Egg quality evaluation of japanese quail (*Coturnix coturnix japonica*) supplemented with powdered leaves of jute mallow (*Corchorus olitorius*) and siam weed (*Chromolaena odorata*)

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Abstract. The study aimed to evaluate the egg quality of Japanese quail (Coturnix coturnix japonica) supplemented with powdered leaves of jute mallow and Siam weed. A total of 144 quail eggs were collected and evaluated every Thursday over six weeks using a Complete Randomized Design (CRD). The experimental treatments included four formulations (T1 to T4) combining commercial rations with varying levels of jute mallow and Siam weed leaf powders. Parameters assessed were egg weight, egg width, eggshell weight, eggshell thickness, eggshell strength, egg length, yolk weight, albumen weight, and yolk color, which were analyzed using one-way analysis of variance (ANOVA). The results indicated no significant differences in most egg quality parameters, including egg weight, egg width, eggshell weight, eggshell thickness, eggshell strength, egg length, yolk weight, and albumen weight, among treatments. However, yolk color exhibited a highly significant difference, with quails fed the supplemented rations showing an improved yolk color rating. These findings suggest that incorporating powdered jute mallow and Siam weed leaves into quail diets enhances yolk color, making it a viable natural colorant alternative. This practice is recommended as it utilizes locally available, cost-effective resources rich in nutrients beneficial for egg production. Additionally, the supplementation stimulates the digestive system, enhancing digestive enzyme production and feed utilization efficiency by improving liver function, as supported by [7]. Using such natural feed additives aligns with sustainable agricultural practices, offering a practical and environmentally friendly solution for improving specific aspects of egg quality, particularly yolk pigmentation, in laying quails.

1 Introduction

Egg quality is strongly related to hens' nutrition and digestive function. It should be noted that as an egg is laid, the internal quality of eggs begins to deteriorate due to loss of Moisture,

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carbon dioxide and the entrance of bacteria via the eggshell pores [1]. The quality of the egg, once laid, cannot be improved. Hence, efforts to maintain its quality must start right now as eggs stored longer than necessary may negatively impact egg quality due to the transition periods. Therefore, improving quality and extending the shelf life of edible eggs are parts of the effort's strategies employed to safeguard public health and increase profitability in egg production. The egg yolk color is one of the leading indicators of egg quality affecting consumer's preference. Hence, some producers use synthetic additives commonly used as colorings in laying hens to affect the egg yolk color, as laying hens cannot synthesize egg yolk pigments [2]. Therefore, it is necessary to embrace natural colorings like carotenoid which can be sourced from herbs, spices and other shrubs that positively affect laying performance and egg quality [3]. Moreover, these herbs would be easily available and can be used effectively in poultry diets (Deka et al., 2019). One of the potential feed additives is the siam weed (Chromolaena odorata) and jute leaves (Corchorus olitorius).

Siam weed *(Chromolaena odorata)* is a perennial shrub that belongs to the Asteraceae family. It is a highly successful plant that has colonized diverse ecological areas of tropical lands. It is generally considered poisonous to animals and thus not recommended as livestock feed [4]. However, the anti-nutrient contents of feeds are reduced by several processing methods, including cooking, toasting, and drying [5]. Some studies showed its benefits in low concentrations, such as up to 5% for egg-laying chickens, which also improved yolk color [6]. Despite anti-nutritional factors in Siam weed, researchers have reported that the plant applies to poultry production.

On the other hand, Jute mallow *(Corchorus olitorius)* is rich in enormous amounts of water and an appreciable number of mineral elements like iron, calcium, potassium, sodium, and phosphorous. Jute mallow leaves are rich sources of potassium, iron, copper, manganese, and zinc, and they have high energy values essential in human and animal nutrition. Additionally, they stimulate the digestive system by increasing the production of digestive enzymes and improving feed utilization efficiency by enhancing liver functions [7]. Based on the findings by these researchers, the hypothesis that these additives may positively affect laying performance and egg quality is most likely to be valid. However, there is no study done on the combination of siam weeds and jute mallow leaves; therefore, the researcher conducted a study using siam weeds and jute mallow leaves in the diet to evaluate its effects on the egg quality of Japanese quail.

1.1 Objectives of the Study

The study's general objective was to evaluate the egg quality of Japanese quail (*Coturnix coturnix japonica*) supplemented with powdered leaves of jute mallow and siam weed**.**

2 Materials and Methods

A total of one hundred forty-four (144) quail eggs were collected weekly and placed correctly in an egg tray. These eggs were evaluated every Thursday of the week with a total of six evaluations until the study were terminated.

A completely randomized design (CRD) was used and all the gathered data for egg external quality characteristics (egg weight, egg width, eggshell weight eggshell thickness, egg length, egg strength) and egg internal quality characteristics (yolk weight, albumen weight, yolk color) were subjected to a one-way analysis of variance (ANOVA). The treatment means were compared using Duncan's Multiple Range Test (DMRT).

The study was conducted at Northwestern Mindanao State College of Science and Technology located in Barangay Labuyo, Tangub City, Misamis Occidental. The location lies between 8°4' north and 123°43' East.

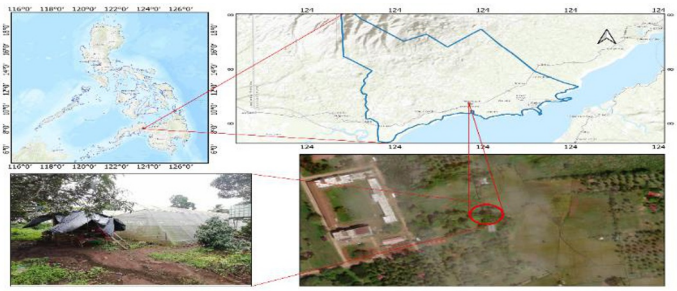

Fig.1. Location of the study area (QGIS 3.0, GOOGLE MAP)

3 Results and Discussion

3.1 Egg External Quality Characteristics

3.1.1 Egg weight

The egg weight of Japanese quails, as presented in Table 1, shows that the values for T1, T3, and T4 were 11.13g/egg, 11.09g/egg, and 11.26g/egg, respectively, while T2 recorded the lowest result at 10.82g/egg. Statistical analysis (ANOVA) revealed no significant differences between treatment means, indicating that the inclusion of jute mallow and Siam weed in the diets of laying quails did not significantly influence egg weight. This finding aligns with the study of Balana et al. (2021), which reported that quail egg weights typically range from 6 to 16 grams, with an average weight of 10 grams. The consistency in egg weight across treatments suggests that the supplemental inclusion of jute mallow and Siam weed leaves does not negatively impact this parameter. This stability is significant as it implies that these locally available and cost-effective feed additives can be incorporated into quail diets without compromising egg weight, a critical factor for market acceptability and productivity.

Furthermore, the result suggests that egg weight is more influenced by genetic factors and baseline nutrition rather than minor dietary changes involving natural additives. While the primary benefits of these supplements may lie in improving other aspects of egg quality, such as yolk color, their use does not detract from maintaining optimal egg weight. This finding reinforces the potential for utilizing natural feed supplements in sustainable quail farming systems.

3.1.2 Egg width

The egg width of Japanese quails, as presented in Table 1, showed similar results for T1 (24.86 mm/egg), T3 (24.75 mm/egg), and T4 (25.00 mm/egg), while T2 recorded the lowest value at 24.63 mm/egg. Statistical analysis (ANOVA) indicated no significant differences among treatment means, suggesting that the inclusion of jute mallow and Siam weed in the diets of laying quails did not affect egg width. This result implies that egg width, like egg weight, is primarily influenced by genetic factors and baseline nutrition rather than the addition of these natural feed supplements. Thus, incorporating jute mallow and Siam weed in quail rations can be pursued without negatively impacting this parameter, supporting their potential as sustainable and cost-effective dietary additives.

3.1.3 Eggshell weight

The eggshell weight of Japanese quails, as presented in Table 1, showed similar results for T1 (1.76g/egg), T2 (1.69g/egg), and T4 (1.71g/egg), while T3 recorded the lowest value at 1.67g/egg. Statistical analysis (ANOVA) revealed no significant differences among treatment means, indicating that the inclusion of jute mallow and Siam weed in the diets of laying quails did not significantly influence eggshell weight. This finding suggests that eggshell weight, a critical factor for egg durability and quality, is likely governed by inherent physiological and genetic factors rather than minor dietary modifications with these natural feed additives. The consistency in eggshell weight across treatments demonstrates that incorporating jute mallow and Siam weed in quail diets does not compromise eggshell quality. This highlights their potential as sustainable and cost-effective feed supplements, particularly for enhancing other egg quality parameters without adversely affecting structural components like eggshell weight.

3.1.4 Eggshell thickness

The eggshell thickness of Japanese quails, as shown in Table 1, was similar for T1 (0.41 mm/egg), T2 (0.42 mm/egg), and T3 (0.43 mm/egg), while T4 recorded the highest value at 0.50 mm/egg. Although statistical analysis (ANOVA) indicated no significant differences among treatment means, the thicker shells observed in T4 suggest a positive trend when jute mallow and Siam weed are combined in the ratio of laying quails. This result implies that combining these natural feed additives may enhance eggshell thickness, which improves egg quality. Thicker shells protect eggs against microbial contamination and physical damage, ensuring better egg preservation and safety. While further studies may be needed to confirm these findings, the potential for jute mallow and Siam weed to improve certain aspects of egg quality highlights their value as sustainable and cost-effective dietary supplements.

3.1.5 Eggshell strength

The eggshell strength of Japanese quails, as presented in Table 1, showed that T3 and T4 had the highest and identical values of 2.39 kg, followed by T2 at 2.26 kg, and T1 with the lowest result at 2.24 kg. Statistical analysis (ANOVA) revealed no significant differences among treatment means, indicating that the inclusion of jute mallow and Siam weed in the rations of laying quails did not significantly affect eggshell strength. These findings suggest that eggshell strength is likely influenced more by intrinsic factors such as genetics and baseline nutrition than by the addition of these natural feed supplements. However, the consistently higher strength observed in T3 and T4 implies that the supplementation may have a stabilizing or supportive effect on maintaining robust eggshell quality. This demonstrates the potential of jute mallow and Siam weed as sustainable feed additives, contributing positively to egg quality without compromising shell integrity.

3.1.6 Egg length

The egg length of Japanese quails, as shown in Table 1, revealed that T1 recorded the highest value at 31.53 mm/egg, followed by T4 (30.93 mm/egg) and T3 (30.67 mm/egg), while T2 had the lowest value at 29.86 mm/egg. Statistical analysis (ANOVA) indicated no significant differences among treatment means, suggesting that the inclusion of jute mallow and Siam weed in the diets of laying quails did not significantly impact egg length. These findings highlight that egg length is likely determined by genetic and physiological factors rather than dietary supplementation with these natural additives. The slight variations observed across

treatments suggest that using jute mallow and Siam weed as feed supplements does not adversely affect egg dimensions, maintaining overall egg quality. This reinforces the potential of these sustainable and cost-effective additives for use in quail production without negatively influencing key physical traits of the eggs.

Table 1. External quality characteristics of eggs from Japanese quail supplemented with powdered leaves of jute mallow and siam weed.

Treatment	Means					
	Egg Weight (g)	Egg Width (mm)	Eggshell Weight (g)	Eggshell Thickness (mm)	Eggshell Strength (kg/cm²)	Egg Length (mm)
T_1 (1000g commercial ration)	11.13	24.86	1.76	0.41	2.24	31.53
T_2 (1000g commercial ration + 50g JMLP	10.82	24.63	1.69	0.42	2.26	29.86
T_3 (1000g commercial ration + 50gSWLP)	11.09	24.75	1.67	0.43	2.39	30.67
T_4 (1000g commercial ration + 50g SWLP + 50g JMLP)	11.26	25.00	1.71	0.50	2.39	30.93
F value	1.14^{ns}	2.02^{ns}	1.49^{ns}	1.51^{ns}	1.76^{ns}	1.22^{ns}
CV (%)	3.69	0.84	3.79	16	5.03	5.11

Note: "ns" denotes non-significant differences.

In general, the study highlights that incorporating powdered Jute Mallow and Siam Weed leaves into the diet of Japanese quails has minimal impact on external egg quality traits such as egg weight, width, shell weight, and shell strength. However, the combined supplementation in T4 positively affected eggshell thickness, suggesting improved shell quality and protection. These findings imply that Jute Mallow and Siam Weed can be safely used in quail diets without compromising egg quality, ensuring consistency in product standards and meeting market expectations. This could offer producers an effective dietary strategy to enhance eggshell quality without negatively affecting other key traits.

3.2 Egg Internal Quality Characteristics

3.2.1 Yolk weight

The yolk weight of Japanese quails, as shown in Table 2, revealed that T1 and T2 had similar values of 3.60g and 3.64g, respectively, while T4 recorded 3.40g, and T3 had the lowest yolk weight at 3.38g. Statistical analysis (ANOVA) indicated no significant differences among treatment means, demonstrating that the inclusion of jute mallow and Siam weed in the diets of laying quails did not significantly influence yolk weight. This result suggests that yolk weight is predominantly governed by genetic and physiological factors, with little impact from dietary supplementation using these natural additives. The stability of yolk weight across treatments implies that incorporating jute mallow and Siam weed into quail diets does not compromise this parameter of egg quality. Additionally, this supports their potential as sustainable and cost-effective feed additives for enhancing other aspects of egg quality without negatively affecting the yolk's contribution to the overall egg composition.

3.2.2 Albumen weight

The albumen weight of Japanese quails, as presented in Table 2, showed that T1, T2, and T4 had comparable values of 5.71g, 5.54g, and 5.80g, respectively, while T3 recorded the lowest value at 5.49g. Statistical analysis (ANOVA) revealed no significant differences among treatment means, indicating that the inclusion of jute mallow and Siam weed in the diets of laying quails did not significantly influence albumen weight. This finding suggests that albumen weight is primarily determined by genetic and physiological factors rather than dietary supplementation with these natural additives. The consistency in albumen weight

across treatments implies that the use of jute mallow and Siam weed as feed additives does not compromise the quality or volume of albumen, which is essential for egg structure and nutritional value. Their inclusion in quail diets remains a viable, sustainable, and cost-effective approach for enhancing other egg quality traits without negatively affecting albumen composition.

3.2.3 Yolk color

The yolk color of Japanese quails, as presented in Table 2 and Figure 2, revealed that T4 achieved the highest rating scale of 8.89, followed by T3 (8.47), T2 (8.21), and T1 with the lowest rating scale of 8.04. Statistical analysis (ANOVA) indicated highly significant differences between treatment means, demonstrating that the inclusion of jute mallow and Siam weed in the diets of laying quails significantly improved yolk color. The enhanced yolk color in T4, which combined both jute mallow and Siam weed, can be attributed to the high levels of pigments like xanthophylls and carotenoids obtained from these natural additives. Jute mallow is a rich source of carotene [8], while Siam weed has also been reported to improve yolk color [6]. These findings highlight the potential of these plants as natural colorants in quail feed, offering an eco-friendly and cost-effective alternative to synthetic additives. The improvement in yolk color is visually appealing, enhancing consumer preference and market value, and reflects the nutritional enrichment of the eggs due to beneficial pigments. These pigments have known antioxidant properties, potentially improving the health benefits of the eggs. Therefore, the use of jute mallow and Siam weed in quail diets is a practical approach to producing high-quality eggs with superior yolk color, aligning with sustainable and health-focused agricultural practices.

Table 2. Internal quality characteristics of eggs from Japanese quail supplemented with powdered leaves of jute mallow and siam weed.

Treatments	Means		
	Yolk weight (g)	Albumen weight (g)	Yolk color
T_1 (1000g commercial ration)	11.13	5.71	8.4c
T_2 (1000g commercial ration + 50g JMLP	10.82	5.54	8.21d
T_3 (1000g commercial ration + 50gSWLP)	11.09	5.49	8.47b
T_4 (1000g commercial ration + 50g SWLP + 50g JMLP)	11.26	5.80	8.89a
F Value	1.51^{ns}	1.42^{ns}	579.45**
CV (%)	6.36	4.57	0.24

Note: "ns" denotes non-significant differences.
"**" denotes highly significant differences.

Different letters (a, b, c, d) in the "Yolk Color" column indicate statistically significant differences between treatments.

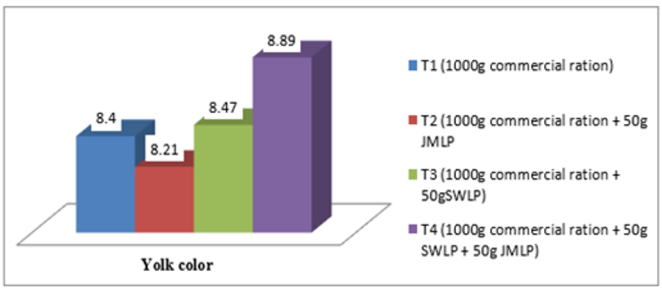

Fig. 2. Yolk color of Japanese Quails supplemented with powdered leaves of jute mallow and siam weeds.

Generally, including Jute Mallow and Siam Weed in the diet of laying Japanese quails has minimal impact on internal egg quality characteristics such as yolk and albumen weights, as shown by the lack of significant differences between treatment groups. This suggests that these dietary supplements can be safely incorporated without affecting the weight components of the eggs, allowing for cost-effective or nutritional modifications in quail feed. However, the study revealed a highly significant positive impact on yolk color, with the combination of supplements in T4 showing the most pronounced effect. The pigments found in Jute Mallow and Siam Weed, such as xanthophyll and carotenoids, are likely responsible for this enhancement, aligning with previous research. Improving yolk color can increase quail eggs' aesthetic and market appeal, offering producers a strategy to enhance product quality without compromising other key egg characteristics. Thus, these dietary additions can support better marketability while maintaining consistency in egg quality.

4 Conclusion and Recommendations

4.1 Conclusion

The study found that quails supplemented with powdered leaves of jute mallow and Siam weed showed no significant differences in several key parameters of egg quality, including egg weight, egg width, eggshell weight, eggshell thickness, eggshell strength, egg length, yolk weight, and albumen weight. However, a highly significant difference was observed in yolk color, with the combination of jute mallow and Siam weed (T4) having a particularly positive impact on the yolk's visual appeal. This improvement in yolk color can be attributed to the beneficial pigments such as xanthophylls and carotenoids derived from these feed additives. Both jute mallow and Siam weed are rich in essential nutrients that contribute to the enhanced quality of yolk color, which is highly favorable in the market for its appeal to consumers. In conclusion, the results of this study suggest that while the supplementation of jute mallow and Siam weed did not significantly alter the other egg quality parameters, it notably improved yolk color, making these natural additives a valuable, cost-effective, and sustainable option for enhancing the marketability of quail eggs. The positive effect on yolk pigmentation highlights the potential of these locally available feed additives in improving the visual quality of eggs without compromising other important traits.

4.2 Recommendations

Based on the findings of this study, egg producers are encouraged to incorporate jute mallow and Siam weed into the diets of laying quails, as they are locally available, cost-effective, and rich in essential nutrients that support overall egg production. Including these plants significantly improves yolk color, which can enhance the visual appeal of the eggs and positively impact marketability, as eggs with deeper yolk colors are more desirable. Additionally, jute mallow and Siam weed provide a sustainable, eco-friendly, and cost-effective feeding option that reduces the need for synthetic additives. While the study focused on yolk color, ongoing monitoring, and further research are recommended to explore the broader effects of these additives on other egg quality parameters. By adopting these practices, egg producers can improve the quality and marketability of their eggs while promoting sustainable and efficient farming.

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