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Research Article

Egg Quality Traits of Quail (Coturnix Coturnix Japonica) Supplemented with Aguingay (Rotboella Cochinchinensis) Inflorescence Meal

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ABSTRACT

One of the factors impacting the quality of animal food is the feed. *The production of food from animals manifests excellent value, which helps sustain the needs of the human population.* The demand for food grows in tandem with the world's population. As a result, new animal food sources, such as plants introduced as a potential supplement, emerge. *This study utilizes "aguingay," a noxious weed, as a food supplement to Japanese quail.* Standard procedures are used to determine the exterior and internal egg quality features of Japanese quail. *Likewise, data were analyzed using Analysis of Variance (ANOVA) and Tukey's Honest Significant Difference (HSD) Test to compare treatment using STATA version 14.2 software. The egg weight of the Japanese quails has high significance between the four treatments (p-value<0.001), possessing different levels of aguingay inflorescence meal. The positive control (T0) has the lightest egg weight with an average of 10.312 grams, which is statistically equal to T1 and T3, an average egg weight of 10.507 grams, and 10.638 grams. Thus, T2 has the heaviest egg weight of 10.817 grams on average, statistically different from T0, T1, and T3. Moreover,* statistical analysis found that the four treatments have no significant differences in yolk color or shell weight.

Keywords: Aguingay; Japanese quails; Fed Supplement

INTRODUCTION

Animal food production is in high demand due to the needs of a rapidly growing human population. Today's generation has a more significant number of conscious consumers, which leads to the order of healthy foods such as eggs. An egg is a nutritious food full of things needed by the body. As a good source of inexpensive and high-quality protein and a versatile food source, eggs have widely become attractive to people. Egg production comes from various sources of poultry that include ducks, chicken, turkeys, quails, and other egg-producing birds. Some of the most miniature eggs most consumed are from quail eggs. Quail eggs are easily found in Asian markets and many extensive or upscale grocery stores. In quail production, the most studied aspect is nutrition, particularly Japanese egg-type quails. Quail eggs pack a lot of nutrients in their tiny nature. Compared to the chickens, it is easy to raise, which requires a not so complicated housing [1-3].

As cited by Jose, on a commercial site, investors are not attracted to quail rising because of the lack of data, particularly regarding feeding; hence this study is encouraged. The standard ratio for the growth and breeding of quail is not yet available commercially, inducing dietary feed from other poultry such as chicken and turkey. The faulty feeding practice employed by the raiser is the primary cause of failure in quail rising. The use of feeds such as in chicken usually results in a short survival time for the quail. The occurrence of molting is high in feeding chicken mash to quails, severely affecting egg production. The original and essential nutrients for nearly all animal life are from the plant kingdom. Quails primarily eat seeds; they are seed eaters who are also versatile since they can eat insects or other small prey. In the summer, quails seek insects and small vertebrates, but usually, the Japanese quails seek different grass seeds. The fresh feed for farming quails is significant. An aggressive invasive grass species native to Asia is the "aguingay" or the guinea fowl grass (Rottboellia cochinchinensis). Aguingay has seeds that germinate throughout the growing season; it is determined as a prolific seed produce. It is one of the deadliest weeds on the planet and a highly aggressive invasive plant. The plant's inflorescence comprises several cylindrical spikes with

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disarticulating articles produced from a foliated husk. Hence, this study was conducted to utilize the weed grass "aguingay" to supplement Japanese quails [4-6].

OBJECTIVES OF THE STUDY

Generally, this study aims to utilize "aguingay" as a supplement to Japanese quail.

Specifically, it sought to:

- Evaluate the Japanese quail's external and internal egg quality traits supplemented with varying levels of aguingay inflorescence meal.
- Assess the laying performance of Japanese quail supplemented with varying levels of aguingay inflorescence meal.

Scope and Limitations of the Study

This study only focuses on the egg quality traits and laying performance of Japanese quail (Coturnix coturnix japonica) supplemented with varying levels of aguingay (Rottboellia cochinchinensis) inflorescence meal.

Review of Related Literature

Japanese quail

Japanese quails belong to the Phasianidae family; order Galliformes, genus Coturnix, and sp. japonica. The scientific name for Japanese quail is Coturnix japonica in which they are migratory birds that migrate between Asia and Europe. They are considered the smallest member of poultry with huge potentiality used in commercial production for meat and egg. The Japanese quails are favored with many sensible characteristics such as their fast growth, high rate of egg production, early sexual maturity, short generation interval (3-4 generations a year), more minor feed requirements, small floor space, less feed cost, a short incubation period of hatching eggs, and less sensitivity to common chicken diseases. It is said that quails provide more advantages than poultry, such as chicken, because of their resistance to many poultry diseases [7].

The wild-type plumage color is predominately dark cinnamon brown, with the adult female has pale breast feathers speckled with dark-colored spots and uniform dark rust-red feathers on the breast and cheek for the adult males. Japanese quails have a whitish stripe above the eye on the side of the head; their legs are orangish-gray to pinkish gray, as is the beak. These quails eat different kinds of grass seeds, including panicum and white millet. Their diet has a higher degree of protein than the Painted quail. There is an increased production of Japanese quail since its start as a commercial poultry activity. The distribution spreads over large areas of Asia, Europe, and Africa; they were first domesticated in Japan, and then, at the beginning of the 20th century, commercial production started. It is thought to be by the excellent meat quality and the high nutritional value and pleasant flavor of Japanese quail eggs that has resulted in a wide acceptance by consumer [8].

Quail Eggs

Quail eggs are a good source of nutrients for human health. It is a potential source of animal protein and is primarily consumed by many people, especially in Asian countries. Although quail eggs are small, their nutritional value is three to four times greater than chicken eggs. The consumption of eggs regularly helps fight against many diseases and strengthen the immune system. Quail egg's nutritional value is much higher than other eggs and is rich in sources of antioxidants, minerals, and vitamins. The amount of cholesterol in a quail egg yolk is determined by the quail's species and age, as well as the nutrient content of the meal. The cholesterol level of quail eggs shows adverse effects; however, it serves as the precursor for steroid hormones, bile acid synthesis, tissue generation, cell membrane components, and nutrients for the formation of milk (breast milk). According to Mutungi, the cholesterol level of quail eggs is reduced by manipulating the feed by replacing the standard meal with organic feed. Quail eggs help strengthen the immune system, promote memory health, increase brain activity, and stabilize the nervous system. It is dominated by several advantages, including its ability to help with anemia by boosting hemoglobin levels in the body while eliminating pollutants and heavy metals. In China, they use quail eggs to treat tuberculosis, asthma, and even diabetes. Aside from that, it also helps prevent the sufferer of kidney, liver, or gallbladder stones and remove these types of rock [9].

Nutrient Composition of Quail eggs

The proximate composition of quail eggs includes a moisture content of 74.26 %, crude protein 11.98%, crude fat 11.91%, and crude ash of 1.04% in quail eggs reared in farm conditions (Dudusola, 2010). Due to cross breeding of quails, variation may arise in its nutritional composition. The study of Tunsaringkarn et al., 2013 revealed that the total energy in calories was 156.50 kcal in whole Japanese quail eggs. Its nutritional composition includes carbohydrate (4.01 g/dl), protein (12.7 g/dl), fat at (9.89 g/dl), and ash (1.06 g/dl). The nutrient composition of egg yolks in quail eggs shows higher ash, carbohydrate, fat, protein, and calories. Quail eggs both have essential and non-essential nutrients, which most of them are beneficial for human health. As cited by Khan (1992-2012), the essential amino acid (EAA) of egg whites were leucine (1139.0 mg 100g-1), valine (869.5 mg 100g-1), and lysine (790.0 mg 100g-1). Most of non-essential amino acid was aspartic (1488.0 mg 100g-1), alanine (739.0 mg 100g-1) and serine (665.5 mg 100g-1). The main essential fatty acids (EFA) found in egg yolks include linoleic acid (2.58 g 100g-1), docosahexaenoic acid (0.50 g 100g-1), and arachidonic acid (0.44 g 100g-1). For the vitamins, the most fat-soluble vitamins of egg yolk include vitamin E (tocopherol, 5920.0 µg 100g-1), which was significantly higher than vitamin A (717.0 µg 100g-1, $p<0.001$). The whole egg contains the essential mineral such as nitrogen (6.36%) which it was mostly in egg whites (12.2 %), while most of the trace mineral of the whole egg was iron (80.8 mg L-1) and zinc (46.9 mg L-1)[10].

Aguingay

Rottboellia cochinchinensis is a weed that grows in many tropical crops and is one of the most common grass weeds in rainfed rice. This plant is known as "aguingay" in the

Philippines, and it is a self-pollinated annual upland weed. This plant is a vigorous competitor of crops because of its ability to grow fast coupled with its spreading habits. Aguingay is an erect annual grass that reaches heights of 4 meters that grows along roadsides and in other open, well-drained sites. This plant is characterized by pale, green-colored foliage, brace roots near the base of the plant with a cylindrical spikelet seedhead, and siliceous hairs on the leaf sheath that can penetrate and irritate the skin. Problematic issues on aguingay arise due to irritating hairs on its leaf sheath and blades easily detached on contact, making it unpalatable for grazing animals and causing painful infection to workers. This plant is known to be a seed-producing plant that is said to be very palatable to some birds, rodents, and insects. According to research, R. cochinchinensis seeds are identified in the intestines of four out of the 15 species of seed-feeding birds studied in the United States. Only about 0.3% of the seed survived the passage through the gut in feeding trials.

Research Instruments

Preparation of the Housing

The housing was made by separating the cage into equal individual parts, measuring 3 ½ in. x 3 ½ inches. Before the trial, the housing was sterilized, and the recommended 16 hours of light per 24 hour day period is provided.

Experimental Birds

Eighty birds (Japanese quail) were used in the experiment obtained from Ormoc City and were subjected to withdrawal in July 2019. Acclimatization for one week is done before the experiment.

Experimental Design

Quails were assigned to four (4) treatments and were replicated four (4) times with five (5) birds per replication. This experiment was laid out in Randomized Complete Block Design (RCBD). The inclusion of aguingay inflorescence meal into the commercial ratio was varied into three levels (5%, 10%, and 15%).

Table1: Treatments of the experiment

TREATMENTS	JAPANESE QUAIL FEED
T0	Control
T1	Commercial ration with 5% aguingay inflorescence meal
T2	Commercial ration with 10% aguingay inflorescence meal
T3	Commercial ration with 15% aguingay inflorescence meal

$$\%\ HDEP = \frac{\text{Total Number of Eggs Laid during the Period}}{\text{Total Number of Hens Housed in the laying period}} x\ 100$$

Figure1: Experimental Design

Feeding Management of the Experimental Birds

The quails were fed 23 grams per quail per day base on the standard requirement of the Livestock Development Council (LDC) of the Department of Agriculture. The feed that supplements the birds was based on the treatment specified for the group of quails that corresponds to the commercial feed or aguingay inflorescence meal ratio. Freshwater was always accessible, and feedings were done twice a day at 6:30 p.m. and 3:30 p.m.

Data to be gathered

Protein Analysis

The protein content of the egg was analyzed using the standard procedure of protein analysis. The Kjeldahl process was carried out according to AOAC International Method 981.10. Approximately 1 g of raw material was hydrolyzed in a heat block at 420°C for two hours with 15 mL concentrated sulfuric acid (H2SO4) including two copper catalyst tablets. H2O was added to the hydrolysates after cooling, followed by neutralization and titration. The total nitrogen in the raw materials was multiplied by the usual conversion factor of 6.25 and species-specific conversion factors to obtain total protein content.

Egg Laying Performance

Egg Production, %

This was expressed on a percent Hen-day Egg (HDEP) basis and was determined using the formula below.

T_3R_2	T_3R_2	T_2R_2	T_2R_4	T_1R_1	T_1R_3	T_0R_4	T_0R_1
T_3R_1	T_3R_4	T_2R_3	T_2R_1	T_1R_4	T_1R_2	T_0R_2	T_0R_3

Egg Quality Traits

The following are the egg quality traits to be gathered.

- This was determined by weighing the dried quail egg shell using an analytical balance.
- The individual weight of eggs was determined using a digital weighing scale.

Data Analysis

The data that gathered were analyzed using Analysis of Variance (ANOVA) and Tukey's Honest Significant Difference (HSD) Test for comparison of treatment means using STATA version 14.2 software.

RESULTS and DISCUSSION

Egg Quality Traits

Egg Weight

The analysis of variance of the egg weight of Japanese quails supplemented with varying Aguingay inflorescence meal concentration levels are presented in Table 2.

For the egg weight (in grams), it can be inferred that there is very highly significant difference between the four treatments (p-value<0.001). This means that there is significant treatment effect. Furthermore, it implies that there is at least one average egg weight that is different among the treatments.

Table2: Analysis of Variance for the egg weight (g) of Japanese quails supplemented with different concentrations of Aguingay inflorescence meal.

Source	SS	Df	MS	F	p-value
Block (Day)	107.0131	31	3.452	3.76***	0.0000
Treatment	17.46452	3	5.8215	6.34***	0.0004
Residual	438.2492	477	0.9188		
Total	**562.7268**	**511**			

***-Significant at the 0.1% level

To assess all potential pairwise comparisons and determine whether treatment varies substantially from which treatment, the Tukey's Honest Significant Difference (HSD) test was utilized. Based on the results (Table 3), the positive control (T0) has the lightest egg weight with an average of 10.312 grams (standard error of 0.10041 grams) which is statistically equal to T1 and T3, which has an average egg weight of 10.507 grams (standard error of 0.08457 grams) and 10.638 grams (standard error of 0.08951 grams), respectively. Moreover,

T2 has the heaviest egg weight of 10.817 grams on average (standard error of 0.09108 grams), statistically different from T0, T1, and T3. In general, T2 produced the heaviest egg weight among the treatments. Lastly, the blocking variable, which is the day of collection from July 24 to August 24, is highly effective, which means that on at least one of the days, the mean egg weight is substantially different compared to the other days. The reliability index of the experiment is approximately 9% (Appendix A) which means that this experiment has very acceptable reliability. The egg weight of the Japanese quail studied fits into the standard egg weight range, which is from 6 to 16 g, with an average weight of 10 grams.

Table3: Post-Hoc Analysis (Pairwise Comparison) for the egg weight of Japanese quail using Tukey's Honest Significant Difference at the 5% level.

Treatment	Mean	Tukey's HSD Group
T0	10.312 ± 0.10041	A
T1	10.507 ± 0.08457	AB
T2	10.817 ± 0.09108	C
T3	10.638 ± 0.08951	B

Yolk Color

For the egg yolk color, it can be inferred that there is no significant difference between the four treatments (p-value>0.05), as shown in Table 4, which means that there is no practical treatment effect. The yolk color is influenced by factors such as the length of storage, feed intake, stability of fats in the feed, and daylight hours. The calcium and vitamin A level of the feed may also influence or reduce the yolk color of the egg.

Table4: Analysis of Variance for the yolk color of Japanese quails supplemented with different concentrations of Aguingay inflorescence meal.

Source	SS	Df	MS	F	p-value
Block (Day)	1658.375	31	53.496	39.37***	0.0000
Treatment	7.28125	3	2.4271	1.79ns	0.1901
Residual	648.2188	477	1.3589		
Total	**2313.875**	**511**			

ns- Not significant

***-Significant at the 0.1% level

Moreover, it implies that the egg yolk color is statistically equal across the treatments, on average. We can say that treatments 1, 2, and 3 produced a similar egg yolk color with the positive control (T0). Lastly, the blocking variable, which is the day of collection from July 24 to August 24, is highly effective, which means that on at least one of the days, the egg yolk color is substantially different compared to the other days. The reliability index of the experiment is approximately 18% which means that this experiment has relatively acceptable reliability.

Table5: Post-Hoc Analysis (Pairwise Comparison) for the yolk color of Japanese quail egg using Tukey's Honest Significant Difference at the 5% level.

Treatment	Mean	Tukey's HSD Group
T0	6.336 ± 0.19570	A
T1	6.414 ± 0.18644	A
T2	6.539 ± 0.18019	A
T3	6.648 ± 0.19070	A

Shell Weight

For the shell weight (in grams), it can be inferred that there is no significant difference between the four treatments (p-value>0.05) as shown in Table 6. This also means that there is no significant treatment effect.

Table6: Analysis of Variance for the shell weight of Japanese quail eggs supplemented with different concentrations of Aguingay inflorescence meal.

Source	SS	df	MS	F	p-value
Block (Day)	572.2849	31	18.4608	9.33***	0.0000
Treatment	5.029507	3	1.6765	0.85ns	0.5338
Residual	944.0069	477	1.9791		
Total	**1521.321**	**511**			

ns- Not significant

***-Significant at the 0.1% level

Moreover, it implies that the shell weight is statistically the same among the four treatments, on the average. In general, we can say that treatments 1, 2, and 3, produced the same shell weight with the positive control (T0). Lastly, the blocking variable which is the day of collection from July 24 to August 24 is highly effective which means that at least one of the days the shell weight is substantially different compared to the other days. The reliability index of the experiment is approximately 103% which means that this experiment has unacceptable reliability.

Table7: Post-Hoc Analysis (Pairwise Comparison) for the shell weight of Japanese quail eggs using Tukey's Honest Significant Difference at the 5% level.

Treatment	Mean	Tukey's HSD Group
T0	1.347 ± 0.15768	A
T1	1.233 ± 0.11210	A
T2	1.354 ± 0.14933	A
T3	1.512 ± 0.18316	A

Egg Performance

The egg laying performance is inferred that there is no significant difference between the four treatments as shown in Table 8. This means that the varied level of aguingay inflorescence meal has no significant treatment effect. The positive control (T0) produced similar egg laying performance with treatments 1, 2, and 3. Blocking variable of the study is effective because of the significant effect as the laying performance is different compared to the other days. There are a lot of factors that affects the laying performance of quails. This includes the breed, house, body weight, lighting schedule, climate, and especially the feed. These factors are necessary to be met to ensure that the laying birds are at its most comfortable condition.

Table8: Analysis of Variance for the egg laying performance of Japanese quail eggs supplemented with different concentrations of Aguingay inflorescence meal.

Source	SS	DF	MS	F	p-value
Block (Day)	31635.48	30	1054.516	2.31**	0.0012
Treatment	2367.742	3	789.2473	1.73ns	0.2041
Residual	211132.3	462	456.9962		
Total	**245135.5**	**495**			

ns- Not significant

**-Significant at the 1% level

Protein Content

As a source of nutrients for human health, quail eggs could be of good help. Based on the results for protein analysis, T2 has the highest percentage of 33.19 with T1 having the lowest crude protein of 13.74. The supplementation of Japanese quail with aguingay inflorescence meal gave higher crude protein percentage as compared to the control. This study gave higher values of crude protein compared to the study of Thomas et al. (2016) having a crude protein result of 13.30± 0.08%.

Table9: Protein analysis results of the Japanese quail eggs supplemented with different concentrations of Aguingay inflorescence meal.

Treatment	% MC	% Dry Matter	Crude Protein
T0	67.63	32.37	29.18
T1	73.8	26.2	13.74
T2	74.83	25.17	33.19
T3	72.09	27.91	31.95

SUMMARY

This study primarily aims to examine the external and internal egg quality traits of Japanese quail supplemented with variable levels of aguingay inflorescence meal and the laying performance of Japanese quail supplemented with varying levels of aguingay inflorescence meal. The study showed a very highly significant difference between the four treatments (p-value<0.001) in terms of the egg weight of the Japanese quails. There is a significant treatment effect on the egg weight of the Japanese quails. The positive control (T0) has the lightest egg weight with an average of 10.312 grams which is statistically equal to T1 and T3, an average egg weight of 10.507 grams, and 10.638 grams. Moreover, T2 has the heaviest egg weight of 10.817 grams on average, statistically different from T0, T1, and T3. In general, T2 produced the heaviest egg weight among the treatments. There is no significant difference in the other egg quality traits

such as yolk color, shell weight, and the egg-laying performance of the Japanese quails. Protein analysis revealed that T2 has the highest percentage of 33.19, with T1 having the lowest crude protein of 13.74.

CONCLUSION

- The varied levels of aguingay inflorescence meal have high significant difference in terms of the egg weight of the Japanese quails.
- There is no significant difference between the four treatments on the yolk color and shell weight of the Japanese quail eggs.
- Egg laying performance of the Japanese quails gave no significant difference between the varied level of aguingay inflorescence meal.
- The supplementation of aguingay inflorescence meal to Japanese quails results to higher protein composition of the eggs.

RECOMMENDATION

- Longer duration period should be done for the study.
- Proximate analysis should be done for the aguingay inflorescence meal.
- Analysis on the nutritional component of the egg should be done.

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