

Egg Performance and Quality Evaluation of Quail (*Coturnix coturnix*) Supplemented with Calphos using Oyster Shell

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Date received: April 22, 2025

Date revised: August 19, 2025

Date accepted: September 8, 2025

Originality: 97%

Grammarly Score: 99%

Similarity: 3%

Recommended citation:

Ellaga, J. E., & Vergara, J. (2025). Egg performance and quality evaluation of quail (*Coturnix coturnix*) supplemented with Calphos using the oyster shell. *Journal of Interdisciplinary Perspectives*, 3(10), 164–171. <https://doi.org/10.69569/jip.2025.303>

Abstract. The study investigates the impact of supplementing quail diets with Calphos, a calcium source derived from oyster shells, on egg performance and quality. Calcium is a vital nutrient for laying birds, influencing egg production and shell integrity. Despite previous research exploring various calcium sources, there is a lack of clarity regarding their specific effects on quail productivity. This research addresses this gap by evaluating the effect of different concentrations of Calphos in water (20ml, 25ml, and 30ml per liter) on the number of eggs laid, laying rate, feed conversion ratio (FCR), and egg quality, including shell thickness, egg length, width, and weight. Using a Completely Randomized Design with four treatments and three replicates, the results reveal significant improvements in egg performance and quality, particularly with 20ml Calphos supplementation, which produced the highest laying rate and egg count. While FCR and shell thickness showed minimal improvement, egg weight, length, and width were significantly enhanced at higher Calphos concentrations (25ml and 30ml). These findings suggest that incorporating Calphos supplementation, especially at 20ml to 30ml per liter, can be an effective strategy for improving egg production and quality in quail farming. Further research is recommended to optimize dosage and assess the long-term economic impact on poultry production.

Keywords: Calcium phosphate; Egg production; Laying rate; Poultry production; Water supplement.

1.0 Introduction

The supplementation of quail diets with calcium sources, especially Calphos combined with oyster shells, has garnered attention for its potential to improve egg quality and overall performance in quails. Calcium is a crucial nutrient for laying birds, impacting egg production, shell integrity, and, ultimately, the profitability of quail farming. Research shows that various calcium sources can distinctly influence the productive performance of quails. Mendonça et al. (2022) observed no significant differences in the performance of meat quails fed diets with different calcium sources, such as charred mussel shell, maçunim shell meal, and oyster shell meal, suggesting that the type of calcium source may not critically affect growth performance. In contrast, Eberhart et al. (2021) found that the use of Ovosigo® resulted in a higher percentage of eggshell formation, indicating better calcium availability, which positively influenced egg weights and shell quality. These findings align with Mako et al. (2020), who demonstrated that hen-day production did not significantly differ between hens fed limestone and those fed oyster shells, further supporting the idea that oyster shells can serve as an effective calcium source.

The particle size and form of calcium sources also play a key role in their efficacy. Tunç and Çufadar (2014) noted that substituting fine limestone with larger particle sizes of oyster shells improved shell quality and performance

metrics in laying hens. This suggests that the careful selection of calcium source and particle size can optimize calcium release and absorption. Similarly, Olgun et al. (2015) confirmed that calcium sources like oyster shells improved eggshell quality and performance metrics, underscoring the importance of calcium supplementation during the laying period. Thus, combining Calphos with oyster shells emerges as a promising strategy for meeting the dietary calcium needs of quails. This combination can enhance calcium bioavailability, improving eggshell thickness and strength—a vital factor in reducing egg breakage during handling and transport—and may correlate with better laying performance and larger eggs.

Calphos, a concoction made from eggshells, bones, and vinegar, is rich in natural minerals such as calcium and phosphorus (Hubilla, 2020). It has been shown to improve egg production, growth, and eggshell quality in poultry. Therefore, this study aims to assess the laying and egg performance of quails supplemented with different levels of Calphos combined with oyster shells. Specifically, to determine the egg performance of quails supplemented with different levels of calphos using oyster shells in terms of a) the number of eggs laid, (b) laying rate, and c) feed conversion ratio, and to evaluate the egg quality of quails supplemented with different levels of calphos using oyster shells in terms of a) shell thickness, b) egg length, c) egg width, and egg weight.

2.0 Materials and Methods

2.1 Experimental Design and Layout

The study was conducted using a Completely Randomized Design (CRD) with four (4) treatments replicated three (3) times. Each treatment consisted of five (5) quails per replicate. Twenty (20) heads were allotted as replacements for mortality, for a total of 80 heads of quails.

C	B	A
A	D	B
A	B	D
C	D	C

Legend:
 Treatment A-Control
 Treatment B-20ml Calphos
 Treatment C-25ml Calphos
 Treatment D-30ml Calphos

Figure 1. *Experimental Layout*

2.2 Preparation and Procedure of Making Calphos

The researchers prepared all the necessary materials. Oysters and coconut vinegar were purchased in the area. The oyster shells were cleaned and roasted until burnt. Calphos was prepared according to the Calphos procedure of the Department of Agriculture. The oyster shells were gathered. They were washed and roughly ground using a hammer. They were toasted in a large frying pan until some shells turned black. The charred and black shells represent phosphorus, and the white/brown shells are calcium. The shells were placed into a plastic jar with vinegar in a ratio of one (1) part shell to 5 parts vinegar (1:5). When the mixture started to bubble, it was a good thing. Once it had stopped, the container was sealed and left to ferment for 20 days. After 20 days, the liquid was strained and filtered. They were placed in plastic bottles and ready for use.

2.3 Feeding Management

The study used commercial starter, finisher, and layer feeds. The feeds were reserved a week before the arrival of the quails to ensure supply during the study's conduct.

2.4 Water Management

Water is the most critical nutrient for poultry. The quails were provided with clean and potable water in their troughs. Calphos was added per liter of water according to treatment: Treatment A-Control (1 L pure water),

Treatment B-20 ml Calphos, Treatment C-25 ml Calphos, and Treatment D-30 ml Calphos. The water was changed regularly.

2.5 Preconditioning

A week after the arrival of the stocks, the quails were preconditioned to treatment. They were subjected to a water supplement transition, wherein Calphos was gradually offered to prepare their digestive system for the new supplementation (B, C, and D) and to adapt to the treatments, except for the control treatment, which was given with pure water alone (A). During the conditioning period, the birds were administered Calphos at an adjusted amount. The table below (Table 1) shows the levels of treatment added per 1 L of water. It was done three (3) days before the actual study started.

Table 1. Preconditioning Table

Treatments	Day 1 (25%)	Day 2 (50%)	Day 3 (75%)	Day 4 (100%)
A	Pure water	Pure water	Pure water	Pure water
B	5ml	10ml	15ml	20ml
C	6.25ml	12.50ml	18.75ml	25ml
D	7.5ml	15ml	22.50ml	30ml

2.6. Data Gathering

The study collected data on the laying and egg performance of quails using the following parameters:

Egg performance

The egg performance of quails was determined using the following parameters: total number of eggs laid, Laying rate, Feed intake, and Feed Conversion Ratio (FCR). Every day, the total number of eggs in each cage was counted and recorded. This was done for six (6) weeks. The mean values per week were calculated. The total number of eggs laid was used to assess the laying rate of quails. The feed intake was recorded daily from the start of the raising period and was calculated by subtracting the remaining feed from the total feed given. The formula used was: *Feed intake = Feed given – Feed remained*. The water intake was recorded daily from the start of the raising period and was calculated by subtracting the remaining water from the total water given. The formula used was: *Water intake = Water given – Water remained*. The FCR is the ratio between the feed consumed and the egg mass. The formula used was: *FCR = Feed consumed ÷ Egg produced*

Egg Quality

The egg performance of quails was determined using the following parameters: shell thickness, egg length, egg width, and egg weight. Shell thickness was measured every seven (7) days for six (6) weeks. The cracked egg shell was measured by using a digital Vernier caliper in centimeters, and the mean values per week were calculated. The egg length was measured from the top to the bottom of the egg using a Vernier caliper in millimeters. The width of the egg was determined by measuring its widest part using a Vernier caliper in millimeters. The weight of the quail eggs was determined by using a digital weighing scale in grams. To guarantee that the precise weight of the egg was obtained, the weighing scale was placed on a flat surface.

2.7. Statistical Analysis

At the end of the study, all collected data were classified, tabulated, and computed. Each data set was analyzed using the Analysis of Variance (ANOVA) at 1% and 5% probability using the Statistical Tool for Agricultural Research (STAR). Treatment means with significant effects were tested using the Least Significant Difference (LSD) to determine the most significant treatment.

2.8. Ethical Considerations

The authors followed ethical principles when conducting the research and preparing the manuscript. All the data are recorded, kept, and treated with high confidentiality.

3.0 Results and Discussion

3.1 Egg Performance

Number of Eggs Laid

Table 2 presents the results of an experiment on quail egg production with varying doses of Calphos supplementation. The data reveal that the control group (Treatment A), without Calphos supplementation,

produced the lowest average number of eggs at 4.2. However, Treatment B, which received 20 ml of Calphos, significantly outperformed all other treatments, yielding the highest average of 5.0 eggs. Treatments C (25 ml) and D (30 ml) also showed an increase in egg production compared to the control, with averages of 4.8 and 4.6 eggs, respectively. The low coefficient of variation (5.7%) indicates that the results are consistent and reliable.

Table 2. *Several Eggs are Laid by Quails Supplemented with Calphos*

Treatment	Number of Eggs laid
Treatment A-Control	4.2 ^b
Treatment B-20ml Calphos	5.0 ^a
Treatment C-25ml Calphos	4.8 ^a
Treatment D-30ml Calphos	4.6 ^{ab}
f-test	*
cv %	5.7%

These findings suggest that Calphos supplementation, particularly at 20 ml, improves egg production, with diminishing returns observed at higher dosages. Therefore, farmers should consider using 20 ml of Calphos for optimal egg production, as increasing the dosage beyond this amount does not yield significant improvements. Further research could explore the long-term effects and efficiency of Calphos supplementation over multiple breeding cycles. Based on the F-test, significant differences in the number of eggs between treatments could be attributed to the effect of Calphos supplementation.

As reported by Mendunca et al. (2020), the use of oyster shells as a calcium source in quail diets has been examined for their influence on egg production and quality. Calcium is essential for laying birds, supporting egg formation and eggshell quality. Studies have demonstrated that dietary calcium sources, including oyster shells and limestone, can significantly impact egg production rates, albeit with variations in efficacy depending on the source and form of calcium. The digestibility of calcium from various sources, including oyster shells, was shown by Leão et al. to have high bioavailability, implying that quail can effectively utilize it for egg production.

Laying Rate

Table 3 displays the laying rate of quails supplemented with varying doses of Calphos in their water. The control group (Treatment A) had the lowest laying rate at 55.5%. However, Treatment B, which was supplemented with 20 ml of Calphos per liter of water, showed the highest laying rate at 64.1%, which was significantly different from the control. Treatment C, which received 25 ml of Calphos per liter of water, had a similar laying rate of 63.9%, also significantly higher than the control. Treatment D, with 30 ml of Calphos, had a laying rate of 61.5%, which was higher than the control but not as high as Treatment B or C. The low coefficient of variation (CV%) of 5.4% reflects a moderate level of consistency in the results.

Table 3. *Laying Rate of Quails Supplemented with Calphos*

Treatment	Laying Rate
Treatment A-Control (pure water)	55.5 ^b
Treatment B-20ml Calphos/L of water	64.1 ^a
Treatment C-25ml Calphos/L of water	63.9 ^a
Treatment D-30ml Calphos/L of water	61.5 ^{ab}
f-test	*
cv %	5.4%

The F-test indicates significant differences among the treatments. These results suggest that Calphos supplementation improves the laying rate of quails, with the best results observed at 20 ml per liter of water, and that higher dosages provide slightly less improvement. Based on these findings, it is recommended to use 20 ml of Calphos for optimal laying rates. The coefficient of variation (CV%) is 5.4%. These findings align with the claims of Mendonça et al. (2020), who investigated the impact of various calcium sources on meat quails and found benefits associated with oyster shell supplementation. They reported that including oyster shells did not adversely affect the performance of meat quail, suggesting that it might also enhance laying performance in quail populations, as discussed by Leão et al. (2020), who emphasized the digestibility and bioavailability of calcium from organic sources, including oyster shells. Their study indicated that quails showed favorable nutrient absorption and egg production metrics with enhanced calcium supplementation.

Feed Conversion Ratio

Table 4 shows quails' feed conversion ratio (FCR) supplemented with Calphos. The FCR values reflect the efficiency of feed utilization in egg production of the quails under different treatments. Treatment B (20ml Calphos/L of water) had the lowest FCR at 8.4, indicating the most efficient feed conversion. Treatment C (25ml Calphos/L) had a slightly higher FCR of 8.7, while Treatment D (30ml Calphos/L) had an FCR of 9.1. The control group (Treatment A) had the highest FCR at 9.6, suggesting lower feed efficiency.

Table 4. A Feed Conversion Ratio of Quails Supplemented with Calphos

Treatment	FCR
Treatment A-Control (pure water)	9.6
Treatment B-20ml Calphos/L of water	8.4
Treatment C-25ml Calphos/L of water	8.7
Treatment D-30ml Calphos/L of water	9.1
f-test	ns
cv%	5.0%

Although Treatment B shows the best feed conversion, the F-test indicates that the differences between treatments are not statistically significant (ns). This means that the Calphos supplementation did not lead to substantial differences in feed efficiency across the treatments. While there is a trend toward better feed conversion with Calphos supplementation, especially at 20ml/L, the lack of statistical significance suggests that other factors may influence feed efficiency. Further research with a larger sample size or different concentrations could help clarify whether Calphos supplementation has a more pronounced impact on FCR. The coefficient of variation (CV%) is 5.0%. Based on the reports of Mendonça et al. (2022), in examining different calcium sources, including oyster shells, on the productive performance of meat quails, they found no significant differences in FCR among the various diets provided. This aligns with findings from Santos et al. (2020), which indicated that different feeding strategies did not significantly affect FCR in egg-type quails, suggesting that under certain dietary conditions, shell calcium sources may not enhance feed efficiency.

3.2 Egg Quality

Shell Thickness

Table 5 shows the shell thickness of eggs from quails supplemented with Calphos. The measurements reflect the impact of Calphos supplementation on the strength of the egg shells under different treatment conditions. Treatments B, C, and D all resulted in a shell thickness of 0.3 cm, whereas the control group (Treatment A) had a shell thickness of 0.2 cm. It indicates a potential improvement in shell strength with Calphos supplementation, particularly at 20ml/L and higher concentrations.

Table 5. Shell Thickness of Eggs of Quails Supplemented with Calphos

Treatment	Shell Thickness (cm)
Treatment A-Control (pure water)	0.2
Treatment B-20ml Calphos/L of water	0.3
Treatment C-25ml Calphos/L of water	0.3
Treatment D-30ml Calphos/L of water	0.3
f-test	ns
cv%	22%

Despite the observed differences in shell thickness, the F-test indicates that the differences between the treatments are not significant (ns). Although Calphos supplementation appears to increase shell thickness, the lack of statistical significance and the high variability in the data suggest that the effect may not be consistent across the sample. Further studies with more controlled conditions or larger sample sizes may be needed to confirm the potential benefits of Calphos on eggshell quality. The coefficient of variance is 22%.

The supplementation of calcium sources, such as oyster shells, in the diets of quails has been researched extensively. However, the effects on shell thickness appear inconsistent across various studies. Specifically, Mendonça et al. (2022) conducted an analysis where they found that different dietary calcium sources, including oyster shells, did not produce significantly different performance metrics in meat quail, indicating that shell thickness was not adversely affected by the inclusion of these calcium sources. This aligns with observations made by Rezvani et al., who reported no significant variation in eggshell quality when comparing diets with differing calcium sources, including oyster shells.

Egg Length

Table 6 presents the egg length of quails supplemented with Calphos. The data compares the egg length under different treatment conditions, including the control group (pure water) and three Calphos-supplemented groups. Treatment C (25ml Calphos/L) and Treatment D (30ml Calphos/L) showed the longest egg lengths at 30.9 cm and 30.8 cm, respectively. These were significantly longer than the control group (30.2 cm) and Treatment B (20ml Calphos/L), which measured 30.3 cm. The F-test indicates that the differences between treatments are highly significant ($p < 0.01$).

Table 6. *Egg Length of Quails Supplemented with Calphos*

Treatment	Egg Length (mm)
Treatment A-Control (pure water)	30.2 ^b
Treatment B-20ml Calphos/L of water	30.3 ^b
Treatment C-25ml Calphos/L of water	30.9 ^a
Treatment D-30ml Calphos/L of water	30.8 ^a
f-test	**
cv%	0.6%

The results suggest that Calphos supplementation, particularly at 25ml and 30ml per liter, significantly increases egg length. The significant increase in egg length with Calphos supplementation suggests that it positively affects the size of eggs produced by quails. This finding could be helpful for quail farmers aiming to improve egg size through dietary supplementation. Further studies could explore the impact on other egg quality parameters. The coefficient of variation (CV%) is 0.6%. Evidence from Tabeekh (2011) supports this, as they examined various external quality traits of quail eggs and observed that diets optimized with calcium supplementation were associated with improved egg length and overall size. Other studies of Sarmiento-García et al. (2022) and Souza et al. (2016) have reiterated that adequate dietary calcium directly correlates with improved egg weight and dimensions, reinforcing the efficacy of oyster shells as a calcium source.

Egg Width

Table 7 presents the egg width of quails supplemented with Calphos. The data compares the egg width under different treatment conditions, including the control group (pure water) and three Calphos-supplemented groups. Treatment D (30ml Calphos/L) showed the widest egg width at 25.4 cm, followed closely by Treatment C (25ml Calphos/L) at 25.3 cm. Both treatments showed a slight but significant increase in egg width compared to the control group (25.0 cm) and Treatment B (20ml Calphos/L), which also had an egg width of 25.0 cm.

Table 7. *Egg Width of Quails Supplemented with Calphos*

Treatment	Egg Width (mm)
Treatment A-Control (pure water)	25.0 ^b
Treatment B-20ml Calphos/L of water	25.0 ^b
Treatment C-25ml Calphos/L of water	25.3 ^a
Treatment D-30ml Calphos/L of water	25.4 ^a
f-test	**
cv%	0.4%

The F-test indicates that the differences between treatments are highly significant ($p < 0.01$). The results suggest that Calphos supplementation, particularly at 25ml and 30ml per liter, significantly increases egg width. The findings suggest that Calphos supplementation may enhance the width of quail eggs, which could be beneficial for producers looking to improve egg size. Further research could investigate the broader effects of Calphos on egg quality and production efficiency. The coefficient of variation (CV%) is 0.4%. This aligns with findings from Utami and Akbar (2025), who noted that calcium and phosphorus intake from oyster shells positively influenced egg production metrics in quails.

Egg Weight

Table 8 presents the egg weight of quails supplemented with Calphos. The data compares the egg weight under different treatment conditions, including the control group (pure water) and three Calphos-supplemented groups. Treatment C (25ml Calphos/L) and Treatment D (30ml Calphos/L) both resulted in the highest egg weight at 10.7 grams, while Treatment B (20ml Calphos/L) showed a slightly lower egg weight of 10.3 grams. The control group (Treatment A) had the lowest egg weight at 10.2 grams. The F-test indicates that the differences between treatments are statistically significant ($p < 0.01$), as indicated by the asterisks.

Table 8. *Egg Weight of Quails Supplemented with Calphos*

Treatment	Egg Weight (g)
Treatment A-Control (pure water)	10.2 ^b
Treatment B-20ml Calphos/L of water	10.3 ^b
Treatment C-25ml Calphos/L of water	10.7 ^a
Treatment D-30ml Calphos/L of water	10.7 ^a
f-test	**
cv%	0.9%

The results suggest that Calphos supplementation significantly increased egg weight, particularly at higher concentrations of 25ml and 30ml per liter. The significant increase in egg weight with Calphos supplementation suggests that it can enhance egg production in quails, which could improve both the quality and marketability of eggs. Further research could explore the long-term effects of Calphos supplementation on egg production and overall quail health. The coefficient of variation (CV%) is 0.9%. Ribeiro et al. (2016) reported that increased calcium and phosphorus intake leads to improvements in egg quality parameters, such as weight. Other studies of Sarmiento-García et al. (2022) and De Souza et al. (2016) have reiterated that adequate dietary calcium directly correlates with improvements in egg weight and dimensions, reinforcing the efficacy of oyster shells as a calcium source.

4.0 Conclusion

This study evaluated the effects of Calphos supplementation on quail egg performance and quality. The results indicate that Calphos, particularly at 20 ml per liter of water, significantly improved egg production and laying rate compared to the control group, with diminishing returns observed at higher doses. While no significant changes were observed in feed conversion ratio or shell thickness, the study revealed significant improvements in egg weight, length, and width, especially with 25 ml and 30 ml Calphos supplementation. These findings highlight the potential of Calphos as a cost-effective strategy to enhance egg quality and production in quail farming, benefiting both farmers and markets.

Farmers looking to improve egg production and quality in quail farming should consider supplementing their quails' water with 20 ml of Calphos per liter. This dosage maximizes egg production and laying rate without over-supplementing. Additionally, further research should focus not only on optimizing Calphos dosage but also on the long-term health and welfare of quails to ensure sustainable farming practices. To improve clarity in daily practice, farmers could integrate Calphos supplementation into their feeding regimen, monitor egg quality improvements, and evaluate the cost-effectiveness of supplementation over time. Exploring further benefits related to the health of the birds and potential economic impacts would provide a more comprehensive understanding of the long-term advantages of this supplementation strategy.

5.0 Contributions of Authors

This paper is co-authored. The first author was responsible for the concept, design, analysis, and encoding, while the second author contributed to writing and revision of the manuscript.

6.0 Funding

This study was funded by the College of Agricultural Sciences of the Guimarães State University-Baterna Campus.

7.0 Conflict of Interests

The authors declare no conflicts of interest concerning this article's research, authorship, and publication.

8.0 Acknowledgment

The authors would like to express their deepest gratitude to the University Administration and the Office of Research, Extension, Training, and Innovation for the support extended during this study.

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