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Differences in aquarium background color on the survival and growth performance of juvenile red claw lobsters *Cherax quadricarinatus*

Perbedaan warna latar belakang akuarium terhadap performa kelangsungan hidup dan pertumbuhan lobster capit merah remaja *Cherax quadricarinatus*

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ABSTRACT

This study aimed to investigate the effect of different background colors (transparent, blue, brown, and black) on the survival and growth of juvenile red claw lobsters. The experimental method used was a completely randomized design (CRD) consisting of four treatments and four replications. Lobsters with an initial weight of 232 mg were reared at a density of 10 individuals aquarium^{-1} for 45 days. Feeding in the form of pellets was carried out at a dose of 5% of the biomass/day. The parameters observed included survival, absolute weight, and length growth, specific growth rate, condition factor, coefficient of variation, FCR, FCE, and water quality. The results showed that background color had a significant effect (P<0.05) on survival and growth, with the black container treatment providing the best results in survival (83 ± 5.77%), absolute weight growth (492.64 ± 6.26 mg), specific weight growth rate (2.53 ± 0.02 %/day), as well as the lowest FCR (1.28 ± 0.07) and the highest FCE (78.56 ± 4.44%). Meanwhile, absolute length growth and length coefficient of variation were not significantly different between treatments (P>0.05). Water quality during the study was within the optimal range. Overall, the use of dark background colors (brown and black) is recommended to improve the survival and growth performance of juvenile red claw lobsters.

Keywords: crustaceans, cannibalism, controlled environment, rearing media, growth performance

ABSTRAK

Penelitian ini bertujuan untuk menyelidiki pengaruh warna latar belakang yang berbeda (transparan, biru, coklat, dan hitam) terhadap kelangsungan hidup dan pertumbuhan lobster cakar merah muda. Metode eksperimental yang digunakan adalah rancangan acak lengkap (CRD) yang terdiri dari empat perlakuan dan empat ulangan. Lobster dengan berat awal 232 mg dipelihara dengan kepadatan 10 individu per akuarium selama 45 hari. Pemberian pakan berupa pelet dilakukan dengan dosis 5% dari biomassa/hari. Parameter yang diamati meliputi kelangsungan hidup, pertumbuhan berat dan panjang absolut, laju pertumbuhan spesifik, faktor kondisi, koefisien variasi, FCR, FCE, dan kualitas air. Hasil penelitian menunjukkan bahwa warna latar belakang berpengaruh signifikan (P<0,05) terhadap kelangsungan hidup dan pertumbuhan, dengan perlakuan wadah hitam memberikan hasil terbaik dalam hal kelangsungan hidup (83 ± 5,77%), pertumbuhan berat absolut (492,64 ± 6,26 mg), laju pertumbuhan berat spesifik (2,53 ± 0,02 %/hari), serta FCR terendah (1,28 ± 0,07) dan FCE tertinggi (78,56 ± 4,44%). Sementara itu, pertumbuhan panjang absolut dan koefisien variasi panjang tidak berbeda secara signifikan antar perlakuan (P>0,05). Kualitas air selama penelitian berada dalam kisaran optimal. Secara keseluruhan, penggunaan warna latar belakang gelap (coklat dan hitam) direkomendasikan untuk meningkatkan kelangsungan hidup dan kinerja pertumbuhan lobster cakar merah muda.

Kata kunci: krustasea, kanibalisme, lingkungan terkontrol, media pemeliharaan, kinerja pertumbuhan

INTRODUCTION

Optimizing the cultivation environment is a fundamental component in increasing the success of aquaculture production, especially for crustacean commodities. Various environmental parameters including water quality, food, density, and visual condition of the container are known to play a significant role in influencing the physiological responses, behavior, and survival rates of aquatic organisms. Optimal environmental conditions can improve production performance, feed utilization efficiency, and the physiological status of aquatic organisms (Indriani *et al*., 2023). The red claw lobster (*Cherax quadricarinatus*) is a fishery commodity with high economic value and potential for development (Fahruddin *et al.,* 2022). Freshwater lobster hatcheries still face serious challenges in the form of low seed survival rates, particularly from the fry to juvenile stages. Mortality at this stage is generally triggered by cannibalism, which causes injuries, deformities, and even death (Saekhow *et al.,* 2019). This condition is a major obstacle to increasing cultivation productivity.

One strategy that can be adopted to improve growth performance and survival is the selection of color for rearing. According to Sopandi *et al.* (2023), the sensitivity level is high depending on the size of the fry due to cannibalism. According to Mamuaya *et al.* (2019), observations show that the survival rate of reared juveniles is low, averaging below 50% across all treatments. This cannibalism can cause skin injuries and deformities. Wounded skin releases chemicals (amino acids) that provide positive feedback, stimulating cannibalism. Background color is known to play a crucial role in aquaculture, influencing feeding behavior, stress levels, and energy efficiency of aquatic organisms (Nasir *et al.,* 2017; Wang *et al.,* 2019).

Crustaceans, including freshwater crayfish, can adapt to changes in environmental color through the distribution and concentration of exoskeleton pigments, which serve as camouflage mechanisms (Mynott *et al.,* 2018; Stevens, 2016). In addition, visual factors such as light intensity, contrast between the organism and its surroundings, and spectral wavelength preferences can further modulate stress responses, where mismatches between visual conditions and sensory capacity may elevate alertness, disrupt visual comfort, and alter energy expenditure during daily activities. This camouflage process requires energy allocation, thus limiting the energy available that can be directed towards metabolism and growth. Therefore, research on the effect of background color on the survival and growth of freshwater lobsters is crucial as a basis for developing strategies to increase productivity in aquaculture systems. This research gap is crucial because a deeper understanding of visual and physiological responses to environmental color can help optimize rearing conditions, minimize stress, and increase energy efficiency, thus enabling more appropriate culture practices and resulting in better growth performance development.

MATERIALS AND METHODS

Time and place

This research was conducted from May to July 2025 at the Integrated Laboratory of the Faculty of Fisheries and Marine Sciences, Bung Hatta University.

Materials

The equipment used in the study included an aquarium for maintenance, digital scales with an accuracy of 0.01 grams, digital calipers, and aeration tubes. A 1-inch diameter pipes are equipped with an internal tubular structure that functions as a hiding space. Water quality measuring equipment consisted of a pH meter, a DO meter, and a thermometer. The research materials were 120 lobster red claw juveniles fry measuring ±1 cm in length, as well as Feng Li FL 1 pellet feed with the following nutritional content: 41% protein, 7% fat, 13% crude fiber and ash, measuring 0.4–0.7 mm. Claw juveniles fry measuring ±1 cm in length, as well as Feng Li FL 1 pellet feed with the following nutritional content: 41% protein, 7% fat, 13% crude fiber and ash, measuring 0.4–0.7 mm. This pellet feed is a sinking feed, making it suitable for lobsters, which typically forage at the bottom of the water (Noviana *et al.,* 2018).

Research method

The research used an experimental method with a completely randomized design (CRD). It consisted of four container color treatments with four replicates. The treatments given were C1: transparent aquarium background (control), C2: blue aquarium background, C3: brown aquarium background, and C4: black aquarium background.

Research parameters

Survival rate

Calculated using the formula according to Effendie (1997):

$$SR\ (\%) = \frac{N_t}{N_0} \times 100\%$$

Note:
SR = Survival Rate (%)
Nt = Number at the end (individuals)
No = Number at the beginning (individuals)

Absolute length growth

Calculated based on Zonneveld *et al.* (1991) as follows:

$$Pm = Pt - Po$$

Note:
Pm = Absolute length growth (mm)
Pt = Average length of lobsters at the end (mm)
Po = Average length of lobsters at the beginning (mm)

Absolute weight growth

Calculated using the formula Zonneveld *et al.* (1991) as follows:

$$Bm = B_t - B_o$$

Note:
Bm = Absolute weight growth rate (mg)
Bt = Average weight of lobsters at the end (mg)
Bo = Average weight of lobsters at the beginning (mg)

Specific weight growth rate

Calculated using the formula Zonneveld *et al.* (1991) as follows:

$$LPS = \frac{(LnWt - LnW0)}{t} \times 100$$

Note:
LPS = Specific Growth Rate (%/day)
Wt = Juvenile weight at the end (mg)
Wo = Juvenile weight at the beginning (mg)
t = Maintenance time (days)

Relative condition factor

Calculated using the formula of Effendie (1979):

$$K = \left(\frac{W}{L^3}\right) \times 100$$

Note:
K = Relative condition factor (%)
W = Average weight at the end (mg)
L = Average length at the end (mg)

Coefficient of variation

Calculated according to Warwick *et al.* (1990):

$$KV\ (\%) = \frac{\text{Standard deviation of juvenile weight}}{\text{Average juvenile weight}} \times 100$$

$$KV\ (\%) = \frac{\text{Standard deviation of juvenile length}}{\text{Average juvenile length}} \times 100$$

Feed conversion ratio (FCR) and feed conversion efficiency (FCE)

Calculated based on Effendie (1997):

$$FCR = \frac{F}{(Wt + D) - W0}$$

Note:
FCR = Feed Conversion Ratio
Wt = Lobster biomass at the end of thestudy (mg)
Wo = Lobster biomass at the beginning of the study (mg)
D = Lobster biomass that died during the study (mg)
F = Total feed during the study

$$FCE = \frac{(Wt + D) - W0}{F} \times 100$$

Note:
FCE = Feed conversion efficiency (%)
Wt = Lobster biomass at the end of the study (mg)
Wo = Lobster biomass at the beginning of the study (mg)
D = Lobster biomass that died during the study (mg)
F = Total feed during the study

Water quality

The water quality parameters observed included temperature (°C), pH, dissolved oxygen (DO, mg/L), and ammonia (mg/L). Temperature was measured daily, pH and DO once a week, while ammonia was measured at the end of the study.

Data analysis

Data were tested for normality and homogeneity using SPSS 27 before being analyzed using One-Way ANOVA at the 95% confidence level. If there were significant differences, the analysis was continued with Duncan's test to determine the differences between treatments.

RESULTS AND DISCUSSION

Results

Survival rate

The results showed that the highest survival rate of juvenile red claw lobsters was achieved in the C4 (black) treatment at 83 ± 5.77%, while the lowest was in the C1 (transparent) treatment at 50 ± 10.00%. Juvenile mortality mostly occurred on days 15 to 22. ANOVA analysis showed a significant difference between treatments ($F = 9.200$; $P = 0.006$). Duncan's test showed that treatments C3 and C4 were significantly different from C1 ($P<0.05$), while C1 and C2 were not significantly different ($P>0.05$). This indicates that the use of a dark background is more effective in increasing the survival rate of red-claw lobster juveniles. Biologically, using a dark background can reduce visual stress in juveniles due to the lower light intensity they receive. A dimmer environment reduces excessive visual stimuli, including shadows or light reflections, which can trigger a stress response. With reduced stress, the juveniles' energy is more optimally allocated to physiological maintenance, thereby increasing survival. Data on the average survival rate of juvenile freshwater lobsters from each treatment are shown in Table 1.

Absolute length growth

The initial length of juvenile red claw lobsters was relatively uniform (14.68–15.04 mm). During rearing, the highest absolute length growth was achieved in treatment C4 (18.31 ± 0.86 mm) and the lowest in treatment C2 (17.95 ± 0.38 mm). However, ANOVA analysis showed that differences in background color did not significantly affect absolute length growth ($P>0.05$). Biologically, body length increases in crustaceans tend to occur more slowly than weight changes because linear growth is highly dependent on the molting cycle. The frequency and success of molting can vary between individuals, so this variability causes the length growth response to be less consistent across treatments. Consequently, the effect of background color did not appear significant on absolute length growth in juveniles. Average length growth data for juvenile lobsters are shown in Table 1.

Absolute weight gain

The initial weight of juvenile red claw lobsters was relatively uniform (232.47–233.90 mg). The highest absolute weight growth was achieved in treatments C4 (492.64 ± 6.26 mg) and C3 (483.47 ± 10.92 mg), significantly different ($P<0.05$) from treatments C1 (314.52 ± 92.05 mg) and C2 (292.53 ± 75.09 mg). ANOVA analysis ($F = 9.624$; $P = 0.005$) showed that dark background color (black and brown) were more effective in increasing absolute weight gain compared to light background colors or the control. Biologically, a dark environment can reduce visual stress and increase spatial comfort for juveniles, allowing for optimal feeding activity. Reduced stress also allows for greater energy allocation to anabolism, thus supporting increased weight gain. The average data on lobster juvenile length growth are shown in Table 1.

Specific weight growth

The highest specific growth rate of red claw lobster juveniles was obtained in treatments C4 (2.53 ± 0.02 %/day) and C3 (2.50 ± 0.04 %/day), while the lowest was in treatment C2 (1.88 ± 0.37 %/day). The results of the ANOVA analysis ($F = 7.483$; $P = 0.010$) showed a significant difference between treatments, and Duncan's further test showed that treatments C3 and C4 were significantly different from C1 ($P<0.05$), while C1 and C2 were not significantly different ($P>0.05$). This indicates that the use of dark backgrounds (black and brown) is more effective in increasing the specific growth rate of freshwater lobster fry compared to light-colored aquariums or controls. Biologically, dark background colors can reduce visual stimulation and stress levels, resulting in more stable feeding activity and increased feed utilization efficiency. This condition allows for greater energy allocation for growth, resulting in a higher SGR value. Average growth data for juvenile lobsters can be seen in Table 1.

Condition factors

The highest condition factor for juvenile red claw lobsters was found in treatments C3 (2.04 ± 0.16) and C4 (1.96 ± 0.15), while the lowest was found in treatment C2 (1.49 ± 0.20). ANOVA analysis ($F=7.515$; $P = 0.010$) showed significant differences between treatments, with Duncan's test showing that treatments C3 and C4 were significantly different from C1 (P<0.05), while C1 and C2 were not significantly different (P>0.05). These results indicate that dark backgrounds (black and brown) are more effective in improving the condition factor of freshwater lobster fry than bright backgrounds or the control. Data on the average length growth of juvenile lobsters can be seen in Table 1.

Weight variation coefficient *and length variation coefficient*

The coefficient of variation in weight of juvenile red claw lobsters showed a significant difference between treatments (F = 6.357; P = 0.016), with the lowest values in treatments C3 (3.61 ± 1.20%) and C4 (5.48 ± 0.96%), and the highest in C1 (50.89 ± 31.30%) and C2 (53.24 ± 16.31%). Duncan's test showed that treatments C3 and C4 were significantly different from C1 (P<0.05), while C1 and C2 were not significantly different (P>0.05). These results indicate that a dark background is more effective in increasing uniformity of weight growth. Meanwhile, the coefficient of variation in length (5.93–8.09%) was not significantly different between treatments (P>0.05), so that the background color did not affect the uniformity of length growth. Biologically, extreme variability may be caused by differences in stress responses among juveniles, with some individuals experiencing decreased appetite or unstable feeding activity due to high visual stimulation in a bright background. Variations in molting frequency among individuals can also magnify differences in weight growth. Thus, high CV reflects growth irregularities in bright environments, in contrast to dark backgrounds that provide more stable conditions and result in better growth uniformity. The average length growth of juvenile red claw lobsters is presented in Table 1.

Feed conversion ratio and feed conversion efficiency

The FCR values of red claw lobster juveniles differed between treatments (F = 4.057; P = 0.050), with the highest value in C1 (transparent) at 3.77 ± 1.72, while the lowest values were in treatments C3 (brown) and C4 (black), at 1.37 ± 0.19 and 1.28 ± 0.07, respectively. Conversely, the FCE values were significantly different between treatments (F = 18.742; P = 0.001), which showed the opposite pattern with treatments C4 and C3 producing the highest feed efficiency, at 78.56 ± 4.44% and 73.96 ± 9.87%, respectively. Therefore, the dark background color proved to be more effective in increasing feed utilization than other treatments. Data on the average length growth of lobster juveniles can be seen in Table 1.

Water quality

In this study, several water quality parameters were measured, namely temperature, pH, DO, and ammonia. Water quality data during lobster cultivation are shown in Table 3. Based on the data obtained, only the ammonia parameter exceeded the lobster tolerance limit, while the other parameters remained within the tolerance limits based on related references. Table 3 presents various water quality parameters in the

Table 1. Average value of red claw lobsters in test parameters.

Parameters	C1	C2	C3	C4
Initial Weight (mg)	232.90 ± 0.26	232.47 ± 0.47	232.90 ± 0.53	232.70 ± 0.44
Final Weight (mg)	547.42 ± 91.83	525.00 ± 75.36	716.37 ± 10.40	725.34 ± 5.96
Initial Length (mm)	14.68 ± 0.28	14.83 ± 0.07	14.75 ± 0.03	15.04 ± 0.04
Final Length (mm)	32.65 ± 0.52	32.78 ± 0.43	32.76 ± 0.72	33.35 ± 0.84
Survival Rate (%)	50 ± 10.00[a]	60 ± 10.00[a]	80 ± 10.00[b]	83 ± 5.77[b]
Absolute Length Growth (mm)	17.97 ± 0.28[a]	17.95 ± 0.39[a]	18.01 ± 0.74[a]	18.31 ± 0.87[a]
Absolute Weight Growth (mg)	314.52 ± 92.05[a]	292.53 ± 75.09[a]	483.47 ± 10.92[b]	492.64 ± 6.26[b]
Specific Weight Growth (%/day)	1.88 ± 0.37[a]	1.79 ± 0.33[a]	2.50 ± 0.04[b]	2.53 ± 0.02[b]
Condition Factors	1.57 ± 0.19[a]	1.49 ± 0.20[a]	2.04 ± 0.16[b]	1.96 ± 0.15[b]
Weight Variation Coefficient (%)	36.04 ± 36.05[a]	53.24 ± 16.31[a]	3.61 ± 1.20[b]	5.48 ± 0.96[b]
Length Variation Coefficient (%)	5.93 ± 2.44[a]	6.00 ± 2.22[a]	8.08 ± 3.31[a]	7.43 ± 2.57[a]

Note: C1 (transparent), C2 (blue), C3 (brown), C4 (black). The letters above the numbers indicate that the superscript letters are significantly different (P<0.05).

lobster rearing environment throughout the study. These parameters remained within acceptable ranges for lobster survival. This was achieved through consistent maintenance control.

Discussion

The results of the study showed that background color significantly affected the survival and growth of juvenile red claw lobster except for length growth. Treatments with dark backgrounds, particularly black and brown, proved more effective than aquariums with light-colored backgrounds or controls. Dark colors can create environmental conditions that mimic natural habitats, such as rocky or coral areas that tend to have minimal light. Biologically, lower light intensity reduces excessive visual stimulation, thereby decreasing the activation of the stress response in the juvenile neuroendocrine system. This reduced stress supports stable feeding behavior, optimizes energy utilization for growth, and enhances survival. These conditions reduce stress levels, reduce aggressive behavior, and increase the visual comfort of the fry, thus improving survival (Huang *et al.,* 2024; Zheng *et al.,* 2023). This phenomenon also aligns with the statement by Zhang *et al.* (2024) that dark-colored tanks can reduce visual stress in crustaceans, increase feed conversion efficiency, and support optimal growth.

Absolute length and weight growth of juvenile red claw lobsters showed the best results in the dark-colored treatment, while the C1 and C2 produced relatively low growth. This is likely due to high light intensity and bright color reflections which induce visual stress. Physiologically, this stress increases the secretion of the crustacean hyperglycemic hormone (CHH), diverting energy from growth and feed utilization, thus inhibiting juvenile growth (Miranda-Benabarre *et al.,* 2024; Mynott *et al.,* 2018). Furthermore, dark coloration provides better camouflage, allowing lobsters to adapt to their environment and reducing the risk of cannibalism (Sacchi *et al.,* 2021; Duarte *et al.,* 2017). This allows more energy to be allocated to growth rather than defense.

The condition factor and growth coefficient of variation also showed differences between treatments, but not the length coefficient of variation. Higher condition factor values in treatments C3 and C4 indicate that the fry have a proportional body with good growth and stable physiological conditions (Jamlean *et al.,* 2018). The condition factor is a biological parameter used to describe the level of fish plumpness based on the relationship between body length and weight. Condition factor values are influenced by environmental conditions and food availability, with higher values reflecting better organism condition (Hasan & Afriani, 2021). Meanwhile, a lower weight coefficient of variation in the dark treatment indicates better growth uniformity. This is important in aquaculture because homogeneous growth can suppress competition, reduce the risk

Table 2. Feed conversion ratio and feed conversion efficiency.

Treatment	FCR	FCE (%)
C1	3.77 ± 1.72[a]	30.12 ± 11.99[a]
C2	3.15 ± 1.30[ab]	35.10 ± 12.27[a]
C3	1.37 ± 0.19[b]	73.96 ± 9.87[b]
C4	1.28 ± 0.07[b]	78.56 ± 4.44[b]

Note: C1 (transparent), C2 (blue), C3 (brown), C4 (black). The letters above the numbers indicate that the superscript letters are significantly different (P<0.05).

Table 3**.** Water quality data during the study.

Parameters	Treatment				Literature
	C1	C2	C3	C4	
Temperature (°C)	25 ± 0.87	25 ± 0.65	25 ± 0.80	25 ± 0.50	25-28*
pH	7.66 ± 0.05	7.5 ± 0.10	6.89 ± 0.43	7.1 ± 0.34	6.8-8.4**
DO (mg/L)	5.70 ± 0.26	6.10 ± 0.04	6.10 ± 0.02	5.83 ± 0.32	5-8***
Ammonia (mg/L)	0.23	0.14	0.08	0.03	0.36****

Note: C1 (transparent), C2 (blue), C3 (brown), C4 (black). *Temperature (Novita *et al.,* 2024), **pH (Astiyani *et al.,* 2023), ***DO (Shehata *et al.,* 2023), ****Ammonia (Yong-Chun *et al.,* 2022).

of cannibalism, and increase productivity (Zheng *et al.,* 2023).

Size uniformity is a crucial factor in aquaculture because it reduces competition between individuals for food, resulting in more even growth. Good size uniformity can improve the production performance of cultivated organisms, and optimal maintenance conditions also play a role in supporting growth and increasing overall production success (Budiardi *et al.,* 2023). Feed efficiency is also influenced by container color. Lower FCR values and higher FCE in the dark-colored treatments C3 and C4 indicate that feed can be more optimally utilized for biomass growth. The Feed Conversion Ratio (FCR) is an indicator of feed utilization efficiency in aquaculture. The FCR value is influenced by various factors, such as the culture system and feeding method. Research shows that different rearing systems result in different FCR values, while appropriate feeding methods can improve feed utilization efficiency (Albani *et al.,* 2023; Pratiwi *et al.,* 2025).

A comfortable visual environment calms lobsters, allowing energy normally allocated to stress responses to be allocated to feeding and growth, increasing feed efficiency. This occurs because a suitable visual environment can reduce stress levels and promote more stable physiological responses in crustaceans. Under these conditions, a comfortable visual environment can reduce food wastage and increase energy conversion efficiency. Zheng *et al.* (2023) reported that dark tanks improved growth and feed efficiency in juvenile red claw lobsters. In line with these findings, Hayati *et al*. (2025) also showed that crustaceans reared under less stressful conditions exhibited better physiological performance, contributing to more efficient utilization of available energy resources. This higher feed efficiency is directly related to the lobster's internal physiological state, specifically the stress response mediated by Crustacean Hyperglycemic Hormone (CHH) activity and hemolymph glucose levels.

Increased CHH activity is not simply a general response, but rather a distinct indicator of physiological stress; CHH is released when organisms experience environmental stress, affecting energy metabolism, molting, and gonadal development (Li *et al.,* 2024; Lacerda *et al.,* 2025). Exposure to high light intensity can amplify these stress signals, triggering increased CHH secretion and higher hemolymph glucose levels, reflecting the organism's physiologically challenging state (Toyota *et al.,* 2025). Conversely, environmental conditions with a dark background tend to reduce visual stress stimuli, thereby reducing the body's need to activate this hormonal response. By reducing CHH activity and thus reducing emergency energy mobilization, lobsters can conserve energy previously used to maintain homeostasis during stress. This energy can then be allocated more effectively to biological processes that support growth, such as tissue synthesis and biomass increase, thus explaining the increased growth rates observed in lobsters reared in the dark.

Water quality during rearing also supports the survival of freshwater lobster fry. The temperature around 25°C, which is suitable for maintenance (Andriyeni *et al.,* 2022). In this study the pH 6.89–7.66 is still within the optimal range according to Astiyani *et al.* (2023), which states that the appropriate pH to support lobster life ranges from 6.8-8.4, which can support healthy lobster life. Even slightly lower pH in treatments C3 and C4 can reduce the unionized ammonia fraction, thereby reducing the risk of toxicity.

According to Misrawati *et al.* (2025), dissolved oxygen in water is an important element to support lobster metabolism. Stable dissolved oxygen (5.70–6.10 mg/L) is within the range needed to support the physiological and metabolic processes of lobsters (Shehata *et al.,* 2023). Meanwhile, ammonia concentrations (0.03–0.23 mg/L are still safe and below the threshold of 0.36 mg/L (Yong-Chun *et al.,* 2022). However, ammonia levels approaching the tolerance limit can potentially disrupt hepatopancreatic function, reduce immunity, and inhibit growth (Lin *et al.,* 2023; Novita *et al.,* 2024).

Overall, the results of this study confirm that background color management, particularly the use of dark colors, is a simple yet effective strategy for improving the survival, growth, uniformity, and feed efficiency of red-clawed lobster fry. Supporting appropriate water quality further enhances the physiological performance of juveniles, thus making this strategy potentially applicable in intensive cultivation practices to increase the productivity and sustainability of red-clawed lobster aquaculture businesses.

CONCLUSION

The results of this study indicate that differences in aquarium background color significantly influence survival and growth performance (absolute weight growth, specific growth, condition factor, weight coefficient of variation, feed conversion ratio, and feed conversion efficiency) in juvenile red-clawed lobsters (P<0.05). Meanwhile, absolute length growth and length coefficient of variation do not significantly influence differences in aquarium background color (P>0.05). A dark background is recommended to improve survival and growth performance in cultivation.

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