented soybean meal improved the final body weight of broiler chickens, particularly during the starter period, although the responses in average daily gain, feed intake, and feed conversion ratio varied depending on the microbial strains used during fermentation. Direct evidence on okara, however, remains limited. Diaz-Vargas *et al.* (2016) observed that increasing dietary inclusion levels of okara from 0% to 10% resulted in decreasing body weight gain from 1 to 21 days of age, although carcass yield and cut-up part weights at 42 days were not significantly affected.

While the feeding value of okara has been investigated in several livestock species and, to a limited extent, in broiler chickens, its effects on the egg production traits of native chickens remain insufficiently documented. Therefore, this study aimed to determine the effects of partially including okara in the layer diet of Darag native chickens on egg

production and egg quality traits and to assess its economic viability.

## MATERIALS AND METHODS

The study was conducted at the Institute of Animal Science research facilities at the University of the Philippines Los Baños and in compliance with the requirements of the Institutional Animal Care and Use Committee of the University of the Philippines Los Baños (IACUC Approval No. CAFS-2019-003).

### Animals and Experimental Design

A total of 36 Darag native chicken layers were used in this study and were randomly allocated following a Randomized Complete Block Design (RCBD) with age as the blocking factor. Four age blocks were used; within each block, individual birds served as the experimental units or replicates and were randomly assigned to the two dietary treatments: Block 1 consisted of 44-week-old birds with six replicates per treatment, Block 2 consisted of 47-week-old birds with four replicates per treatment, Block 3 consisted of 64-week-old birds with two replicates per treatment, and Block 4 consisted of 65-week-old birds with six replicates per treatment. The number of replicates per treatment within each block was determined based on the availability of apparently healthy hens in each age group. The experiment consisted of two dietary treatments: (T1) 100% commercial layer feed, and (T2) 80% commercial layer feed with 20% dried okara. The birds were fed the experimental diets for 92 days. Egg collection was initiated after a 7-day acclimatization period during which the birds were fed their respective experimental diets. The okara used in this study was from Tiwala 6 (Psb Sy2), a variety of soybean developed by the Institute of Plant Breeding (IPB), University of the Philippines Los Baños, Laguna, and was sourced from Likhaya Community Store and Café, Los Baños, Laguna. The collected fresh okara was dried in an oven at approximately 70°C until a constant weight was achieved.

### Experimental Diets

The birds were fed a commercial layer mash diet. Table 1 presents the proximate analysis of the feeds used in the study, which includes commercial layer mash and dried okara. A restricted feeding system was implemented, with a daily feed allocation of 65 g. Birds in the T1 group received 65 g of commercial layer feed daily, while birds in the T2 group received 52 g of commercial feed and 13 g of dried okara. Table 2 shows the nutrient composition of the diets used in the study, calculated based on the amounts given to both treatments, showing no significant difference in %CP content. The 20% partial inclusion of dried okara was determined as a practical replacement rate that could provide potential economic benefits without having significant differences in production parameters, while minimizing the nutrient dilution of its high fiber content and the potential impact of residual antinutritional factors (Sinha *et al.*, 2013).

### Management and Care of Birds

The Darag native layer chickens were placed in individual cages measuring 14x9x13 inches within an open-sided house. Uniform care and management were provided to the birds throughout the duration of the study. Water was given *ad libitum* through nipple drinkers.

Table 1. Proximate analysis of commercial layer mash (CLM) and dried okara (as fed basis).

| Nutrient                   | Value            |                  |
|----------------------------|------------------|------------------|
|                            | CLM              | Dried okara      |
| Moisture $\pm$ dev, %      | 7.90 $\pm$ 0.16  | 6.75 $\pm$ 0.03  |
| Ash $\pm$ dev, %           | 11.24 $\pm$ 0.17 | 4.03 $\pm$ 0.04  |
| Crude Protein $\pm$ dev, % | 16.48 $\pm$ 0.10 | 13.52 $\pm$ 0.34 |
| Crude Fat $\pm$ dev, %     | 4.58 $\pm$ 0.13  | 7.17 $\pm$ 0.01  |
| Crude Fiber $\pm$ dev, %   | 2.86 $\pm$ 0.09  | 19.26 $\pm$ 0.15 |
| Calcium $\pm$ dev, %       | 2.98 $\pm$ 0.02  | 0.31 $\pm$ 0.00  |
| Phosphorus $\pm$ dev, %    | 0.46 $\pm$ 0.00  | 0.34 $\pm$ 0.01  |

Table 2. Computed nutrient composition of diets for treatments with and without okara.

| Nutrient         | Value |                      |
|------------------|-------|----------------------|
|                  | CLM   | CLM +<br>Dried okara |
| Moisture, %      | 5.13  | 4.99                 |
| Ash, %           | 7.31  | 6.37                 |
| Crude Protein, % | 10.71 | 10.33                |
| Crude Fat, %     | 2.98  | 3.31                 |
| Crude Fiber, %   | 1.86  | 3.99                 |
| Calcium, %       | 1.96  | 1.59                 |
| Phosphorus, %    | 0.30  | 0.28                 |

## Data Collection

**Egg production performance.** Total number of eggs, egg weight, and feed refusal were collected daily from individual hens. Initial and final body weight were measured at the beginning and end of the study, respectively. Production parameters, including weight gain, feed conversion ratio, and percent hen-day egg production, were calculated and determined.

**Egg quality.** The quality of eggs was determined thrice, every month, by obtaining the values of the eggs' shape index, eggshell weight and thickness, albumen height and weight, and yolk color and weight. Equipment and tools needed are a digital caliper, tripod micrometer/Haugh meter, yolk color fan, and digital weighing scale, respectively.

**Income over feed cost.** To determine the IOFC, the difference between the average produced eggs per bird multiplied by the retail price of the farm for native eggs, and the average amount of feedstuff consumed per bird multiplied by the cost per kilogram of the feed. All monetary values presented in the study are expressed in Philippine pesos (Php).

## Statistical Analysis

All data gathered were subjected to normality and homogeneity of variance tests. For variables that were normal and with equal variances, Analysis of Variance (ANOVA)

was used following a Randomized Complete Block Design (RCBD), where statistical significance was set at  $P < 0.05$  using Statistical Analysis Software (SAS). For variables with non-normal distribution and/or unequal variances, the Kruskal-Wallis test was used. Post hoc analysis was not performed because the study involved only two treatment groups, for which direct comparison of treatment means was considered sufficient.

## RESULTS AND DISCUSSION

### Feed Consumption

Table 3 presents the results for feed intake, body weight, and feed conversion ratio (FCR) of Darag native hens fed a diet with and without okara. Birds fed without okara had a significantly higher feed intake compared to the birds fed with okara ( $P=0.0064$ ). This suggests that the inclusion of okara led to a decrease in the amount of feed consumed by the birds. This is contrary to an increase in feed intake of birds fed a reformulated diet with 20% of okara (Attakpa *et al.*, 2014). The differences in results can be attributed to the variations in how okara was incorporated into the experimental diets. In this study, okara was used as a partial replacement for commercial feeds, whereas in the aforementioned study, experimental diets were reformulated.

Table 3. Production performance and body weights of Darag native hens (44 weeks of age) fed diet with and without okara for three months.

| Nutrient                         | Treatment     |            | SEM  | p-value |
|----------------------------------|---------------|------------|------|---------|
|                                  | Without okara | With okara |      |         |
| Gain in weight, kg               | 0.076         | -0.059     | 0.02 | 0.0013* |
| Feed intake, g/bird <sup>a</sup> | 5,884         | 5,591      |      | 0.0064* |
| FCR                              | 3.16          | 3.69       | 0.21 | 0.2884  |
| Hen-day egg production, %        | 36.67         | 32.50      | 2.63 | 0.2663  |
| Egg weight, g                    | 42.91         | 41.51      | 0.86 | 0.2954  |

\* - Statistical difference observed among treatment means ( $P < 0.05$ ).

<sup>a</sup> - Non-parametric analysis (Kruskal-Wallis test); SEM not reported.

Figure 1 shows the average daily feed intake of hens fed with and without okara, where a notable decrease in feed intake at the beginning of the feeding trial can be observed, specifically from 1 to 10 and 45th day of the study. After this initial drop, the feed intake for hens fed with okara stabilizes and closely follows the pattern of intake for hens without okara. But it can still be observed that there is a consistently lower feed consumption of birds fed with okara throughout the study. Results indicate that the observed decrease in feed intake could be due to the higher fiber content of the T2 diet (Table 1). The decrease in feed intake with fiber-rich diets causes a feeling of fullness in the hens (Abdollahi *et al.*, 2021). The changes in the feed—nutrient composition, texture, and taste (Kumar, 2023) could have also triggered the decrease in the birds' feed intake.

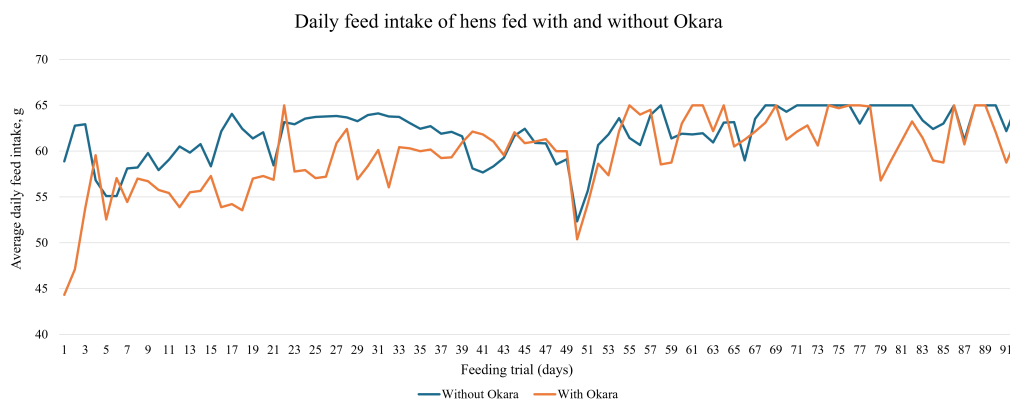


Figure 1. Average daily feed intake of Darag native hens fed diet with and without okara for three months.

There was a significant difference in the gain in weight ( $P=0.0013$ ) of birds fed with experimental diets. Lower final body weight and a negative weight gain were observed in birds fed with okara. The results obtained for body weight indicate that the differences in feed intake had a major impact on the final body weight and gain in weight of the birds. But the body weight of the birds was still within the ideal weight for Darag native chicken hens.

Traditionally, native chickens are managed under scavenging or semi-scavenging systems and are commonly fed with non-conventional feed ingredients (Ncobela & Chimonyo, 2015) and have exhibited physiological adaptations, including well-developed digestive organs. Darag chickens develop larger gizzards relative to body weight, which may indicate a greater ability to effectively break down feed particles and enhance nutrient digestion (Nerida *et al.*, 2024), and exhibit a slower but more comprehensive intestinal maturation, which may be advantageous under low-input production systems (Juarez *et al.*, 2025). The current study used a 20% substitution rate as an initial baseline to simulate a practical feeding strategy for farmers. The need to establish a baseline for this specific breed of native chicken is important prior to introducing extreme inclusion rates. Future studies should build upon these results by evaluating higher inclusion levels of commercial feed replacement to fully determine the upper boundaries of okara utilization in native poultry production.

### Egg Production Performance

There were no statistically significant differences observed in hen-day egg production, egg weight, and feed conversion ratio between the two groups (Table 3). This suggests that, despite the decrease in feed intake and body weight of the birds, the partial replacement of feed with okara did not negatively impact these major egg production parameters. Similar findings from two different studies reported that the use of alternative feed ingredients, such as food waste at a 20% substitution rate (Yaemkong *et al.*, 2026) and supplementation of diets with yeast derived from dried banana residue (Yaemkong *et al.*, 2025), did not manifest any significant differences in egg production performance of laying hens. These findings suggest that alternative feed ingredients can be incorporated at moderate levels without compromising the egg production performance of laying hens. Meanwhile, the higher fiber content of the diet due to the inclusion of okara may have

also contributed to this outcome. The use of moderate amounts of fiber can improve the production of bile enzymes and hydrochloric acid, and the composition of cecal microbiota, which can consequently enhance nutrient digestibility (Mateos *et al.*, 2012).

### Egg Quality

Tables 4 to 7 show Month 1-3 and overall egg quality parameters of Darag native chicken layers fed with and without okara. Comparing the egg quality values, these values were in agreement with the egg quality parameters of native chickens obtained in the study of Bondoc *et al.* (2021). The results of the study showed that there was no effect on the quality of the eggs produced by the hens fed with okara, as there were no significant differences observed in most of the overall quality and composition of eggs—egg weight, shape Index, albumen height and weight, Haugh unit, yolk weight, and eggshell weight and thickness. Significant differences, however, were observed for yolk color score ( $P=0.0169$ ) and eggshell thickness ( $P=0.0230$ ) for the first month. Although the overall yolk color score for both treatments is within the required yolk color range of most egg marketing authorities (Stable Micro Systems, n.d.), the differences in yolk color score may be attributed to the decrease in carotenoids in the diet with okara (Bondoc *et al.*, 2021; Hammershøj, 2011). Meanwhile, the significant difference observed in the eggshell thickness for the first month of the study can be attributed to the acclimatization of the birds to the change in the nutritional composition of the feed, specifically the sudden decrease in calcium level from the diet. The recovery in eggshell thickness for the succeeding months of the experiments is attributed to the hens' drawing up and utilizing calcium from internal sources—bones, which can be related to the occurrence of lameness (Mehring & Titus, 1963) in the population under the treatment fed with okara. However, even though there was variation in eggshell thickness, the value for the eggs from the hens fed with okara is still equal to the standard average eggshell thickness of 0.30 mm (Yalcinalp, n.d.).

Table 4. Month 1 egg quality traits analysis of eggs from Darag native hens fed diet with and without okara.

| Nutrient                        | Treatment     |            | SEM  | p-value |
|---------------------------------|---------------|------------|------|---------|
|                                 | Without okara | With okara |      |         |
| Egg weight, g                   | 42.52         | 41.01      | 1.04 | 0.3824  |
| Shape Index                     | 74.08         | 74.1       | 0.79 | 0.9081  |
| Albumen height, mm <sup>a</sup> | 5.11          | 4.86       |      | 0.9266  |
| Haugh Unit <sup>a</sup>         | 76.54         | 74.07      |      | 0.9816  |
| Albumen weight, g               | 24.29         | 23.64      | 0.73 | 0.5849  |
| Yolk weight, g                  | 14.21         | 13.75      | 0.38 | 0.4882  |
| Yolk color score                | 10.20         | 9.46       | 0.2  | 0.1723  |
| Eggshell weight, g              | 4.01          | 3.62       | 0.14 | 0.0926  |
| Eggshell thickness, mm          | 0.33          | 0.30       | 0.01 | 0.0230* |

\* - Statistical difference observed among treatment means ( $P<0.05$ ).

<sup>a</sup> - Non-parametric analysis (Kruskal-Wallis test); SEM not reported.

Table 5. Month 2 egg quality traits analysis of eggs from Darag native hens fed diet with and without okara.

| Nutrient               | Treatment     |            | SEM  | p-value |
|------------------------|---------------|------------|------|---------|
|                        | Without okara | With okara |      |         |
| Egg weight, g          | 44.03         | 43.87      | 0.99 | 0.9200  |
| Shape Index            | 73.44         | 74.12      | 0.72 | 0.6304  |
| Albumen height, mm     | 4.39          | 4.75       | 0.29 | 0.5980  |
| Haugh Unit             | 69.90         | 72.69      | 2.36 | 0.6194  |
| Albumen weight, g      | 25.07         | 25.41      | 0.62 | 0.8947  |
| Yolk weight, g         | 14.90         | 14.363     | 0.36 | 0.5243  |
| Yolk color score       | 10.27         | 9.70       | 0.2  | 0.0904  |
| Eggshell weight, g     | 4.06          | 4.09       | 0.13 | 0.6938  |
| Eggshell thickness, mm | 0.33          | 0.32       | 0.01 | 0.3710  |

Table 6. Month 3 egg quality traits analysis of eggs from Darag native hens fed diet with and without okara.

| Nutrient                      | Treatment     |            | SEM  | p-value |
|-------------------------------|---------------|------------|------|---------|
|                               | Without okara | With okara |      |         |
| Egg weight, g                 | 43.04         | 42.30      | 0.99 | 0.8119  |
| Shape Index                   | 74.47         | 76.06      | 0.86 | 0.4216  |
| Albumen height, mm            | 4.61          | 4.48       | 0.18 | 0.4387  |
| Haugh Unit                    | 71.90         | 71.61      | 1.44 | 0.5361  |
| Albumen weight, g             | 24.56         | 24.07      | 0.61 | 0.9295  |
| Yolk weight, g                | 14.56         | 13.90      | 0.46 | 0.5076  |
| Yolk color score <sup>a</sup> | 10.23         | 9.91       |      | 0.3403  |
| Eggshell weight, g            | 3.92          | 3.86       | 0.12 | 0.8723  |
| Eggshell thickness, mm        | 0.32          | 0.32       | 0.01 | 0.7866  |

<sup>a</sup> - Non-parametric analysis (Kruskal-Wallis test); SEM not reported.

Table 7. Overall average egg quality traits analysis of eggs from Darag native hens fed diet with and without okara.

| Nutrient      | Treatment     |            | SEM  | p-value |
|---------------|---------------|------------|------|---------|
|               | Without okara | With okara |      |         |
| Egg weight, g | 43.14         | 41.11      | 0.92 | 0.3963  |

Table 7 continued . . .

| Nutrient               | Treatment     |            | SEM  | p-value |
|------------------------|---------------|------------|------|---------|
|                        | Without okara | With okara |      |         |
| Shape Index            | 74.06         | 74.7       | 0.70 | 0.5002  |
| Albumen height, mm     | 4.65          | 4.68       | 0.26 | 0.9037  |
| Haugh Unit             | 72.39         | 73.41      | 2.12 | 0.9195  |
| Albumen weight, g      | 24.5          | 23.6       | 0.62 | 0.7652  |
| Yolk weight, g         | 14.7          | 13.78      | 0.36 | 0.1643  |
| Yolk color score       | 10.23         | 9.68       | 0.2  | 0.0169* |
| Eggshell weight, g     | 3.94          | 3.73       | 0.13 | 0.4669  |
| Eggshell thickness, mm | 0.32          | 0.31       | 0.01 | 0.0782  |

\* - Statistical difference observed among treatment means (P<0.05).

Table 8. Income over feed cost of feeding Darag native hens diets with and without okara for three months.

| Nutrient                                 | Treatment     |            |
|------------------------------------------|---------------|------------|
|                                          | Without okara | With okara |
| Average eggs produced <sup>1</sup> , pcs | 30            | 27         |
| Sale value of eggs <sup>2</sup> , Php    | 300.00        | 270.00     |
| Layer feeds consumed <sup>3</sup> , kg   | 5.88          | 5.59       |
| Feed Cost, Php                           | 205.80        | 181.93     |
| IOFC, Php                                | 94.20         | 88.07      |
| IOFC per egg, Php                        | 3.14          | 3.26       |

<sup>1</sup>Average egg production per bird for 12 weeks

<sup>2</sup>Price of egg, Php 10.00.

<sup>3</sup>Average layer feeds consumed per bird for 13 weeks

Commercial diet costs Php 35.00/kg, while fresh okara costs Php 5.00/kg with 78% moisture.

### Economic Analysis

Table 8 presents the computation of the income over feed cost (IOFC) of feeding Darag native hens diets with and without okara for three months. Results indicate that the inclusion of dried okara in the diet decreased the cost for layer feeds by Php 2.45 per kg and increased the IOFC per egg sold. Despite having observed no significant difference in the percent hen-day egg production, the hens fed with okara produced a lower revenue from egg sales, with their eggs amounting to Php 270.00 compared to Php 300.00 from hens fed the commercial diet only, selling them at Php 10.00 per egg. Meanwhile, hens fed diets without okara consumed 5.88 kg of layer feed in 13 weeks, slightly higher than the 5.59 kg consumed by those fed with okara. Consequently, the feed cost was reduced from Php

205.80 in the control group to Php 181.93 in the okara-fed group, indicating a decrease of Php 23.87 in the feed cost, with commercial feed costing Php 35.00 per kg and fresh okara costing Php 5.00 per kg (78% moisture). Accordingly, the hens fed with okara yielded a lower Income Over Feed Cost (IOFC) at Php 88.07, but resulted in a higher IOFC per egg at Php 3.26; while hens fed the commercial diet only yielded an IOFC of Php 94.20, amounting to Php 3.14 IOFC per egg. This shows a Php 0.12 increase in the IOFC per egg upon the inclusion of okara in the diet.

The economic implications of substituting conventional feed with dried okara remain highly favorable over an extended production timeline. Although a reduction in voluntary feed intake and body weight gain was observed, these changes did not compromise overall egg production or egg quality parameters. Economically, the significant reduction in feed formulation costs compensates for the lower feed intake, suggesting long-term cost efficiency for native poultry producers. However, to sustain this economic benefit and prevent chronic body weight loss or a potential eventual drop in laying intensity, future dietary treatments must be reformulated to have balanced energy levels.

## CONCLUSION

A significant decrease in feed intake was observed in birds fed with 20% okara, which corresponded to a lower final body weight and gain in weight. Nonetheless, these body weights were still within the ideal weight for their breed. Meanwhile, feeding Darag native hens diets containing okara did not have any significant effect on hen-day egg production, daily egg weight, feed efficiency, or overall egg quality parameters except for minor differences in yolk color and eggshell thickness. It also resulted in a higher Income Over Feed Cost (IOFC) per egg. Overall, the inclusion of okara in the feed could be considered a viable feeding strategy for Darag native chickens in the laying stage, as it did not compromise important production parameters for layer chickens and shows potential in decreasing the feed cost.

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