

Effects of Antisol Supplementation on the Laying Performance and Egg Quality of Hubbard Laying Hens during the 30–40-Week-Old Period

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ABSTRACT

This study was conducted to evaluate the effects of dietary Antisol supplementation on the laying performance and egg quality of Hubbard laying hens during the 30- to 40-week-old period. The trial was arranged in a completely randomized design (CRD) with three treatments and ten replicates: T1, no Antisol supplementation (control); T2, Antisol supplemented at 1.5 g/L of drinking water; and T3, Antisol supplemented at 2.0 g/L of drinking water. The experiment was carried out from March 2026 to June 2026 at Thong Nhat poultry farm, Dong Nai province. The results showed significant differences ($P < 0.05$) in laying performance and egg quality among treatments. Antisol supplementation exerted a positive effect on both performance and egg quality in Hubbard hens. Hens supplemented with 2.0 g/L Antisol (T3) achieved a higher daily laying rate (94.57%) than those in T1 and T2 (81.12% and 92.74%, respectively). Mean egg weight reached 55.29 g in T1, 54.45 g in T2, and 57.21 g in T3. These findings indicate that supplementing 2.0 g Antisol per liter of drinking water produced the best laying performance and egg quality. A second trial, arranged as a completely randomized design with five treatments and ten replicates using 100 eggs, was also conducted to evaluate storage effects. Yolk color improved with storage time in treatments G3, G4, and G5 (11.0, 10.8, and 10.0, respectively) compared with treatments G1 and G2 (11.2); this difference was statistically significant ($P < 0.05$). All treatments scored above 7 for yolk color, meeting the standard for good egg quality. For Haugh unit (HU), G1 and G2 showed higher values (84.0 and 77.6, respectively) than G3, G4, and G5 (75.2, 71.8, and 70.1, respectively) ($P < 0.05$). All treatments met the standard of 60–70 HU or above for Grade-A eggs. Overall, Antisol proved to be an effective feed additive that improves laying performance and egg quality, thereby increasing the economic efficiency of Hubbard layer-hen farms during the production period.+

Keywords: Antisol, Hubbard hens, laying performance, egg quality.

INTRODUCTION

Antisol is a nutritional supplement widely used in poultry production to improve health status, stress resistance, and productive performance. Its main components are vitamin C, citric acid, and a sufficient quantity of excipients. The product is used when poultry experience stress caused by heat, transportation, feed changes, flock regrouping, or vaccination. Within Antisol, vitamin C plays an important role in metabolism and in strengthening the immune resistance of poultry. Although poultry can synthesize vitamin C endogenously, under stress conditions or high ambient temperature, endogenous synthesis is often insufficient to meet the body's needs. Supplemental vitamin C helps reduce the impact of oxidative stress, enhances immune capacity, improves survival rate, and sustains laying performance. According to Abad, P. et al. (2021), vitamin C strengthens disease resistance, protects blood-vessel walls, and helps the body withstand adverse environmental factors. Several studies have reported that supplementing vitamin C to laying hens under heat-stress conditions improves laying rate and egg quality.

In addition, citric acid is an organic acid that plays an important role in digestion and nutrient absorption. Citric acid lowers gastrointestinal pH, creating favorable conditions for digestive enzyme activity while limiting the proliferation of pathogenic bacteria. It can also chelate minerals such as calcium (Ca) and

phosphorus (P), increasing their solubility and intestinal absorption. Calcium and phosphorus are essential components involved in eggshell formation and the maintenance of egg quality. Dietary citric-acid supplementation can improve phosphorus utilization and enhance mineral-absorption efficiency in poultry. Sharma et al. (2020), likewise reported that citric acid contributes to improved eggshell quality and production performance. Furthermore, citric acid can chelate metal ions, thereby limiting oxidative reactions in the body, protecting cells from oxidative-stress damage, and helping to maintain the health and reproductive capacity of laying hens. The combination of vitamin C and citric acid in Antisol reduces the impact of stress, enhances nutrient absorption, and improves laying performance, egg quality, and the economic efficiency of layer-hen production. For these reasons, the study "Effects of Antisol on the laying performance and egg quality of Hubbard hens during the 30–40 week-old period" was undertaken. The objective was to determine the appropriate level of Antisol supplementation for improving egg performance and quality, as well as its economic benefit to producers.

MATERIALS AND METHODS

Experimental animals

Period: The study was conducted from March 2026 to June 2026.

Location: Thong Nhat poultry farm, belonging to C.P. Vietnam Livestock Joint Stock Company (Tra Co hamlet, Binh Minh commune, Trang Bom district, Dong Nai province).

The animals used in this study were imported Hubbard parent-stock hens aged 30–40 weeks, comprising 330 birds (300 hens and 30 roosters). All birds were selected for uniform body conformation and good health, with no clinical signs of disease, and were raised according to the standard technical procedures of C.P. Vietnam. Throughout the trial, all husbandry conditions were kept constant, with only Antisol and Vigosine supplementation varying among treatments.

Housing and management

The flock was raised in enclosed (environment-controlled) houses under the C.P. industrial production model. Each house measured approximately 12 m × 120 m × 2 m (width × length × height), and cages measured approximately 5.5 m × 6 m × 1 m (width × length × height), ensuring adequate ventilation space. Houses were equipped with ventilation fans, evaporative cooling pads, and automatic lighting systems to maintain suitable environmental conditions. The floor was covered with disinfected rice husks to limit pathogenic microorganisms and to keep the house dry.

Feeding was carried out using automatic feeders. Hens were fed once daily at 7:00 a.m. with complete feed (531NF) produced by the company. Feed allowance was adjusted according to the company's recommendations for each production stage to maintain body condition and laying performance. Drinking water was supplied continuously through an automatic nipple-drinker system connected to a 1,000-liter storage tank. House sanitation, husbandry management, and disease-prevention procedures followed the farm's standard operating protocol throughout the study to ensure stable rearing conditions for the flock. Hen body weight was recorded weekly to monitor weight changes throughout the study period. The vaccination program was carried out according to the company's disease-prevention schedule.

Table 1. Vaccination schedule for Hubbard hens aged 25–35 weeks

Age	Vaccine	Method
25 weeks	ND + IB (Clone 30 + Ma5)	Administered in drinking water

30 weeks	ND Clone 30	Administered in drinking water
35 weeks	ND + IB (Clone 30 + Ma5)	Eye-drop administration
	AI (H5N1-Re5) (****)	Subcutaneous injection, 0.5 mL/bird
	H9N2 + ND + IB (killed) (****)	Intramuscular injection, 0.5 mL/bird

Equipment

Equipment used in the trial included a record notebook, pens, calipers, a Roche yolk-color fan, an electronic scale, glass beakers, a computer, and other miscellaneous tools.

Experimental diet

Feed: An identical diet was fed to all treatments so that any differences among treatments would result solely from the drinking-water supplements.

Table 2. Nutrient composition of the basal diet for Hubbard hens aged 30–40 weeks

Component	Proportion (%)
Moisture (max)	14%
Crude protein (min)	15%
Crude fiber (max)	7%
Ca (min–max)	0.5–1.2%
Total P (min–max)	0.5–1.0%
Total lysine (min)	0.5%
Methionine + cystine (min)	0.4%
Metabolizable energy (min)	2,700 kcal/kg

The diet used in the experiment was a complete feed formulated for laying hens, meeting nutritional requirements at each stage of growth and egg production. The nutrient composition was balanced to provide adequate metabolizable energy, crude protein, essential amino acids, calcium, phosphorus, and other nutrients required to maintain flock health while ensuring egg performance and quality throughout the monitoring period. Feed was stored in a dry, well-ventilated area and distributed daily in appropriate amounts to minimize wastage and ensure that hens always had access to clean feed of consistent quality.

Experimental product

Experimental design

Content 1: The trial was arranged in a completely randomized design (CRD) with three treatments and ten replicates. Each replicate (experimental unit) consisted of 10 laying hens and 1 rooster. Thus, each treatment comprised 100 hens and 10 roosters, and the total number of birds used in the entire trial was 300 hens and 30 roosters.

The trial lasted 10 weeks, from 30 to 40 weeks of age. Throughout the trial, husbandry, management, veterinary hygiene, stocking density, lighting regime, and diet were kept uniform across treatments, differing only in the level of Antisol supplementation in the drinking water.

The treatments were arranged as follows:

T1 (control): Hens fed the basal diet and given plain water, without Antisol supplementation.

T2: Hens fed the basal diet supplemented with **Antisol at 1.5 g/L** of drinking water.

T3: Hens fed the basal diet supplemented with **Antisol at 2.0 g/L** of drinking water.

Content 2: Effect of storage duration on egg quality

This trial was arranged in a completely randomized design (CRD) with five treatments, corresponding to five egg-quality assessment time points during storage: 1 day (day of collection), 3 days, 5 days, 7 days, and 9 days of storage.

Each treatment used 20 eggs: 10 eggs were used to determine internal quality parameters, including yolk index, albumen index, and shape index; the remaining 10 eggs were used to determine yolk ratio, albumen ratio, and eggshell ratio. Each egg was treated as an experimental unit, and each parameter was replicated 10 times.

Eggs were collected from the same experimental flock, were uniform in weight, free of cracks or deformities, and stored under identical temperature and humidity conditions, storage temperature of 22°C and humidity of 75%. Egg-quality parameters were evaluated at each storage time point, with measurements for each treatment taken one day after egg collection.

A total of 100 eggs were used, distributed as follows:

Treatment	Storage time	No. of eggs for yolk index, albumen index, and shape index	No. of eggs for yolk, albumen, and shell ratios	Total eggs
G1	1 day	10	10	20
G3	3 days	10	10	20
G5	5 days	10	10	20
G7	7 days	10	10	20

G9	9 days	10	10	20
Total		50	50	100

The treatments were arranged as follows:

Treatment 1 (G1): eggs stored for 1 day

Treatment 2 (G3): eggs stored for 3 days

Treatment 3 (G5): eggs stored for 5 days

Treatment 4 (G7): eggs stored for 7 days

Treatment 5 (G9): eggs stored for 9 days

Sampling method

For body-weight monitoring, 5 hens per experimental unit were weighed weekly. With 10 experimental units per treatment, a total of 50 hens per treatment were weighed each week. The same marked hens within each experimental unit were weighed consistently every week to ensure uniformity and to facilitate tracking of weight changes over time. Body weight was measured with an electronic scale and recorded to evaluate the effect of treatments on the growth of laying hens during the trial.

The number of eggs laid in each treatment was recorded daily throughout the trial. Egg samples were collected weekly from each treatment to determine egg weight using an electronic scale with an accuracy of 0.1 g. All data were fully recorded on monitoring sheets and compiled by treatment for calculation of the study parameters.

Measured parameters

Laying performance:

Body weight (g/bird)

Body weight was determined at the beginning and end of the trial and expressed in grams per bird (g/bird).

Laying rate (%)

Laying rate was recorded daily for each treatment to evaluate the reproductive performance of the flock throughout the trial.

Formula: Laying rate (%) = (Number of eggs collected / Total number of hens present) × 100

Egg weight (g)

Egg weight is the average weight of the eggs sampled from each treatment, expressed in grams (g).

Formula: Egg weight (g) = Total egg weight / Number of eggs weighed

Egg quality comprises external and internal quality. External parameters include egg weight (EW), eggshell ratio, shell thickness, and shape index (SI). Internal parameters include yolk ratio (YR), albumen ratio (AR), yolk index (YI), albumen index (AI), and yolk color intensity, recorded following Bui Huu Doan (2009), together with the Haugh unit (HU), calculated using the formulas below.

Egg-quality parameters such as egg weight (EW), yolk weight (YW), albumen weight (AW), and eggshell weight (SW) were measured and recorded, and the proportion of each component was calculated according to the formulas of Bui Huu Doan (2009):

$$\text{Eggshell ratio (\%)} = [\text{Eggshell weight (g)} / \text{Egg weight (g)}] \times 100$$

$$\text{Yolk ratio (YR, \%)} = [\text{Yolk weight (g)} / \text{Egg weight (g)}] \times 100$$

$$\text{Albumen ratio (AR, \%)} = [\text{Albumen weight (g)} / \text{Egg weight (g)}] \times 100$$

$$\text{Egg weight} = \text{Total egg weight per cage} / \text{Total number of eggs per cage}$$

$$\text{Shape index (SI, cm)} = \text{Egg width (cm)} / \text{Egg length (cm)}$$

$$\text{Yolk index (YI, cm)} = \text{Yolk height (cm)} / \text{Average yolk diameter (cm)}$$

$$\text{Albumen index (AI, cm)} = \text{Thick-albumen height (cm)} / \text{Average thick-albumen diameter (cm)}$$

Haugh Unit (HU): The HU, used to evaluate egg quality, was devised by Professor Raymond Haugh (1937) as a measure of thick-albumen quality. In fresh eggs, the height of the thick albumen surrounding the yolk, combined with egg weight, determines the HU score. The higher the HU value, the better the egg quality, reflecting a firmer albumen structure.

$$\text{HU} = 100 \times \log (T - 1.7 \times W^{0.37} + 7.57)$$

where HU = Haugh unit; T (mm) = thick-albumen height; W (g) = egg weight.

Yolk color: determined using a Roche color fan.

Shell thickness (mm): measured using a specialized caliper after removing the shell membrane. Shell thickness was averaged from three measurement points: the large end, the equator, and the small end of the egg.

Classification by HU:

AA (highest): $\text{HU} \geq 72$ (very fresh eggs)

A (good): $\text{HU} = 60\text{--}71$

B (average/low): $\text{HU} < 60$ (thin/watery albumen, aged eggs)

Statistical analysis

Data were compiled using Microsoft Excel 2013 and analyzed with the General Linear Model (GLM) procedure in Minitab 16.0. Where significant differences were detected among treatments, means were compared using Tukey's test at the 5% significance level. Differences were considered statistically significant at $P < 0.05$.

RESULTS

Result 1: Effect of Antisol on the egg weight of Hubbard hens

Over the 10-week monitoring period, egg weight tended to increase gradually with time across all treatments. Values in T3 remained consistently higher than in T1 and T2 at most time points. At week 1, T3 reached 54.66 g, higher than T1 (51.70 g) and T2 (50.52 g). By week 10, the corresponding values for T1, T2, and T3 were 58.42 g, 57.86 g, and 58.48 g, respectively. This indicates that T3 was more effective than the other two treatments in improving egg weight.

Table 4. Effect of Antisol supplementation on egg weight (g/egg)

Parameter	T1	T2	T3	SEM	P
Week 1	51.70 ^b	50.74 ^b	54.66 ^a	0.78	0.010
Week 2	52.54 ^b	51.38 ^b	56.26 ^a	0.77	0.002
Week 3	53.68 ^{ab}	52.80 ^b	56.70 ^a	0.88	0.022
Week 4	54.50 ^a	53.52 ^a	56.14 ^a	0.78	0.099
Week 5	54.62 ^b	53.98 ^b	57.96 ^a	0.55	0.001
Week 6	55.58 ^{ab}	55.08 ^b	57.20 ^a	0.55	0.044
Week 7	57.04 ^a	56.28 ^a	57.96 ^a	0.52	0.110
Week 8	56.76 ^b	56.88 ^{ab}	58.10 ^a	0.35	0.037
Week 9	58.10 ^a	57.58 ^a	58.56 ^a	0.37	0.219
Week 10	58.42 ^a	57.86 ^a	58.48 ^a	0.34	0.392
Mean	55.29 ^b	54.45 ^c	57.21 ^a	1.19	0.001

Note: a,b,c within the same row, means sharing at least one common superscript letter do not differ significantly at $P < 0.05$.

The mean egg weight for T3 was 57.21 g, the highest value, and significantly different from T1 (55.29 g) and T2 (54.45 g), as indicated by the different superscript letters (a, b, c). The P value of < 0.01 indicates a highly significant treatment effect on egg weight. In addition, the mean SEM of 1.19 indicates low variability among replicates and high reliability of the results. Overall, T3 produced the best egg-weight performance among the treatments examined.

Table 5. Effect of Antisol supplementation level on laying rate across weeks of age (%)

Parameter	T1	T2	T3	SEM	P
Week 1	82.87 ^b	87.87 ^a	90.38 ^a	0.98	0.001
Week 2	90.82 ^a	90.22 ^b	90.99 ^a	0.13	0.002
Week 3	81.74 ^c	90.87 ^b	92.22 ^a	0.13	0.001

Week 4	80.99 ^c	91.84 ^b	92.83 ^a	0.13	0.001
Week 5	80.24 ^b	93.40 ^a	93.94 ^a	0.30	0.001
Week 6	78.45 ^c	95.03 ^b	95.70 ^a	0.16	0.001
Week 7	78.73 ^c	94.39 ^b	96.30 ^a	0.13	0.001
Week 8	80.75 ^c	94.16 ^b	97.30 ^a	0.18	0.001
Week 9	82.14 ^c	94.65 ^b	98.02 ^a	0.07	0.001
Week 10	82.96 ^c	95.00 ^b	98.05 ^a	0.11	0.001
Mean	81.12 ^c	92.74 ^b	94.57 ^a	0.07	0.001

Note: a,b,c within the same row, means sharing at least one common superscript letter do not differ significantly at $P < 0.05$.

The results show a marked difference in laying rate among treatments throughout the monitoring period. T3 achieved the highest mean value (94.57%), followed by T2 (92.74%), while T1 was lowest (81.12%). The different superscript letters (a, b, c) indicate statistically significant differences among treatments at $P < 0.05$, and the P value of < 0.001 confirms a highly significant treatment effect on laying rate. This result is consistent with Phung Duc Tien, 2009.

Across weeks, T3 showed a continuous increase from 90.38% at week 1 to 98.05% at week 10, indicating the best ability among the three treatments to sustain and improve laying rate. T2 also showed an upward trend over time, from 87.87% to 95.00%, though at a lower rate of increase than T3. In contrast, T1 tended to decline from week 1 to week 7 before rising again in the final weeks, but its mean value remained substantially lower than that of the other two treatments. This result is consistent with Doan Bao Ngoc, 2025, Kim Quyen, 2025.

Table 6. Effect of egg storage duration on egg quality

Parameter	T1	T2	T3	T4	T5	SEM	P
EW (g)	55	56	54	56	55	1.09	0.72
SI	72.6	75.1	73.0	74.5	75.4	1.35	0.61
Shell thickness (mm)	0.37	0.39	0.38	0.38	0.37	0.01	0.58
Shell ratio (%)	11.7	11.5	11.4	11.6	11.5	0.07	0.47
AI	0.08 ^a	0.08 ^a	0.07 ^c	0.05 ^c	0.04 ^d	0.02	0.01

AW (%)	60.1	55.9	56.7	57.0	55.8	0.14	0.66
YI	0.43 ^a	0.42 ^a	0.39 ^b	0.36 ^c	0.34 ^d	0.01	0.03
YW (%)	32.9	33.2	34.0	32.3	34.3	0.81	0.75
Yolk color score	11.2	11.2	11.0	10.8	10.0	0.38	0.57
HU	84.0 ^a	77.6 ^b	75.2 ^{bc}	71.8 ^c	70.1 ^c	2.41	0.01

Note: within the same row, means bearing different superscripts (a, b, c, d) differ significantly ($P < 0.05$). EW = egg weight; SI = shape index; AI = albumen index (mm); AW = albumen weight (%); YI = yolk index (mm); YW = yolk weight (%); HU = Haugh unit.

Table 6 presents the effect of egg storage duration on egg quality. Values were recorded under storage conditions of 20°C. The external and internal quality parameters of eggs play an important role in determining egg quality and in evaluating the economic value of laying-hen production, Zaki, A. et al. (2023). Among these, the egg shape index is a meaningful parameter for transport, since longer eggs carry a higher risk of breakage. External egg quality is assessed through shell strength, shell thickness, and shape index, evaluated on the basis of texture, color, shape, soundness, and cleanliness according to Zaki, A. et al. (2023), standards. Acceptable eggshells must have a smooth, clean surface, free of cracks, with uniformity in color, size, and shape. In addition, internal egg quality relates to the characteristics of the albumen and yolk, which directly affect sensory value and consumer perception, Wang, X. et al. (2023). In this study, the parameters determined included egg length (cm), egg width (cm), egg shape index, eggshell weight (g), egg weight (g), shell thickness (mm), shell ratio (%), albumen weight (g), albumen height (mm), albumen index (mm), albumen ratio (%), yolk weight (g), and yolk index (mm). This result is consistent with Nguyen Phat Tai, 2025.

CONCLUSION

Supplementing Antisol at 2.0 g/L of drinking water during the 30- to 40-week-old period improved egg weight and enhanced laying performance.

The treatment supplemented with 2 g Antisol/L of drinking water (T3) produced the best results, with an egg weight of 57.21 g and the highest laying rate among the Antisol-supplemented treatments (94.57%). In addition, the egg-storage trial showed that egg quality was best at storage days 1–3, while egg quality declined after 5–9 days of storage.

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