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Impact of dietary vitamin e supplementation on the reproductive performance and egg and larval quality of snubnose pompano (*Trachinotus blochii*) Broodstock

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Abstract
This study evaluated the effects of dietary vitamin E supplementation on the reproductive performance and the quality of eggs and larvae in snubnose pompano (*Trachinotus blochii*). Broodstock were fed diets supplemented with vitamin E at 0, 250, 500, 750, and 1,000 mg/kg for 30 days before induced spawning. Results showed that vitamin E significantly improved the maturation rates of both males and females, with the highest values observed in the 750 mg/kg group (90.47% for males and 89.66% for females) ($P < 0.05$). Fecundity increased with higher vitamin E levels, reaching 94,833 eggs/kg at 1,000 mg/kg. However, egg diameter and oil globule size were not significantly affected. Larval length was greatest in the 750 mg/kg group (2.62 mm), while yolk sac and larval oil globule diameters showed no significant variation among treatments. Vitamin E also enhanced fertilization and hatching rates, with the highest fertilization rate (~82%) recorded at 500 mg/kg and the highest hatching rate (~89%) at 750 mg/kg ($P <$ 0.05). Although egg buoyancy tended to improve with vitamin E, the differences were not statistically significant. Furthermore, larval deformity rates decreased from ~9% (control) to 4-6% in supplemented groups, while 3-day-old larval survival rates increased significantly, with the best performance observed at 500 mg/kg (~56%). These findings confirm that vitamin E is a crucial nutrient for improving reproductive success and seed quality in *T. blochii*, with optimal supplementation levels ranging from 500 to 750 mg/kg.

Keywords: Vitamin E, Snubnose pompano (*Trachinotus blochii*), reproduction, eggs, larvae, broodstock nutrition

1. Introduction

Subnose pompano (*Trachinotus blochii*) is considered a promising marine aquaculture species due to its rapid growth rate, broad salinity tolerance, ability to utilize formulated feeds, and high economic value (Mapunda *et al*. 2021a, b) [10, 11]. However, seed production efficiency remains limited, with inconsistent maturation rates (57.14-95.45%), relatively low fertilization and hatching rates (46.34-78.53% and 28.0-75.3%, respectively), large fluctuations in larval survival (2.38-28.20%), and a high incidence of deformities (Ngo, 2007; Lại *et al*., 2011) [14,].

In aquaculture, broodstock nutrition is considered a critical factor influencing gonadal development, egg quality, and larval viability (Izquierdo *et al*., 2001; Hernández de-Dios *et al*., 2022) [6, 5]. Among essential micronutrients, vitamin E (α-tocopherol) plays a key role as a potent antioxidant, protecting cellular membranes and participating in reproductive processes. Vitamin E deficiency has been associated with gonadal degeneration, reduced fertilization and hatching rates, and increased incidence of abnormal larvae (Izquierdo *et al*., 2001; Griesh *et al*., 2024) [6, 4].

Several studies have demonstrated that dietary vitamin E supplementation can enhance fecundity, fertilization rate, hatching success, and larval survival across various fish species such as gilthead seabream (*Sparus aurata*), Nile tilapia (*Oreochromis niloticus*), zebrafish (*Danio rerio*), and cobia (*Rachycentron canadum*) (Utomo *et al*., 2014; Najafabadi *et al*., 2025; Nascimento *et al*., 2014) [17, 12, 13].

However, to date, no studies have specifically evaluated the effects of different dietary vitamin E levels on the reproductive performance and egg and larval quality of snubnose pompano (*T.*

blochii). Therefore, this study was conducted to determine the optimal level of vitamin E supplementation in broodstock diets to enhance reproductive outcomes and larval quality, thereby improving survival rates and the overall efficiency of seed production in this species.

2. Materials and Methods

2.1. Experimental Animals and Location

The experiment was conducted on snubnose pompano (*Trachinotus blochii*) broodstock with an average body weight of 2.68 kg (ranging from 2.35 to 3.84 kg). The cage culture conditions, number of fish per treatment, stocking density, spawning method, and evaluation of reproductive and larval quality indicators were consistent with those applied in this experiment. Broodstocks were fed a moist diet consisting of 70% trash fish, 15% shrimp, and 15% squid at a daily ration equivalent to 9% of body weight. Vitamin E was supplemented in the diet twice a week using powdered α-tocopherol.

2.2. Experimental Design

Five dietary treatments were established with different levels of vitamin E supplementation. Treatment 1 served as the control group with no added vitamin E (0 mg/kg feed). Treatment 2 received 250 mg vitamin E/kg feed, Treatment 3 received 500 mg/kg, Treatment 4 was supplemented with 750 mg/kg, and Treatment 5 received the highest level of supplementation at 1,000 mg/kg feed. The vitamin E used was in the form of a white powder containing 50% α-tocopherol, produced by Synchem International Co., Ltd (China). The powder was dissolved in soybean oil at a concentration of 1 g vitamin E per 25 mL oil and injected into the fresh feed using a syringe immediately before feeding.

Broodstocks were fed the vitamin E-enriched diet for a minimum of one month before spawning induction. After the feeding period, fish were examined for gonadal development, and hormone-induced spawning was initiated. Female fish were injected with human chorionic gonadotropin (HCG) at a dose of 1,200 IU/kg body weight, while males received half this dosage, following the protocol of Lai Van Hung *et al*. (2011) [9]. Spawning was carried out in spawning nets with a mesh size of 250 µm placed in sea cages. Each treatment group underwent three separate spawning trials, each involving 7 to 10 females with a 1:1 male-to-female ratio. The interval between spawning events was 30-35 days.

Eggs were collected 2-3 hours post-spawning to determine various reproductive and larval quality parameters, including relative fecundity, egg diameter, oil globule diameter, egg buoyancy (floating egg rate), fertilization rate, hatching rate, fatty acid composition, larval length, yolk-sac diameter, larval oil globule diameter, deformity rate, and survival rate of 3-day-old larvae. At 12 hours after spawning, all hormone-injected females were recaptured and anesthetized to verify which fish had spawned. This allowed for the accurate calculation of actual fecundity per female for each treatment.

2.3. Methods for determining reproductive parameters, egg and larval quality

Reproductive performance, egg, and larval quality parameters were determined and calculated based on the methods described by Bromage (2001) [1] and Lại *et al*. (2011), as follows:

Maturation rate (%): Gonadal maturity was assessed using a cannula to collect gonadal products from all broodstock individuals in each treatment group before each spawning event. Females were considered mature if they exhibited round, loose eggs with diameters of 400-500 µm; males were considered mature if the milt was white and opaque.

Maturation rate (%) = (Number of mature fish × 100%) / Total number of fish examined

Determination of spawning females: Female fish injected with spawning-inducing hormones were examined one day after spawning. Fish were weighed and cannulated to check for post-spawning status. Females were confirmed to have spawned if only follicular membranes and small residual oocytes were present.

Gonadal redevelopment interval (days): Starting on day 26 post-spawning, previously spawned broodstock were checked every 3 days to determine the time required for them to reach maturity for the next spawning event.

Actual fecundity

Actual fecundity (eggs/kg female) = Total number of eggs collected / Total body weight (kg) of spawning females after hormone injection.

Floating egg rate (%): One hour after spawning, a minimum of 100 eggs per sample were collected and placed in 200 mL of seawater in a glass beaker. After settling for 10 minutes, the number of floating and sinking eggs was counted.

Floating egg rate (%) = (Number of floating eggs × 100%) / Total number of eggs per beaker.

This test was repeated three times per spawning event.

Fertilization rate (%): Fertilization was assessed two hours post-spawning using at least 100 eggs per test. The number of fertilized eggs was counted under a microscope.

Fertilization rate (%) = (Number of fertilized eggs × 100%) / Total number of eggs examined.

Each spawning was assessed in triplicate.

Hatching rate (%): To determine hatching success, 100 fertilized eggs were incubated in 2-liter buckets containing seawater with 33 ppt salinity and gentle aeration. This was repeated three times. After hatching, the number of hatched larvae was counted.

Hatching rate (%) = (Number of hatched larvae × 100%) / Number of fertilized eggs incubated.

Deformity rate of newly hatched larvae (%): Two hours after hatching, larval samples were collected and examined for deformities under a microscope. A minimum of 100 larvae were analyzed per sample.

Deformity rate (%) = (Number of deformed larvae × 100%) / Total number of larvae examined.

This was repeated three times.

Survival rate of 3-day-old larvae (%): To assess 3-day larval survival, 100 newly hatched larvae were reared in 5-liter buckets with 33 ppt seawater and gentle aeration, repeated three times. After 3 days, surviving larvae were counted.

Survival rate (%) = (Number of 3-day-old larvae × 100%) / Initial number of larvae stocked.

2.4. Statistical Analysis
All data were analyzed using SPSS software version 22.0. One-way ANOVA was employed to compare reproductive parameters among treatments, and Duncan's multiple range test was used for post hoc comparisons at a significance level of $p < 0.05$.

3. Results
3.1. Effects of vitamin e on reproductive performance and the quality of eggs and larvae
The results presented in Table 1 demonstrate that dietary vitamin E supplementation significantly affects the reproductive performance and the quality of eggs and larvae in snubnose pompano (*Trachinotus blochii*). The maturation rate of both male and female broodstock increased notably with vitamin E supplementation. Specifically, the highest male maturation rate was observed in the group supplemented with 750 mg/kg (90.47%), whereas the control group (no supplementation) showed only 48.89% ($P < 0.05$). For females, the maturation rate increased from 41.94% (control) to 89.66% at the 750 mg/kg level, then slightly declined at 1,000 mg/kg, with statistically significant differences among treatments ($P < 0.05$).
Regarding fecundity, the average number of eggs per kilogram of female also increased with higher levels of vitamin E, ranging from 45,002 eggs/kg in the control group to 94,833 eggs/kg in the 1,000 mg/kg group. The difference became statistically significant at supplementation levels of 500 mg/kg or higher ($P < 0.05$). However, egg diameter and oil globule size were not significantly affected by vitamin E levels, with values ranging from 0.99-1.02 mm and 0.26-0.28 mm, respectively ($P > 0.05$).
Larval length after hatching was significantly influenced by vitamin E supplementation, with the largest size recorded in the 750 mg/kg group (2.62 mm) and the smallest in the non-supplemented group (2.48 mm), showing a statistically significant difference ($P < 0.05$). In contrast, yolk sac diameter (0.92-1.12 mm) and larval oil globule size (0.23-0.26 mm) showed no significant differences among treatments ($p > 0.05$), indicating that these parameters were less affected by dietary vitamin E levels.

Table 1: Maturation rate and fecundity of snubnose pompano (*Trachinotus blochii*) broodstock fed diets supplemented with different levels of vitamin E

Parameters	Dietary vitamin E supplementation level (mg/kg diet)				
	0	250	500	750	1,000
MR ♂ (%)	48.89 ± 2.22^{a}	70.83 ± 4.17^{b}	73.21 ± 6.76^{b}	90.47 ± 4.76^{c}	76.19 ± 4.76^{bc}
MR ♀ (%)	41.94 ± 1.86^{a}	75.04 ± 14.54^{b}	82.42 ± 2.77^{b}	89.66 ± 2.34^{b}	87.33 ± 2.19^{b}
Fecundity (egg/kg)	$45,002 \pm 4,709^{a}$	$64,341 \pm 9,866^{ab}$	$81,478 \pm 11,115^{b}$	$91,125 \pm 7,669^{b}$	$94,833 \pm 13,256^{b}$
ED (mm)	0.99 ± 0.01	0.99 ± 0.01	0.99 ± 0.00	1.02 ± 0.04	1.01 ± 0.02
OGD_e (mm)	0.26 ± 0.01	0.27 ± 0.01	0.28 ± 0.00	0.27 ± 0.02	0.27 ± 0.00
LL (mm)	2.48 ± 0.02^{a}	2.61 ± 0.02^{c}	2.56 ± 0.01^{b}	2.62 ± 0.01^{c}	2.60 ± 0.01^{bc}
YSD (mm)	0.92 ± 0.06	0.99 ± 0.07	1.08 ± 0.02	0.98 ± 0.12	1.12 ± 0.05
OGD_l (mm)	0.24 ± 0.01	0.26 ± 0.01	0.23 ± 0.01	0.26 ± 0.01	0.25 ± 0.02

Note: Within the same row, means followed by different letters indicate statistically significant differences ($P < 0.05$). ED: Egg diameter; LL: Larval length; OGD_e: Oil-globule diameter of the egg; OGD_l Oil-globule diameter of fish larvae; MR♂: Maturation rate of male; MR ♀: Maturation rate of male-female; YSD: Yolk-sac diameter.

3.2. Effects of dietary vitamin E levels on fertilization rate, egg buoyancy and hatching rate
The Figure 1 results indicate that vitamin E supplementation in the diets of snubnose pompano (*Trachinotus blochii*) broodstock has a positive effect on fertilization rate, egg buoyancy, and hatching rate. Specifically, the fertilization rate increased significantly with vitamin E supplementation, with the highest value (~82%) observed at the 500 mg/kg level, which was significantly higher than that of the control group (~65%) ($P < 0.05$). The 250, 750, and 1,000 mg/kg treatments also yielded higher fertilization rates than the control, although no statistically significant differences were observed among these treatments. Egg buoyancy ranged from approximately 65% to 80%, showing an increasing trend with higher vitamin E levels, particularly at 750 mg/kg; however, the differences were not statistically significant ($P > 0.05$). In terms of hatching rate, the most notable improvement was recorded in the 750 mg/kg group, reaching about 89%, significantly higher than the control group (67%) ($P < 0.05$), while the remaining treatments ranged from 78% to 84%, with no significant differences. These findings suggest that vitamin E plays a beneficial role in enhancing reproductive efficiency in broodstock by improving fertilization and hatching rates, although its effect on egg buoyancy remains less conclusive.

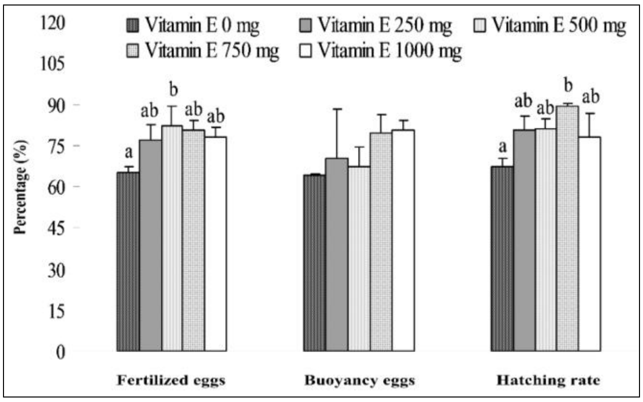

Fig 1: Fertilization rate, egg buoyancy, and hatching rate of golden pompano (*Trachinotus blochii*) broodstock fed diets supplemented with different levels of vitamin E (Different letters above bars indicate statistically significant differences ($P < 0.05$))

3.3. Effects of dietary vitamin E levels on deformity rate and survival rate of 3-day-old larvae

The Figure 2 results showed that dietary vitamin E supplementation in snubnose pompano (*Trachinotus blochii*) broodstock had a significant impact on the deformity rate and survival rate of 3-day-old larvae. Specifically, the deformity rate of larvae was notably reduced with vitamin E supplementation. In the control group (0 mg/kg), the deformity rate was highest (~9%), while the treatments with vitamin E ranged between approximately 4-6%, with the lowest deformity rate observed at the 750 mg/kg level. This indicated that vitamin E contributed significantly to the protection of embryonic cell membranes, supporting to avoidance of malformations and helping normal larval development. Moreover, supplementing with vitamin E led to a marked improvement in the 3-day larval survival rate, increasing from approximately 45% in the control group to above 50% in all treated groups. The highest survival rate of 56% was noted at the 500 mg/kg level, with the 250, 750, and 1,000 mg/kg treatments also exhibiting significant and comparable improvements over the control. These results confirmed the positive effect of vitamin E in improving post-hatch larval quality through decreased deformities and improved early survival.

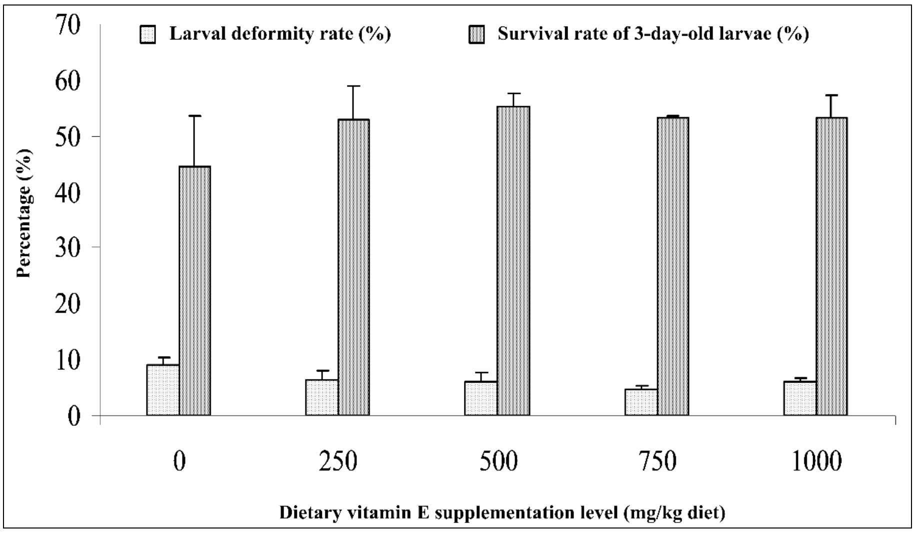

Fig 2: Larval deformity rate and 3-day-old larvae survival of snubnose pompano (*Trachinotus blochii*) from broodstock fed diets with varying levels of vitamin E.

4. Discussion

The findings of this study explained that supplementing broodstock diets with vitamin E significantly improved reproductive performance and enhanced both egg and larval quality in snubnose pompano (*Trachinotus blochii*). Notably, the 750 mg/kg level produced the most pronounced advantages in both female and male broodstock, although positive effects were confirmed between 250 and 1,000 mg/kg diet.

4.1. Maturation rate and fecundity

Maturation rates and fecundity were significantly improved by dietary vitamin E supplementation, with the most pronounced effects obtained at the 750 mg/kg level, where female and male maturation rates reached 90.47% and 89.66%, respectively; markedly higher than those in the control group without vitamin E supplementation. These results were consistent with the findings of Puangkaew *et al*. (1984) [15], who emphasized the role of vitamin E in protecting cellular membrane integrity and facilitating steroid hormone synthesis, both of which were critical for gonadal development. Similarly, Izquierdo *et al*. (2001) [6] reported that inadequate vitamin E in the diet can weaken reproductive endocrinology, resulting in delayed maturation and reduced reproductive performance.

4.2. Egg quality

In terms of egg quality, no significant differences were recorded in egg diameter or oil globule size among the treatment groups. However, fertilization and hatching rates enhanced significantly with vitamin E supplementation, particularly at levels of 500-750 mg/kg diet. These enhancements were likely due to the antioxidant capacity of vitamin E, which diminished oxidative stress during embryogenesis (Griesh *et al*., 2024) [4], and its role in stabilizing highly unsaturated fatty acids (HUFA), essential structural components of egg membranes (Lai, 2004) [8]. Maintaining HUFA reliability was critical for improving egg quality and supporting normal embryonic development (Fernández-Palacios *et al*., 2011) [3].

4.3. Larval deformity

Remarkably, vitamin E supplementation led to a significant decline in larval deformity rates and an improvement in 3-day post-hatch survival. While the control group demonstrated a deformity rate close to 9% and a survival rate of around 45%, the groups added with 500-750 mg/kg vitamin E exhibited deformity rates below 5% and survival rates exceeding 55%. These outcomes were similar to the findings of Serrano *et al*. (2022) [16], who reported that vitamin E provides the stabilization of cellular membranes during early ontogeny, thereby diminishing embryonic deformities and improving larval viability.

In conclusion, the present study supports the crucial role of vitamin E in enhancing reproductive performance and seed quality in marine finfish. A dietary inclusion level of 750 mg/kg was recognized as the most effective for broodstock conditioning in *Trachinotus blochii*, offering an optimum balance between physiological benefits and nutritional safety. These results were in agreement with previous studies carried out on other species by Utomo *et al*. (2014) [17] and Najafabadi *et al*. (2025) [12].

4.4. Practical Implications for Aquaculture

The findings of the present study show that dietary vitamin E supplementation in broodstock snubnose pompano (*Trachinotus blochii*) exerts a significant positive effect on reproductive performances and seed quality. Improved maturation, fertilization, and hatching rates, together with enhanced larval survival and a marked reduction in deformity rates, emphasize the critical role of vitamin E in ineffective broodstock nutritional management (Izquierdo *et al*., 2001; Griesh *et al*., 2024) [6, 4].

Despite advances in hatchery technology, many production facilities continue to encounter challenges such as conflicting broodstock maturation, poor gamete and larval quality, low survival rates, and enhanced deformity rates (Fernández-Palacios *et al*., 2011) [3]. Adding with vitamin E to broodstock diets at an optimal range of 500-750 mg/kg presents a practical and cost-effective strategy to improve reproductive performance without resorting to complex techniques like hormone administration or environmental influence (Watanabe & Vassallo-Agius, 2003) [18].

In addition, the reproductive benefits of vitamin E have been proven in a wide range of teleost species, including Nile tilapia (*Oreochromis niloticus*), gilthead seabream (*Sparus aurata*), and zebrafish (*Danio rerio*) (Utomo *et al*., 2014; Nascimento *et al*., 2014; Najafabadi *et al*., 2025) [17, 13, 12]. These findings propose that this nutritional approach holds promise for other marine finfish with multiple spawning models and high seed quality demands, such as cobia (*Rachycentron canadum*) and barramundi (*Lates calcarifer*).

In conclusion, vitamin E in broodstock diet represents a practical and effective strategy to improve both the quantity and quality of seed in artificial propagation. This approach provides for the establishment of more consistent, sustainable, and cost-effective hatchery practices in the aquaculture systems.

5. Conclusion and Recommendations

5.1. Conclusion

This study highlighted the supplementation of vitamin E in snubnose pompano (*Trachinotus blochii*) broodstock diet, demonstrating significant improvements in reproductive performances and seed quality at supplementation levels of 250-1,000 mg/kg. The 750 mg/kg diet level was found to be most effective, optimizing both reproductive outcomes and larval viability.

Vitamin E was indicated to play crucial roles in maintaining gonadal development, supporting egg integrity, and improving embryonic and larval performance through its physiological and antioxidant functions.

5.2. Recommendations and Future Research Directions

To enhance reproductive performances and larval quality, snubnose pompano (*Trachinotus blochii*) hatcheries should implement dietary vitamin E supplementation at 500-750 mg/kg diet during broodstock conditioning. This practical strategy can effectively diminish deformities and improve larval survival.

Further research should consider potential synergistic interactions between vitamin E and other micronutrients like selenium, vitamin C, and HUFA to optimize feed formulations for broodstock marine finfish. Moreover, research under varied hatchery conditions: considering seasonality, stocking density, and water quality are essential to validate field applicability. Expanding this approach to other key marine finfish species, such as barramundi, cobia, grouper, golden trevally and red snapper, will be supported by the development of species-specific nutritional strategies in marine finfish aquaculture.

6. References

1. Bromage N. Recent developments in the control of reproduction of farmed fish. Nato Asi Ser A Life Sci. 2001;314:243-60.
2. El-Sayed AFM, Izquierdo M. Role of dietary vitamin E in fish and shrimp nutrition. In: Reilly MC, Kumar P, editors. Aquaculture nutrition: Recent advances. Springer; 2022. p. 145-68.
3. Fernández-Palacios H, Izquierdo MS, Robaina L, Valencia A, Salhi M, Vergara JM. Effect of n-3 HUFA and vitamin E levels in broodstock diets on egg and larval quality of gilthead seabream (*Sparus aurata* L.). Aquaculture. 2011;202(3-4):487-502. https://doi.org/10.1016/S0044-8486(01)00634-3
4. Griesh AS, El-Nahla AM, Aly SM, Badran MF. Role of vitamin E supplementation on the reproductive and growth performance, hormonal profile and biochemical parameters of female hybrid red tilapia. Thalassas. 2024;40:1169-78. https://doi.org/10.1007/s41208-024-00683-5
5. Hernández de-Dios MA, Tovar-Ramírez D, Maldonado-García D, Galaviz-Espinoza MA, Spanopoulos Zarco M, Maldonado-García MC. Functional additives as a boost to reproductive performance in marine fish: A review. Fishes. 2022;7(5):262. https://doi.org/10.3390/fishes7050262
6. Izquierdo MS, Fernandez-Palacios H, Tacon AGJ. Effect of broodstock nutrition on reproductive performance of fish. Aquaculture. 2001;197(1-4):25-42. https://doi.org/10.1016/S0044-8486(01)00581-6
7. Juniyanto A, Rimmer MA, Williams KC, Nguyen NH. The effect of dietary n-3 HUFA and vitamin E on egg and larval quality of golden pompano (*Trachinotus blochii*). Aquac Nutr. 2008;14(3):177-85. https://doi.org/10.1111/j.1365-2095.2007.00519.x
8. Lai VH. Nutrition and Feed in Aquaculture. Hanoi: Hanoi Agriculture Publishing House; 2004. Vietnamese.
9. Lai VH, Ngo VM, Hoang TT, Nguyen MD. Pilot Study on Seed Production of Golden Pompano (*Trachinotus blochii* Lacepède, 1801) in Khanh Hoa. Final Report of the Provincial-Level Project. Nha Trang: Nha Trang University; 2011. Vietnamese.
10. Mapunda J, Mtolera MS, Yahya SA, Ngo VM, Golan M, Nguyen VM. Effect of tank colour on growth, survival, stress level, digestive enzymatic activities and body composition of snubnose pompano (*Trachinotus blochii* Lacépède) larvae. Aquac Res. 2021;52(12):6244-55. https://doi.org/10.1111/are.15487
11. Mapunda J, Mtolera MS, Yahya SA, Ngo VM, Golan M. Light colour affect the survival rate, growth performance, cortisol level, body composition, and digestive enzymes activities of different snubnose pompano (*Trachinotus blochii* (Lacépède, 1801)) larval stages. Aquac Rep. 2021;21:100804. https://doi.org/10.1016/j.aqrep.2021.100804
12. Najafabadi MZ, Mohammadiazarm H, Mozanzadeh MT, Shahriari A. Effects of dietary vitamin E supplementation on reproductive performance and health indices of Arabian yellowfin seabream (*Acanthopagrus arabicus*).

Aquac Rep. 2025;41:102710. https://doi.org/10.1016/j.aqrep.2025.102710
13. Nascimento TSR, Stéfani MV, Malheiros EB, Koberstein TCD. High levels of dietary vitamin E improve the reproductive performance of female Oreochromis niloticus. Acta Sci Biol Sci. 2014;36(1):19-26. https://doi.org/10.4025/actascibiolsci.v36i1.19830
14. Ngo VH. Project on the Introduction of Seed Production Technology for Golden Pompano (*Trachinotus blochii* Lacepède, 1801). Scientific Report. Bac Ninh: Bac Ninh Fisheries College; 2007. Vietnamese.
15. Puangkaew J, Kiron V, Somamoto T, Okamoto N, Satoh S, Takeuchi T, *et al*. Nonspecific immune response of rainbow trout (*Oncorhynchus mykiss* Walbaum) in relation to different status of vitamin E and highly unsaturated fatty acids. Fish Shellfish Immunol. 2004;16(1):25-39. https://doi.org/10.1016/S1050-4648(03)00028-7
16. Serrano AE, Bautista LM, Tumbokon BLM. Effects of vitamin E on growth and maturation in the Asian catfish (*Clarias macrocephalus*) at puberty. Isr J Aquac-Bamidgeh. 2022;74:1823200. https://doi.org/10.46989/001c.57186
17. Utomo NBP, Zairin Jr M, Yusuf TL, Mokoginta I, Bintang M. The effect of different levels of vitamin E on the reproductive performance of zebrafish (*Danio rerio*). J Akuakultur Indones. 2014;13(2):125-34. https://doi.org/10.19027/jai.4.125-129
18. Watanabe T, Vassallo-Agius R. Broodstock nutrition research on marine finfish in Japan. Aquaculture. 2003;227(1-4):35-61. https://doi.org/10.1016/S0044-8486(03)00494-0.