

Effects of Antisol and Vigosine on the Performance and Hatchability of Hubbard Breeder Eggs During the 25–35-Week-Old Period

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ABSTRACT

The study "Effects of Antisol and Vigosine on the Performance and Hatchability of Hubbard Breeder Eggs During the 25–35-Week-Old Period" was conducted at the Thong Nhat chicken farm of C.P. Vietnam Livestock Joint Stock Company from March to June 2026 to evaluate the effects of supplementing Antisol combined with Vigosine in drinking water on the reproductive performance and hatching indices of Hubbard breeder chickens. The experiment was arranged in a completely randomized design with three treatments: T1 (control, no supplementation), T2 (Antisol at 1 g/L drinking water combined with Vigosine at 1 mL/L drinking water), and T3 (Antisol at 1 g/L drinking water combined with Vigosine at 2 mL/L drinking water). The monitored parameters included egg weight, laying rate, fertility rate, hatchability of fertile eggs, hatchability of total eggs set, and embryonic mortality rate. The results showed that supplementation with Antisol combined with Vigosine had a positive effect on the reproductive performance and hatchability of Hubbard chickens. Treatment T3 achieved the highest results, with an average egg weight of 56.69 g/egg, a laying rate of 90.46%, a fertility rate of 85.13%, a hatchability of fertile eggs of 93.65%, and a hatchability of total eggs set of 79.73%, while also showing the lowest embryonic mortality rate (6.35%). All of the above parameters differed significantly from the control treatment ($P < 0.05$). The results indicate that supplementing 1 g/L Antisol combined with 2 mL/L Vigosine in drinking water is an appropriate level of supplementation, contributing to improved reproductive performance and hatching efficiency of Hubbard breeder flocks during the 25–35-week-old period.

Keywords: Antisol, Vigosine, Hubbard chicken, reproductive performance, laying rate, hatchability.

INTRODUCTION

The poultry industry is currently one of the important production sectors of Vietnamese agriculture, contributing to the supply of nutrient-rich food and providing raw materials for processing and export. In recent years, alongside the development of industrial livestock production systems, demand for high-quality breeding stock has increased, driving the need to improve the reproductive performance and hatching efficiency of breeder flocks. According to the Ministry of Agriculture and Environment (2025), Vietnam's total poultry population continues to show a growth trend, with chicken production accounting for a large share and playing an important role in supplying hatching eggs and commercial chicks for production. For meat-type breeder flocks, reproductive performance is evaluated not only through laying rate and egg weight but also depends on fertility rate, hatchability of fertile eggs, hatchability of total eggs set, and embryonic mortality rate. These parameters directly determine the quantity and quality of commercial chicks, thereby affecting the economic efficiency of breeding production facilities. According to North and Bell (1990), reproductive

capacity and egg hatchability are influenced by many factors such as breed, flock age, health status, rearing conditions, environment, and especially nutritional regimen.

The Hubbard breed is one of the meat-type chicken breeds widely used in industrial production systems owing to its rapid growth, good feed conversion efficiency, and high reproductive performance. The period

from 25 to 35 weeks of age is considered the peak reproductive period of breeder flocks. However, this period also coincides with increased nutritional demands to support egg formation and embryonic development. Under adverse conditions such as heat stress, weather fluctuations, high stocking density, or vaccination events, flocks may show reduced feed intake, metabolic disturbances, and decreased hatching-egg quality, thereby affecting reproductive performance and hatchability (Leeson and Summers, 2001). At present, the supplementation of metabolism-supporting and anti-stress products in poultry production is widely applied to maintain health, enhance nutrient utilization, and improve production efficiency. Antisol is a vitamin C-based product that enhances antioxidant capacity, mitigates the effects of stress, and helps maintain a stable physiological state in flocks. Vigosine, meanwhile, provides sorbitol, L-carnitine, magnesium sulfate, and plant extracts, contributing to liver function support, enhanced energy metabolism, and improved nutrient-utilization efficiency. Improving liver function and metabolic processes is of considerable importance for egg formation, hatching-egg quality, and normal embryonic development.

Although Antisol and Vigosine are already fairly widely used in practical production to support poultry flocks under industrial farming conditions, studies evaluating the effectiveness of their combined supplementation in Hubbard breeder flocks — particularly regarding reproductive performance and hatchability parameters — remain very limited. Therefore, evaluating the effects of Antisol combined with Vigosine on egg weight, laying rate, fertility rate, hatchability, and embryonic mortality rate is necessary, providing additional scientific evidence to support the practical application of these products. Based on the above considerations, the study "Effects of Antisol and Vigosine on the Performance and Hatchability of Hubbard Breeder Eggs During the 25–35-Week-Old Period" was conducted to evaluate the effectiveness of supplementing Antisol combined with Vigosine in drinking water on the reproductive performance and hatching indices of Hubbard breeder flocks.

MATERIALS AND METHODS

Experimental Animals

Duration: the study was conducted from May 2026 to August 2026.

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

The animals used in the study were imported Hubbard breeder chickens aged 25 to 35 weeks, totaling 330 birds, comprising 300 hens and 30 roosters. The entire flock was selected for uniform appearance and good health, with no signs of disease, and was reared according to the technical procedures of C.P. Vietnam Company. Throughout the experiment, all husbandry conditions were kept constant, with only the Antisol and Vigosine supplementation varying by treatment.

Housing and Management

The flock was raised in enclosed houses following C.P. Company's industrial farming model. Each house measured approximately 12 m × 120 m × 2 m (width × length × height), while the rearing 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. Floors were covered with disinfected rice-husk bedding to limit pathogenic microorganisms and keep the house dry.

The feeding system used troughs with automatic dispensers. Chickens were fed once daily at 7:00 a.m. with the company's complete feed, formula 531NF. Feed amounts were adjusted according to the company's recommendations for each 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 followed the farm's standard procedures throughout the study to ensure stable rearing conditions.

Hens' body weight was recorded weekly to monitor weight changes during the study period. The disease-prevention program was carried out according to the company's vaccination schedule.

Table 1: Vaccination schedule for Hubbard chickens during the 25–35-week-old period

Age	Vaccine	Method
25 weeks	ND+IB (Clone 30+Ma5)	Administered via drinking water
30 weeks	ND Clone 30	Administered via drinking water
35 weeks	ND+IB (Clone 30+Ma5)	Eye drop
	AI (H5N1-Re5) (****)	Subcutaneous injection, 0.5 mL/bird
	H9N2+ND+IB (Killed) (****)	Intramuscular injection, 0.5 mL/bird

Equipment

Equipment used in the study included: an electronic balance with 0.1 g precision, egg collection and storage trays, egg-marking pens, an egg candler, incubators and hatchers, computers, data-recording logbooks, and other tools.

Experimental Diet

Diet: the same feed was used uniformly across all treatments to ensure that differences among treatments depended only on the supplementation of the products in drinking water.

Table 2: Nutrient composition and basal diet of Hubbard chickens during the 25–35-week-old period

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 experimental feed was a complete layer feed meeting nutritional requirements for each growth and laying stage. Its nutrient composition was balanced to provide adequate metabolizable energy, crude protein, essential amino acids, calcium, phosphorus, and other necessary nutrients to maintain flock health while ensuring egg production and quality throughout the monitoring period. Feed was stored in a dry, well-ventilated place and distributed daily in appropriate amounts to minimize waste and ensure chickens always had access to clean feed of consistent quality.

Experimental Products

Table 3: Composition of the Antisol product

Component	Amount
Vitamin C	100 g
Citric acid	1 g
Excipient, q.s.	1 kg

Antisol is a nutritional supplement used to enhance antioxidant capacity and help flocks mitigate the effects of stress factors during rearing, especially heat stress. Under adverse environmental conditions, chickens typically show reduced feed intake, metabolic disturbances, and decreased reproductive performance. Antisol supplementation helps maintain a stable physiological state, supports immune function, and limits the adverse effects of stress. As a result, flocks can maintain better health, creating favorable conditions for egg formation and sustained reproductive capacity throughout the experimental period.

Table 4: Composition of the Vigosine product

Component	Amount
Sorbitol	25 g
Carnitine	5 g
Magnesium sulfate	25 g
Plant extracts	100 mL
Solvent	q.s. to 1 liter of product

Vigosine is a nutritional supplement used to support liver function and enhance nutrient metabolism. The liver plays an important role in synthesizing and metabolizing substances required for the formation of egg yolk, albumen, and shell. In addition, the product helps improve energy-utilization efficiency and maintain electrolyte balance, supporting stable physiological function during the reproductive period. Improved metabolism and nutrient utilization are expected to create favorable conditions for egg formation, enhance hatching-egg quality, and support embryonic development, thereby contributing to improved hatchability parameters in this study.

A total of 330 experimental chickens, comprising 300 hens and 30 roosters, were arranged in a completely randomized design with 3 treatments, each with 10 replicates, for a total of 30 experimental units. Each experimental unit consisted of 10 hens and 1 rooster.

The treatments were arranged as follows:

T1 (control): Chickens were fed the basal diet and given clean drinking water, without Antisol or Vigosine supplementation.

T2: Chickens were fed the basal diet, supplemented with Antisol at 1 g/L drinking water combined with Vigosine at 1 mL/L drinking water.

T3: Chickens were fed the basal diet, supplemented with Antisol at 1 g/L drinking water combined with Vigosine at 2 mL/L drinking water.

Three treatments utilized three different water supply lines. The chickens were provided with water ad libitum, supplemented with Antisol and Vigosine at the dosages specified above.

Selection of Hatching Eggs

Eggs were collected multiple times per day, beginning at 7:00 a.m., from the flock of each treatment. After collection, eggs were inspected and selected according to the hatching standards of C.P. Vietnam Company. Selected eggs weighed 45–60 g, had a well-proportioned shape, and clean, intact shells free of cracks, deformities, or excessive dirt. Eggs failing to meet the standard — too small, too large, cracked, or malformed — were discarded. Qualified eggs were stored according to farm procedures until a sufficient number was available for the experiment.

Incubation Process

Qualified eggs were arranged by treatment on separate hatching trays; each experimental unit comprised 200 eggs, with 30 experimental units in total, for 6,000 eggs incubated overall. All eggs were incubated following the same technical procedure to ensure identical incubation conditions across treatments. During the setting period, temperature was maintained at 37.5°C and relative humidity at 60%. On incubation day 18, eggs were transferred to the hatcher, with temperature adjusted to 36.8°C and humidity increased to 65–70% to favor hatching. Before transfer to the hatcher, eggs were candled to determine the number of fertile eggs, and infertile or dead-embryo eggs were removed. After hatching concluded, the number of live hatched chicks and the number of fertile-but-unhatched eggs were recorded.

The egg storage period ranges from 1 to 7 days. Storage conditions are 20°C and 65%–75% humidity.

Incubation performed once a week constitutes one replicate; ten weeks of incubation constitute ten replicates.

Sampling Method

For hen body-weight monitoring, 5 hens were weighed weekly per experimental unit. With 10 experimental units per treatment, a total of 50 hens per treatment were weighed each week. Weighing was performed on the same hens designated for monitoring within each experimental unit to ensure consistency and facilitate tracking of weight changes across weeks. Body weight was measured with an electronic balance and recorded to assess treatment effects on hen growth during the experimental period.

The number of eggs per treatment was recorded daily throughout the experiment. Weekly egg sampling was performed for each treatment to determine egg weight using an electronic balance with 0.1 g precision. Collected data were fully recorded on monitoring forms and compiled by treatment to calculate the study parameters.

Eggs meeting the daily standard were classified and selected for the experiment. Eggs were divided into 30 experimental units, comprising 3 treatments × 10 replicates. Each experimental unit was marked and monitored separately throughout incubation to ensure accurate data recording and avoid confusion among

treatments. After incubation, the numbers of fertile eggs, hatched chicks, unhatched eggs, and dead embryos were recorded.

Monitored Parameters

Reproductive Performance:

Body Weight (g/bird)

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

Laying Rate (%)

Laying rate was determined daily for each treatment to evaluate the flock's reproductive capacity throughout the experimental period.

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

Egg Weight (g)

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

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

Hatchability:

Fertility Rate (%)

Fertility rate reflects the fertilization capacity of hatching eggs and is determined by candling according to the farm's technical procedure.

Formula: Fertility rate (%) = (Number of fertile eggs / Total number of eggs set) $\times$ 100

Hatchability of Fertile Eggs (%)

This parameter reflects the developmental capacity of fertilized eggs through to hatching into healthy chicks.

Formula: Hatchability of fertile eggs (%) = (Number of hatched chicks / Number of fertile eggs) $\times$ 100

Hatchability of Total Eggs Set (%)

This parameter evaluates the overall efficiency of the incubation process and reflects the combined effects of fertilization capacity and embryonic development throughout incubation.

Formula: Hatchability of total eggs set (%) = (Number of hatched chicks / Total number of eggs set) $\times$ 100

Embryonic Mortality Rate (%)

Formula: Embryonic mortality rate (%) = (Total number of dead-embryo eggs / Total number of fertile eggs) $\times$ 100

Analytical Method

Study parameters were determined from data collected throughout the monitoring period and after incubation concluded. Egg weight was measured with an electronic balance with 0.1 g precision. Each week, 30 eggs were randomly selected from each treatment for weighing and calculation of average weight.

Hen body weight was determined by randomly selecting 5 hens from each treatment for weighing at the start and end of the experiment. After incubation, the numbers of hatched chicks, unhatched eggs, and infertile eggs were recorded.

Data Processing

Collected data were compiled using Microsoft Excel 2013. Data were analyzed using the General Linear Model (GLM) in Minitab 16.0 software. Where differences existed 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: Effects of Antisol and Vigosine on the egg weight of Hubbard chickens

Results of egg-weight monitoring in Hubbard chickens over the 10-week experimental period, presented in Table 5, show that egg weight increased with age in all three treatments. Analysis of variance showed that supplementation with Antisol combined with Vigosine had a statistically significant effect on egg weight ($P < 0.05$).

Average egg weights of T1, T2, and T3 were approximately 48.86 g, 53.84 g, and 56.69 g/egg, respectively. T3 achieved the highest value, followed by T2, with T1 the lowest. In many monitoring weeks, T3 differed significantly from T1 and T2, while in some weeks T2 and T3 did not differ from each other but were both higher than the control. This indicates that Antisol combined with Vigosine supplementation, particularly in T3, contributed to improved egg weight in the breeder flock.

This result can be explained by Antisol's role in reducing stress, stabilizing electrolyte balance, and improving flock health, while Vigosine — containing sorbitol, L-carnitine, magnesium sulfate, and plant extracts — supports liver function, enhances energy metabolism, and improves nutrient absorption. As nutrient utilization improves, yolk, albumen, and shell formation occur more efficiently, thereby increasing egg weight.

This finding is consistent with Tri Hai (2026), who supplemented Vigosine to Hubbard chickens during the 30–40-week-old period and likewise reported that the higher Vigosine-supplementation treatment produced significantly greater egg weight than the control. It differs from Nguyen Phat Tai (2025), who studied Ac chickens during the 25–35-week-old period and found egg weight among treatments ranging from approximately 34.4–35.5 g/egg; the higher egg weight in the present study may relate to differences in breed, age stage, and rearing conditions between the two studies. The results also align with Zelaya et al. (2022), who reported that L-carnitine supplementation improves egg weight by enhancing energy-metabolism efficiency. Le Hai Chau (2013) likewise reported that breeder-hen egg weight tends to increase with age and peaks during the reproductive plateau.

Overall, the results show that Antisol combined with Vigosine supplementation, particularly in T3, had a positive effect on improving the egg weight of Hubbard chickens during the 25–35-week-old period.

Table 5: Effects of Antisol and Vigosine supplementation levels on egg weight of chickens across weeks of age (g/egg)

Week	T1	T2	T3	SEM	P
1	51.70 ^b	50.74 ^b	54.66 ^a	0.78	0.01
2	48.86 ^c	51.50 ^b	54.74 ^a	0.54	0.001

3	48.10 ^c	51.64 ^b	55.40 ^a	0.57	0.001
4	48.16 ^c	52.52 ^b	55.88 ^a	0.62	0.001
5	47.64 ^c	53.06 ^b	55.68 ^a	0.68	0.001
6	47.82 ^c	54.14 ^b	57.62 ^a	0.37	0.001
7	49.38 ^c	55.02 ^b	58.04 ^a	0.52	0.001
8	48.92 ^b	55.86 ^a	57.94 ^a	0.56	0.001
9	48.68 ^b	56.78 ^a	58.32 ^a	0.52	0.001
10	49.30 ^c	57.10 ^b	58.66 ^a	0.37	0.001
Mean	48.86 ^c	53.84 ^b	56.69 ^a	0.55	0.001

Note: a,b,c — values in the same row bearing at least one common superscript letter do not differ significantly at $P > 0.05$. Values are presented as Mean $\pm$ Standard Error (Mean $\pm$ SE).

Table 6 shows that hen body weight increased over the experimental weeks in all treatments. Initial average body weights of hens in T1, T2, and T3 were 2,268; 2,271; and 2,305 g/bird, respectively. By the end of the experiment, corresponding body weights reached 2,407; 2,465; and 2,529 g/bird, all higher than at the start.

Body-weight gain differed among treatments: the control (T1) gained 139 g/bird, T2 gained 194 g/bird, and T3 showed the highest gain at 224 g/bird. This indicates that Antisol combined with Vigosine supplementation tends to improve body-weight gain of Hubbard hens during the 25–35-week-old period, with the high-level treatment (T3) performing best. This trend aligns with Ngoc Nhan (2026), who reported that Antisol supplementation improves nutrient absorption, reduces stress effects, and helps maintain good body condition in flocks during the reproductive period. Zelaya et al. (2022) similarly reported that L-carnitine supplementation improves production performance and growth parameters in laying hens, helping explain why T3 achieved the highest body-weight gain in this study.

Table 6. Average initial and final body weight of Hubbard chickens during the 25–35-week-old period

Parameter	T1	T2	T3
Average initial hen body weight (g/bird)	2268	2271	2270
Average final hen body weight (g/bird)	2407	2465	2467
Weight gain (g/bird)	139	194	197
V% (Final weight versus initial weight)	6.13%	8.54%	8.68%

Note: Average BW = average body weight.

Table 6 shows that average body weight in all three treatments increased from the start to the end of the experiment. T3 had the highest weight gain (197 g/bird, 8.68%), followed by T2 (194 g/bird, 8.54%), with T1 the lowest (139 g/bird, 6.13%). Overall, T3 and T2 chickens tended to gain more weight than T1. Hubbard egg weight also differed clearly among treatments over the 10-week monitoring period. T3 consistently maintained the highest egg weight, increasing relatively steadily from about 54.8 g in week 1 to nearly 58.6 g by week 10. T2 also showed a continuous upward trend, from about 50.8 g to 57.1 g by the end of the experiment. T1, in contrast, decreased slightly in the early weeks, then fluctuated around 48–50 g with no clear upward trend.

These results show that Antisol combined with Vigosine supplementation, particularly in T3, contributed to improved egg weight throughout the study period. The gradual increase in egg weight over time reflects improved nutrient absorption and utilization by the chickens, thereby enhancing egg-formation efficiency.

Result 2: Effects of Antisol and Vigosine on the laying rate of Hubbard chickens

Monitoring of laying rate in the Hubbard flock over the 10-week experimental period revealed differences among treatments. Analysis of variance showed that Antisol combined with Vigosine supplementation had a highly significant effect on laying rate ($P < 0.01$). All treatments supplemented with the products achieved higher laying rates than the control.

Across the monitoring weeks, laying rates of T2 and T3 were consistently higher than T1. In most weeks, T3 achieved the highest laying rate or a rate comparable to T2, while T1 consistently produced the lowest results. This indicates that Antisol combined with Vigosine supplementation improved the reproductive capacity of the breeder flock, helping sustain stable laying performance throughout the experimental period.

This result can be explained by Antisol's role in limiting stress effects and maintaining electrolyte balance and flock health, while Vigosine supports liver function, promotes nutrient metabolism, and increases feed-utilization efficiency. When the chicken's body receives adequate energy and nutrients, reproductive-organ function is maintained stably, thereby increasing laying rate. This finding is consistent with Tri Hai (2026), who reported that Vigosine-supplemented treatments had higher laying rates than the control, although the two supplementation levels did not differ significantly from each other. It is also consistent with Nguyen Phat Tai (2025), who studied Ac chickens during the 25–35-week-old period and found laying rates among treatments ranging from 37.2–40.7%; the higher laying rate observed in the present study suggests that differences in breed, age, and rearing conditions can influence egg production.

Overall, Antisol combined with Vigosine supplementation had a positive effect on the reproductive performance of Hubbard chickens, with T3 achieving the highest and most stable results throughout the monitoring period.

Table 7: Effects of Antisol and Vigosine supplementation levels on the laying rate of chickens across weeks of age (%)

Week	T1 ± SE (%)	T2 ± SE (%)	T3 ± SE (%)	P
1	78.83 ^c ± 0.41	83.53 ^b ± 0.41	85.77 ^a ± 0.41	0.001
2	79.39 ^c ± 0.39	84.06 ^b ± 0.39	86.31 ^a ± 0.39	0.001
3	79.91 ^c ± 0.35	84.47 ^b ± 0.35	87.37 ^a ± 0.35	0.001
4	80.40 ^c ± 0.34	85.01 ^b ± 0.34	88.22 ^a ± 0.34	0.001

5	80.26 ^c ± 0.36	85.70 ^b ± 0.36	89.37 ^a ± 0.36	0.001
6	79.66 ^c ± 0.34	86.35 ^b ± 0.34	90.96 ^a ± 0.34	0.001
7	79.75 ^c ± 0.32	87.18 ^b ± 0.32	92.22 ^a ± 0.32	0.001
8	80.47 ^c ± 0.29	88.11 ^b ± 0.29	93.42 ^a ± 0.29	0.001
9	80.46 ^c ± 0.26	89.58 ^b ± 0.26	94.95 ^a ± 0.26	0.001
10	80.41 ^c ± 0.29	90.68 ^b ± 0.29	96.04 ^a ± 0.29	0.001
Mean	79.95 ^c	86.47 ^b	90.46 ^a	0.001

Note: a,b,c — values in the same row bearing at least one common superscript letter do not differ significantly at $P > 0.05$. Values are presented as Mean ± Standard Error (Mean ± SE).

Table 7 shows a clear difference in Hubbard laying rate among treatments over the 10-week monitoring period. In the control (T1), laying rate stayed lowest, ranging from about 79.0–80.6%; it rose slightly in the first four weeks, dipped slightly in weeks 6–7, then recovered and stabilized until the end of the experiment.

In T2, laying rate increased relatively steadily across weeks, from about 83.5% in week 1 to about 90.8% by week 10, indicating that Antisol combined with Vigosine supplementation contributed to improved reproductive capacity. T3 consistently achieved the highest laying rate throughout the experiment, rising from about 85.8% in week 1 to about 96.0% by week 10, and remaining above T1 and T2 at every monitoring point. Notably, from week 6 onward the gap between T3 and the other two treatments widened progressively.

Overall, laying rate tended to increase over time in all three treatments, but the increase was greater in the treatments supplemented with Antisol combined with Vigosine than in the control. T3 achieved the best results, followed by T2, with T1 the lowest — indicating that combined supplementation with the two products improved the reproductive performance of the Hubbard flock during the 25–35-week-old period.

Results in Table 8 show that Antisol combined with Vigosine supplementation had a highly significant effect on the hatchability parameters of Hubbard eggs ($P < 0.01$). All supplemented treatments showed higher fertility rate, hatchability of total eggs set, and hatchability of fertile eggs than the control, along with a reduced embryonic mortality rate.

Specifically, fertility rates in T1, T2, and T3 were 79.60%, 83.87%, and 85.13%, respectively. T2 and T3 did not differ significantly ($P > 0.05$) but were both higher than T1 ($P < 0.05$), indicating that Antisol combined with Vigosine supplementation improved fertilization capacity and hatching-egg quality.

For hatchability of fertile eggs, T3 reached 93.65%, significantly higher than T1 (91.53%) and T2 (91.72%), while T1 and T2 did not differ significantly, demonstrating that the T3 supplementation level supported better embryonic development during incubation.

Hatchability of total eggs set reached 72.87%, 76.93%, and 79.73% in T1, T2, and T3, respectively, with all three treatments differing significantly from one another ($P < 0.05$) — T3 highest, followed by T2, and T1 lowest. As this parameter reflects overall hatching efficiency, the results indicate that Antisol combined with Vigosine supplementation clearly improved chick-production efficiency.

Conversely, embryonic mortality rate decreased from 8.47% in T1 to 8.27% in T2 and 6.35% in T3. T1 and T2 did not differ significantly but were both higher than T3, indicating that Antisol combined with Vigosine supplementation, particularly in T3, improved embryo viability and reduced losses during incubation.

This result is similar to Tri Hai (2026), who also reported that Vigosine-supplemented treatments had higher fertility rate, hatchability of fertile eggs, and hatchability of total eggs set than the control, along with lower embryonic mortality. However, the magnitude of improvement in the present study was smaller than in Tri Hai's study, particularly for fertility rate and hatchability of total eggs set — a difference potentially attributable to variation in mating efficiency, breeder-flock quality, flock-management conditions, or incubation conditions between the two studies.

In addition, Kim Quyen (2025) noted that hatchability is significantly influenced by hatching-egg quality when incubation conditions are held constant. In the present study, all treatments were incubated under identical technical conditions; hence, differences in hatchability parameters mainly reflect the effect of Antisol combined with Vigosine supplementation on egg quality and embryonic developmental capacity. Le Truong Thi (2025) further showed that egg-storage duration is a factor requiring control, as it can affect egg quality and hatchability. Ensuring uniform egg-collection and storage conditions across treatments is therefore necessary to limit the influence of extraneous factors.

Overall, Antisol combined with Vigosine supplementation improved the hatchability of Hubbard eggs by increasing fertility rate and hatch rate and reducing embryonic mortality, with T3 achieving the best results.

Result 3: Effects of Antisol and Vigosine on the hatchability of Hubbard chickens

Table 8. Effects of Antisol and Vigosine supplementation levels on hatchability parameters of Hubbard eggs (%)

Parameter (%)	T1	T2	T3	SE	P
Fertility rate	79.60 ^b	83.87 ^a	85.13 ^a	0.45	0.001
Hatchability of fertile eggs	91.53 ^b	91.72 ^b	93.65 ^a	0.40	0.001
Hatchability of total eggs set	72.87 ^c	76.93 ^b	79.73 ^a	0.67	0.001
Embryonic mortality rate	8.47 ^a	8.27 ^a	6.35 ^b	0.40	0.001

Note: a,b,c — values in the same row bearing at least one common superscript letter do not differ significantly at $P > 0.05$.

Table 8 shows that fertility rate of Hubbard eggs increased progressively with Antisol combined with Vigosine supplementation. The control (T1) had the lowest fertility rate (79.60%), T2 reached 83.87%, and T3 reached the highest (85.13%), indicating that Antisol combined with Vigosine supplementation improved fertility rate. This improvement may relate to enhanced breeder-flock health, improved egg quality, and fertilization capacity, thereby creating favorable conditions for embryo formation.

Hatchability of fertile eggs tended to increase with Antisol combined with Vigosine supplementation. T3 achieved the highest hatchability of fertile eggs (93.65%), followed by T2 (91.72%), with T1 lowest (91.53%). Although the difference between T1 and T2 was small, T3 showed a clear improvement, demonstrating that Antisol combined with Vigosine supplementation improved embryo viability during incubation and increased the likelihood of normal embryonic development and hatching.

Hatchability of total eggs set increased progressively from T1 to T3: 72.87%, 76.93%, and 79.73%, respectively. This reflects the combined efficiency of the reproductive and hatching processes, showing that Antisol combined with Vigosine supplementation improved hatching-egg quality, increased fertility rate,

and enhanced embryo viability during incubation, thereby increasing the number of hatched chicks relative to the total number of eggs set.

Embryonic mortality rate tended to decrease with Antisol combined with Vigosine supplementation in the Hubbard diet. The control (T1) had the highest embryonic mortality rate (8.47%), followed by T2 (8.27%), with T3 lowest (6.35%). This is consistent with the pattern shown above, indicating that Antisol combined with Vigosine supplementation reduced embryonic mortality during incubation; a lower mortality rate corresponds to improved embryo viability, contributing to enhanced hatching efficiency and post-hatch chick quality.

CONCLUSION

Supplementation with Antisol combined with Vigosine in Hubbard chickens during the 25–35-week-old period improved body weight, reproductive performance, and hatchability. The treatment supplemented with Antisol at 1 g/L combined with Vigosine at 2 mL/L drinking water (T3) achieved the best results, with an egg weight of 56.69 g/egg, a final hen body weight of 2,529 g/bird, a laying rate of 90.46%, a fertility rate of 85.13%, a hatchability of fertile eggs of 93.65%, and a hatchability of total eggs set of 79.73%, while reducing embryonic mortality rate to 6.35%. These results indicate that supplementing Antisol combined with Vigosine, particularly at the 2 mL/L Vigosine level, can be applied to improve the reproductive efficiency and hatchability of Hubbard breeder flocks.

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