Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 29(3): 911 – 927 (2025)
www.ejabf.journals.ekb.eg

Application of Young Coconut Water in Gourami (*Osphronemus gourami*) Egg Incubation: Impacts on Hatch Rate, Larval Viability, and Growth Performance

Syofriani[1], Ulfauza[1], Nazran[2], Azrita[3], Hafrijal Syandri[3], Fitri Sil Valen[4], Ahmad Syazni Kamarudin[5], Veryl Hasan[5, 6*]

[1]Department of Aquaculture, Jakarta Technical University of Fisheries (Politeknik Ahli Usaha Perikanan), Ministry of Marine Affairs and Fisheries, Republic of Indonesia, Jl. Raya Pasar Minggi, Jati Padang, Jakarta, 12520, Indonesia
[2]Department of Aquaculture, Politeknik Kelautan dan Perikanan Sidoarjo, Jl. Raya Buncitan 61253, Sidoarjo, East Jawa, Indonesia
[3]Faculty of Fisheries and Marine Science, Universitas Bung Hatta, Padang, Indonesia
[4] Department of Aquaculture, Faculty of Agriculture, Fisheries and Marine, Universitas Bangka Belitung, Jl Campus Terpadu UBB, Balunijuk 33127, Bangka Belitung, Indonesia
[5]School of Animal Science, Aquatic Science and Environment, Universiti Sultan Zainal Abidin, Besut Campus, 22200 Besut, Terengganu, Malaysia
[6]Department of Aquaculture, Faculty of Fisheries and Marine Science, Universitas Airlangga, Surabaya 60115, East Java, Indonesia

[*]**Corresponding Author: veryl.hasan@fpk.unair.ac.id**

ARTICLE INFO

Article History:
Received: April 2, 2025
Accepted: May 3, 2025
Online: May 18, 2025

Keywords:
Osphronemus gourami,
Young coconut water,
Hatchability,
Survival,
Larvae,
Aquaculture introduction

ABSTRACT

Gourami (*Osphronemus gourami*) is a freshwater fishery commodity with high economic value in Indonesia. One of the critical stages in seed production is egg hatching, which determines hatchability, survival, and larval growth. This study aimed to evaluate the effect of adding young coconut water (YCW) to the hatching medium on the hatching success of gourami eggs. YCW is known to contain electrolytes, vitamins, minerals, and bioactive compounds such as phenols that have antioxidant and antimicrobial properties, thus potentially improving the quality of hatching media. The study was conducted using a completely randomized design with four treatments of young coconut water concentration (0, 15, 25, and 35 ml/L) and three replications, and the parameters of hatching rate (HR), survival rate (SR), absolute length and weight growth, and specific growth rate (SGR) were observed. The results showed that YCW treatment significantly increased the hatching rate up to 100% ($P<0.05$) compared to the control (97.67%), with the optimal effect at 25ml/ L treatment. The highest survival was recorded at the 15 ml/L dose (93%), while the 35ml/ L dose significantly reduced SR (80.33%), indicating a negative correlation at high doses. Meanwhile, growth and SGR showed no significant differences between treatments ($P>0.05$), although there was an increasing trend with dose. Water quality in all treatments was within the tolerable range. The addition of young coconut water to the hatching medium can be an effective natural alternative to increase the hatching success of gourami eggs and to support the development of environmentally friendly hatchery technology.

INTRODUCTION

Indonesia is known as a megadiverse country, including the freshwater fisheries sector, which harbors a wide variety of valuable local fish species **(Insani *et al.*, 2022;**

Robin *et al.*, 2022; Hasan *et al.*, 2023). However, in recent decades, fish farming practices in Indonesia have been dominated by invasive species **(Jerikho *et al.*, 2023; Robin *et al.*, 2023)**. These species include the African catfish (*Clarias gariepinus*) **(Ihwan *et al.*, 2020)**, the Nile tilapia (*Oreochromis niloticus*) **(Serdiati *et al.*, 2020)** and the armored catfish (*Pterygoplichthys* spp.) **(Ramadhanu *et al.*, 2024)**. Although these species are advantageous due to their fast growth and high environmental tolerance, they often have negative impacts on local ecosystems **(Islami *et al.*, 2025; Syarif *et al.*, 2025)**.

The presence of these invasive species has led to the disappearance of several endemic species from their natural environments **(Jatayu *et al.*, 2023; Insani *et al.*, 2025)**, reduced the habitats of native fish **(Valen *et al.*, 2023)**, and disrupted the ecological balance **(Insani *et al.*, 2024)**. Therefore, strategic steps are needed to promote the cultivation of local fish as a more sustainable and environmentally friendly solution **(Valen *et al.*, 2020; Nazran *et al.*, 2025)**.

One local fish species with great potential for development is the gourami (*Osphronemus goramy*), a freshwater fishery commodity with high economic value in Indonesia **(Slembrouck *et al.*, 2019)**. The demand for quality gourami seeds continues to increase alongside the development of the aquaculture sector. One of the crucial stages in seed production is the egg hatching process, which determines larval survival rate and growth **(Schmidt *et al.*, 2024)**.

However, the hatching rate and survival rate of gourami larvae often face various obstacles, such as suboptimal water quality, high levels of stress on embryos during the incubation period, and diseases that attack the eggs, particularly fungal infections **(Avery *et al.*, 2009; Arifin *et al.*, 2019)**. Therefore, innovation is needed in hatchery media management to increase the efficiency and success of hatcheries—one of which involves the use of young coconut water (YCW) **(Sulistyo *et al.*, 2021)**.

Young coconut water (YCW) is a popular natural hydration drink in tropical countries **(Wungkana *et al.*, 2024)**. It is rich in essential electrolytes, vitamins, minerals, and bioactive compounds with functional properties **(Halim *et al.*, 2023)**. Coconut water (CW) contains phenolic compounds such as hydroxybenzoic acid, galocatechin, and chlorogenic acid, as well as high total phenol content and strong antioxidant capacity **(Mahayothee *et al.*, 2016)**. In both *in vitro* and *in vivo* tests, coconut wastewater extract has been shown to effectively inhibit fungal infections, providing a preventive benefit with a significant reduction in disease incidence and infected wounds **(Hernández-Flores *et al.*, 2023)**.

Various studies have reported that one of the main causes of hatching failure in fish eggs is fungal infection, in addition to poor water quality and genetic factors **(Shahbazian *et al.*, 2010)**. This study aimed to evaluate the effect of adding young coconut water to gourami egg hatching media on hatchability, survival, and larval growth. The results are expected to contribute scientifically to the development of environmentally friendly and efficient hatchery technologies, while also promoting the use of local natural resources to enhance aquaculture productivity.

MATERIALS AND METHODS

1. Time and place

This research was conducted at the SUPMN Pariaman Freshwater Hatchery located at Jalan Simpang IV Toboh V Koto Kampung Dalam Pariaman, West Sumatra.

2. Materials and equipment

Materials and tools used for detecting the effects of soaking gourami eggs in young coconut water (*Ospherunemus gourami*) are shown in Table (1).

Table 1. Tools and uses for research

Equipment Name	**Specification**	**Function**
Binocular Microscope	Olympus CX23 Multimedia	Used to observe embryonic development and growth
Hatching bucket	10-liter capacity, Ø 30 cm	Container for hatching gourami eggs
Sieve	Plastic sieve, Ø 20 cm	Used as a hatching medium for gourami eggs
Digital Scale	AD-600i, capacity 600g, precision 0.01g	To weigh eggs, larvae, and fry
pH Meter	pHep Hanna HI 98107	To measure the pH of hatching and rearing water
DO Meter	Portable DO meter, AZ-8403 model	To determine the dissolved oxygen concentration in water
Ruler	Precision: 1 mm	To measure the length of fish fry
Measuring Cylinder	100 ml and 1000 ml	To measure volumes of water and coconut water
Plastic Spoon	Teaspoon size	Used to collect eggs for microscopic observation

Table 2. Materials used for research

Item Name	**Specification**	**Function**
Formalin Solution	40% formaldehyde, 10 ml	Used for laboratory sample analysis and histological slide preparation
Coconut Water	Applied at 15 ml/liter, 25 ml/liter, and 35 ml/liter of water	Used as a treatment solution for hatching gourami (*Osphronemus gourami*) eggs
Water	Sourced from municipal supply (PDAM), settled for 4 days	Used as hatching water for gourami eggs
Gourami Eggs	Fertilized	Used as research material for experimental observation

3. Methods

A total of 1200 fertilized gourami eggs were taken from the fertilized gourami egg nests and were then placed in 12 hatching containers. Each container contains 100 eggs each, equipped with hatching media with a volume of 8000ml, aeration and thermometer. Hatching media comes from PDAM water that has passed the physical sterilization process. In this experiment, a completely randomized design (CRD) was used **(Steel & Torrie, 1989)** with the research factor being young coconut water added to the gourami egg hatching medium consisting of 4 treatments and 3 replicates and 12 total experiments. The treatment parameters can be seen in Table (3).

Table 3. The amount of PDAM Water and Kalapa Muda Water used for this study

Treatment	Volume of Young Coconut Water (ml)	Volume of Settled PDAM Water (ml)	Total Volume of Water (ml)
P1 (Control)	0	8000	8000
P2 (15 ml/L)	120	7880	8000
P3 (25 ml/L)	200	7800	8000
P4 (35 ml/L)	280	7720	8000

4. Research analysis

The addition of young coconut water to each gourami egg hatching medium in the experimental treatment was carried out for 72 hours, according to the time required for hatching gourami eggs, which is 3 days. The development of the embryonic stage was observed using a microscope. Then the eggs were transferred to the larval rearing container with water media sourced from PDAM, which has been deposited for 2 days and sterilized. Analysis of the results of the study consisted of observing the development of embryos in eggs, calculating the value of hatching rate (HR), survival rate (SR), growth analysis and specific growth rate (SGR). The following is a description of the research analysis used:

a. Embryo development

Embryo development can be seen visually through observation using a microscope to determine the time of phase change by Hatching Power using the **Effendi (1997)** formula.

b. Hatching rate

Hatching Rate $= \frac{Jumlah\ telur\ yang\ menetas}{Jumlah\ total\ telur} \times 100$

c. Survival rate

$SR = \frac{Jumlah\ larva\ pada\ akhir}{Jumlah\ larva\ pada\ awal} \times 100$

d. Weight growth

Weight Growth Wm = Wt-Wo

Wm : absolute weight growth

Wt : weight of fish seeds at the end of the study
Wo : weight of fish seeds at the beginning of the study

e. Long growth $Lm = Lt - Lo$
Lm : Long growth is absolute
Lt : Long growth at the end of the study
Lo : long growth at the beginning of the study

f. Specific growth rate (SGR %/day (mg) = $\frac{Ln\,Wt - Ln\,Wo}{t}$ x 100%
SGR : Spesifik Growth Rate
W_0 : Bobot awal penelitian
Wt : Bobot akhir penelitian
T : Time Specific Growth Rate

g. Water quality
The water quality parameters observed were pH, DO and temperature. The tools used were DO-meter to measure dissolved oxygen, pH-meter to measure pH and thermometer to measure temperature. The measurement was carried out 4 times, in the morning at 06.00, 12.00, 18.00 and 24.00

RESULTS

1. Hatching rate

The study on the effect of adding young cocnut water (YWC) on the hatching of gourami fish eggs provided measurement results on all variables carried out during 28 days of observation, and data on Hatching Rate in gourami fish eggs (*Ospheronemus gouramy*) were obtained (Table 4).

Table 4. Hatching rate, survival rate, and growth

Variable	Dose of Young Coconut Water			
	P.0 (0 ml)	P.1 (15 ml)	P.2 (25ml)	P.3 (35ml)
Hatching Rate (%)	97,67±1,15[a]	99,67±0,58[b]	100,00±0,00[b]	100,00±0,00[b]
Survival Rate (%)	91,67±3,79[a]	93,00±1,00[a]	89,67±1,53[a]	80,33±6,35[b]
Absolute Weight (mg)	13,93±0,70[a]	14,86±1,15[a]	14,63±2,01[a]	14,77±0,77[a]
Absolute Length (mm)	0,75±0,08[a]	0,89±0,05[a]	2,93±3,39[a]	2,85±3,42[a]
SGR (%/day)	4,75±0,61[a]	5,04±0,18[a]	5,20±0,41[a]	5,24±0,13 [a]

Different superscript letters within the same row indicate a significant difference between treatments ($P< 0.05$). Identical superscript letters indicate no significant difference between treatments ($P > 0.05$).

In addition, the use of young coconut water on egg hatching rate (HR) has a positive correlation relationship (Fig. 1).

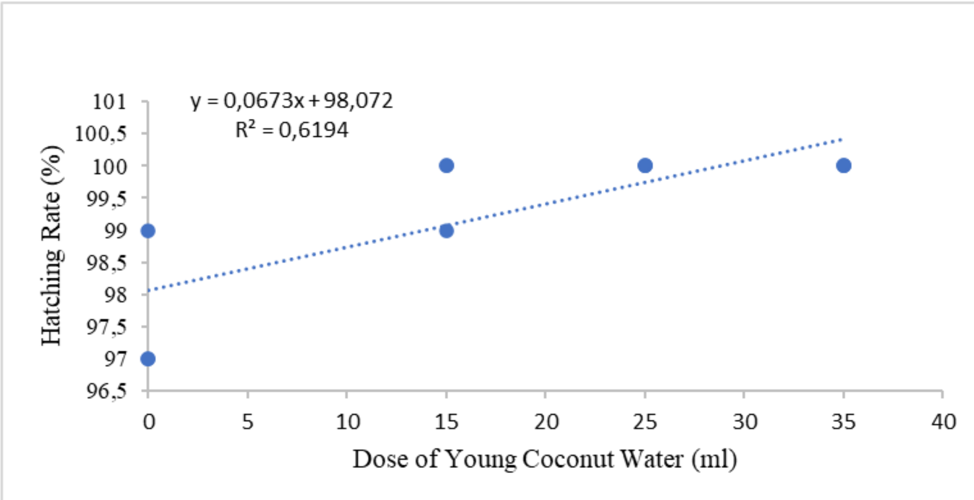

Fig. 1. Correlation relationship with gourami egg hatchability

2. Survival rate

The survival rate variable is a count of the percentage of gourami fish larvae that survived at the end of the study after treatment for 28 days. The correlation relationship of young coconut water dose to survival is seen in Fig. (2).

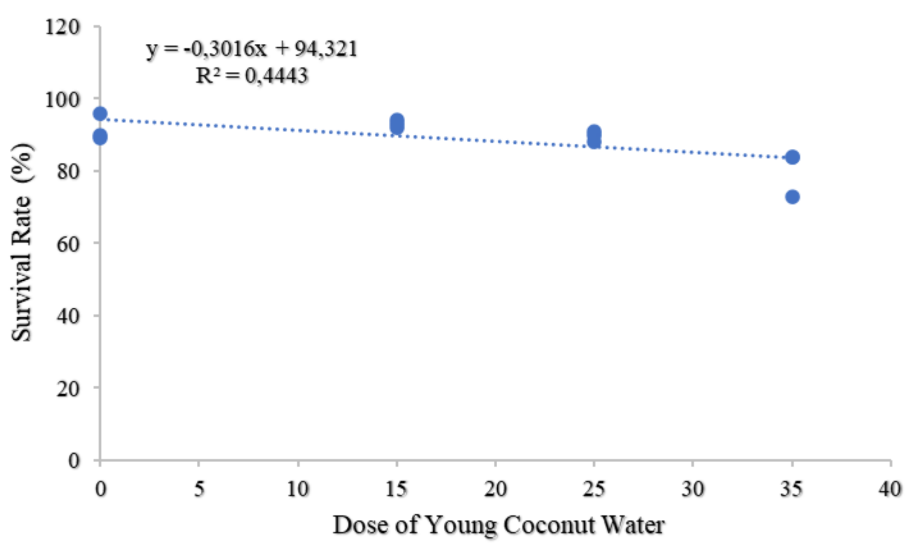

Fig. 2. The correlation between young coconut water dosage and survival rate

Based on Fig. (2), a negative correlation is observed between the dose of coconut water and the survival rate of gourami (*Osphronemus goramy*) larvae. As the concentration of coconut water increases, the survival rate tends to decrease. This indicates that higher doses of coconut water are associated with lower larval survival, suggesting a negative correlation between the two variables.

3. Absolute weight growth

Absolute weight growth refers to the difference in the weight of gourami (*Osphronemus goramy*) larvae measured at the beginning and at the end of the study. The correlation between the concentration of coconut water and the absolute weight growth of gourami larvae is illustrated in Fig. (3).

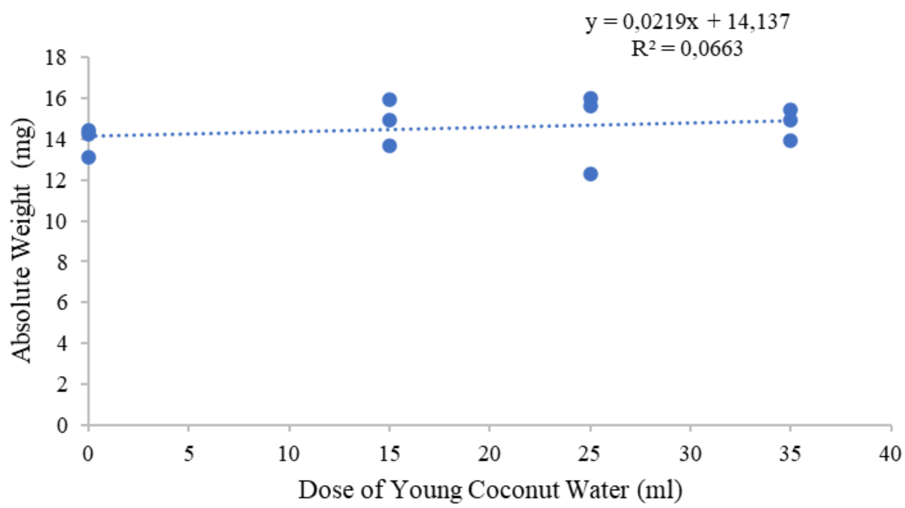

Fig. 3. The correlation relationship between coconut water dose and the absolute weight growth of gourami larvae

Based on Fig. (3), a positive correlation can be observed between the concentration of coconut water and the absolute weight growth of gourami (*Osphronemus goramy*) larvae. The data show that as the dose of coconut water increases, the absolute weight of the larvae also tends to increase. This indicates that higher concentrations of coconut water are associated with improved larval growth in terms of body weight.

4. Absolute length growth

Absolute length growth refers to the difference in the length of gourami (*Osphronemus goramy*) larvae measured at the beginning and at the end of the study. The correlation between the dose of coconut water and the absolute length growth of the larvae is illustrated in Fig. (4).

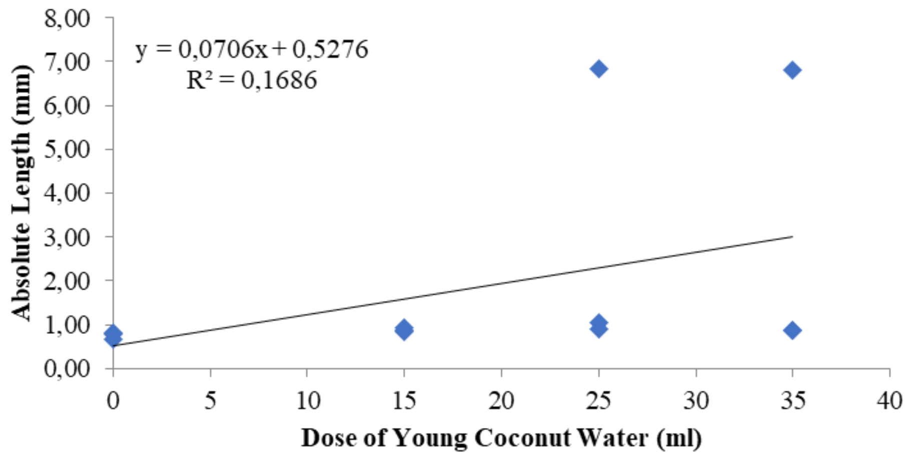

Fig. 4. Correlation relationship between coconut water doses

The correlation between the dose of coconut water and the absolute length growth of gourami (*Osphronemus goramy*) larvae indicates a negative relationship. As the concentration of coconut water increases, the absolute length growth of the larvae tends to decrease. This suggests that higher doses of coconut water are associated with reduced larval length growth, indicating a negative correlation between the two variables.

5. Specific mean group

The average value of the SGR based on the calculation is seen in Fig. (5). The correlation between the dose of coconut water and the specific growth rate (SGR) of gourami (*Osphronemus goramy*) larvae shows a positive relationship. As the concentration of coconut water increases, the absolute weight growth of the larvae also increases. This indicates a positive correlation between coconut water dosage and the specific growth rate of gourami larvae.

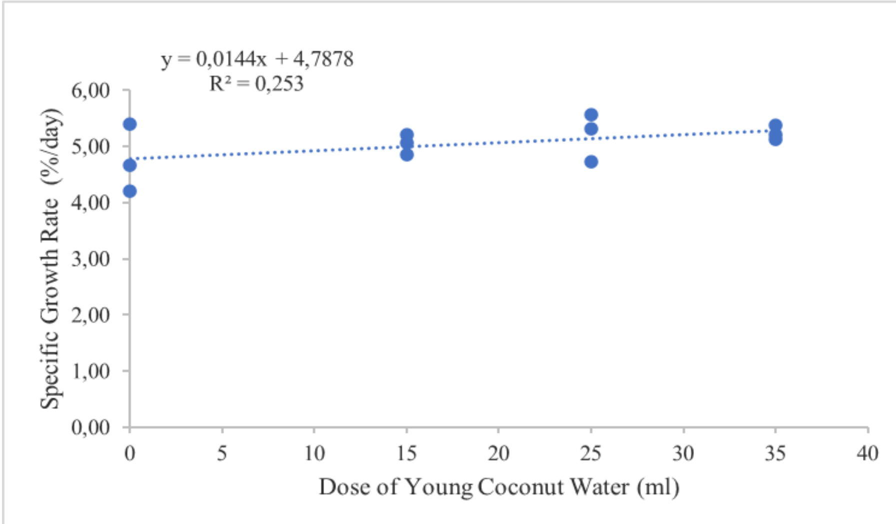

Fig. 5. Correlation relationship between coconut water doses

6. Water quality

The water quality parameters observed and measured during the study were pH, nitrate, nitrite, hardness, and alkalinity. The results of the measurement of water quality values are listed in Table (5).

Table 5. Water quality result

Parameter	Treatment			
	P.0 (0 ml/l)	**P.1 (15 ml/l)**	**P.2 (25ml/l)**	**P.3 (35ml/l)**
pH	6,4	6,65	6,55	5,89
Nitrate	0,045	0,051	0,107	0,134
Nitrite	0,001	0,003	0,004	0,007
Hardness	8,40	88,90	27,30	2,80
Alkalinity	5,200	52,000	20,667	2,333

DISCUSSION

The hatching rate (HR) in this study refers to the percentage of eggs that successfully hatched **(Warni *et al.*, 2024)** following the application of young coconut water in varying volumes over a 3-day observation period. Complete data, including hatching rate calculations and statistical tests, were collected for gourami fish eggs. The results showed a 100% hatching rate in all treatment groups across three replicates, except for the control group, which exhibited a 98% hatching rate. Statistical analysis revealed that soaking gourami fish eggs in young coconut water at different concentrations had a significant effect on hatchability ($P< 0.05$). Young coconut water contains essential minerals such as potassium and sodium **(Shi *et al.*, 2025)**, which play crucial roles in metabolic activity and in the formation of extracellular enzyme cofactors. These minerals are believed to contribute positively to successful hatching.

Based on Figure 1, increasing the dose of young coconut water is associated with a higher hatching rate of gourami eggs, indicating a positive correlation between coconut water concentration and egg hatchability. The effectiveness of coconut water in enhancing hatching is likely due to its beneficial biochemical composition. One key component is fructose, which serves as a significant energy source for spermatozoa outside the testes. As a diluent, fructose provides nutrients in the form of ATP, enabling sperm cells to maintain viability for longer periods **(Bustani *et al.*, 2021)**. Since coconut water contains both glucose and fructose, it is assumed to meet the nutritional requirements of spermatozoa during storage and may contribute to improved fertilization and hatching outcomes **(Ponglowhapan *et al.*, 2004)**.

Previous studies have demonstrated that coconut water treatment can influence the survival rate of various fish species. For instance, soaking the platy swordfish (*Xiphophorus helleri*) in coconut water at 30ppm/ L for 8 hours resulted in survival rates ranging from 60 to 65.8% **(Rahmawati *et al.*, 2023)**. In the red tilapia (*Oreochromis niloticus*), treatment with 30% coconut water yielded a relatively high survival rate of 93%. However, soaking duration also affects outcomes. In another study on tilapia larvae, soaking treatments of 5, 10, 15, and 20 hours produced survival rates ranging from 31.5% to 39.5%, with the lowest rate (31%) observed at 20 hours **(Masprawidinatra *et al.*, 2015)**. These findings suggest that while coconut water has beneficial properties, excessive exposure may reduce survival. Supporting this, other sources indicate that overuse of coconut water may lead to harmful effects, potentially resulting in mortality.

Based on various analyses, soaking gourami (*Osphronemus goramy*) eggs in young coconut water at different concentrations significantly affected ($P< 0.05$) the survival rate (SR) of the resulting larvae. The average survival rate during a 28-day rearing period varied across treatments: P0 (control) recorded 88%, P1 showed the highest survival rate at 92%, followed by P2 at 84%, and P3 with the lowest at 69%. The P3 treatment (35ml/ L) resulted in the lowest larval survival, while P2 (25ml/ L) showed a moderate SR of 84%. P1 (15ml/ L) was considered optimal, achieving the highest larval survival at 92%.

These differences are likely influenced by both egg quality and the impact of varying coconut water concentrations on water quality during incubation. Changes in water parameters can affect larval viability post-hatching. In all treatments, larvae that died after hatching showed similar symptoms: pale whitish-yellow coloration followed by decay. Supporting results from studies on other fish species, such as the betta fish, showed variable survival rates (approximately 83 to 89%) after immersion in different doses of coconut water followed by extended rearing **(Dwinanti *et al.*, 2018)**. Mortality in fish embryos can occur when the embryo fails to develop properly or is unable to perform essential metabolic functions needed for organ and tissue formation **(Hardanigsih *et al.*, 2008)**.

According to Fig. (3), a positive correlation was observed between the dose of young coconut water and the absolute weight gain of gourami (*Osphronemus goramy*) larvae. As the coconut water concentration increased, so did absolute weight growth, suggesting that higher doses may enhance growth performance. This effect is likely related to the nutritional composition of coconut water, which includes phenolic compounds with antioxidant properties and potassium **(Mahayothee *et al.*, 2016)**, both of which support metabolic processes and improve larval health **(Wenzel *et al.*, 2021)**.

However, statistical analysis (ANOVA) showed that soaking gourami eggs in different concentrations of coconut water had no significant effect ($P > 0.05$) on the absolute weight growth of the larvae. Over a 28-day rearing period, all treatments showed relatively similar weight gains. The highest gain was recorded in treatment P1 (14.26mg), followed by P3 (14.14mg), P2 (14.03mg), and the control P0 (13.13mg). These numerical differences were not statistically significant.

In terms of absolute length growth, similar findings were observed. Although statistical tests showed no significant effect ($P > 0.05$) of coconut water concentration on larval length, slight variation in mean length was noted. The highest growth occurred in treatment P2 (297mm), followed by P3 (291mm), P1 (88mm), and the control (P0) with the lowest at 72mm. These differences were not statistically validated.

Interestingly, a negative correlation was noted between the dose of coconut water and absolute length growth. As the concentration increased, length gain tended to decrease. This inverse relationship may suggest that higher doses affect morphological development differently than weight gain.

Regarding specific growth rate (SGR), although increasing trends were observed with higher coconut water doses, the differences were not statistically significant ($P > 0.05$). The highest SGR was recorded in P3 (5.24%), followed by P2 (5.20%), P1 (5.04%), and P0 (4.75%). The lower SGR observed in the control may be linked to reduced water quality, indicated by water discoloration and thickening—suggesting elevated organic matter or ammonia accumulation.

Water quality is a critical factor in larval development and survival **(Ofori-Darkwah *et al.*, 2023)**. Poor water conditions can impair embryonic development, reduce hatchability, and negatively affect growth performance **(He *et al.*, 2022)**. In this study, water pH ranged from 5.89 to 6.65, which is slightly below the optimal range for tilapia (6.7–8.6) but still within the tolerance range for gourami larvae. Other measured water quality parameters included nitrate, nitrite, hardness, and alkalinity. Variations in these parameters may have contributed to the non-significant differences in growth performance across treatments.

The early life stages of fish are highly sensitive to environmental conditions **(Lagunes *et al.*, 2025)**. Stable water quality, combined with adequate nutrition, plays a key role in determining larval survival and growth **(Yoshinaga *et al.*, 2022; Serdiati *et al.*, 2024)**. Additionally, genetic and environmental interactions significantly contribute to variability in development and individual traits within populations **(Gonzalez *et al.*, 2022)**.

CONCLUSION

This study demonstrated that the addition of young coconut water (YCW) to the hatching medium of gourami eggs (*Osphronemus gourami*) significantly influences hatching rate and survival rates, with notable trends in larval growth performance. The highest hatching rate (100%) was achieved with YCW concentrations of 25 and 35ml/ L, indicating that the bioactive and antioxidant compounds in coconut water positively affect embryonic development. However, excessive concentrations (35ml/ L) negatively impacted survival rate, suggesting a threshold beyond which the water quality deteriorates, possibly due to increased organic matter affecting larval resilience. The optimal balance was found at 15ml/ L, which provided both a high hatching rate (99.67%) and the highest survival rate (93%), indicating that moderate enrichment of the hatching medium with coconut water can enhance both embryonic success and early larval viability. Growth parameters such as absolute weight, length, and specific growth rate did not differ significantly between treatments, though positive correlations were noted between coconut water concentration and weight-related growth metrics. The study also highlighted the importance of water quality, as parameters like pH and nitrogen compounds fluctuated with increasing YCW doses. These fluctuations suggest that while coconut water can serve as a natural and locally available additive to improve hatchery success, its concentration must be carefully managed to avoid adverse effects on water chemistry and larval survival. In conclusion, young coconut water at a concentration of 15ml/ L is recommended as an effective and environmentally friendly additive to improve the hatching rate and survival rate of gourami larvae in aquaculture hatchery systems.

ACKNOWLEDGMENT

The author expresses his gratitude to Department of Aquaculture, Jakarta Technical University of Fisheries (Politeknik Ahli Usaha Perikanan), Ministry of Marine Affairs and Fisheries, Jati Padang, Jakarta, Indonesia for funding this research.

REFERENCES

Arifin, O.Z.; Prakoso, V.A.; Subagja, J.; Kristanto, A.H.; Pouil, S. and Slembrouck, J. (2019). Effects of stocking density on survival, food intake and growth of giant gourami (*Osphronemus goramy*) larvae reared in a recirculating aquaculture system. Aquaculture., 509, 159-166.

Avery, T.S.; Killen, S.S. and Hollinger, T.R. (2009). The relationship of embryonic development, mortality, hatching success, and larval quality to normal or abnormal early embryonic cleavage in Atlantic cod, Gadus morhua. Aquaculture., 289(3-4): 265-273.

Bustani, G.S. and Baiee, F.H. (2021). Semen extenders: An evaluative overview of preservative mechanisms of semen and semen extenders. Vet World., 14(5):1220-1233

Dwinanti, S.H.; Yusuf, M. & Syaifudin, M. (2019). Maskulinisasi Ikan Cupang (*Betta splendens*) Menggunakan Air Kelapa (*Cocos nucifera*) melalui Metode Perendaman Embrio. In Seminar Nasional Lahan Suboptimal (74-81).

Effendi. M.I. (1997). Biologi Perikanan. Yayasan Pustaka Nusantara. Yogyakarta. Hlm 53-163

Gonzalez, C., Gallardo-Hidalgo, J., & Yáñez, J. M. (2022). Genotype-by-environment interaction for growth in seawater and freshwater in Atlantic salmon (Salmo salar). Aquaculture., 548: 737674.

Halim, H. H., Dek, M. S. P., Hamid, A. A., Saari, N., Lazim, M. I. M., Abas, F., ... & Jaafar, A. H. (2023). Novel sources of bioactive compounds in coconut (*Cocos nucifera* L.) water from different maturity levels and varieties as potent skin anti-aging strategies and anti-fatigue agents. Food Bioscience., 51: 102326.

Hasan, V.; Andraini, N.E.; Isroni, W.; Sari, L.A.; Nafisyah, A.L.; Dewi, N.N.; Putri, D.N.A.; Prasasti, T.A.B.; Ramadhani, A.A.; Daniel, K.; South, J.; Vieira L.O., Ottoni F.P., Maftuch, Faqih A.R., Wirabuana P.Y.A.P., Tamam M.B. and Valen F.S. (2023). Fish diversity of the Bengawan Solo River estuary, East Java, Indonesia. Biodiversitas., 24(4): 2207-2216

He, J.; Wan, L.; Yu, H.; Peng, Y.; Zhang, D. & Xu, W. (2022). Effect of water temperature on embryonic development of Protunus trituberculatus in an off-season breeding mode. Frontiers in Marine Science., 9: 1066151.

Hernández-Flores, E.J.; Blancas-Benitez, F.J.; Montaño-Leyva, B. and González-Estrada, R.R. (2023). Antifungal potential of aqueous extracts of coconut (*Cocos nucifera L.*) by-products against blue mold disease on Persian lime during storage. Food Control., 148: 109632.

Ihwan.; Pratama, F.S.; Yonarta, D.; Faqih, A.R.; Widodo, M.S.; Valen, F.S.; Tamam, M.B. and Hasan V. (2020). Presence of asian catfish clarias batrachus (Siluriformes, clariidae) in Madura Island, Indonesia. AACL Bioflux., 13(2): 958 – 962

Insani L.; Jatayu, D.; Valen, F.S.; Widodo, M.S. and Hasan V. (2022). Comparing genetic *Mystacoleucus marginatus* and *Mystacoleucus padangensis* (Cypriniformes: Cyprinidae) based on Cythochrome C Oxidase sub unit I (COI) gene. Iranian Journal of Ichthyology., 9(4): 195 – 203.

Insani, L.; Jatayu, D.; Valen, F.S. and Hasan V. (2024). First Record of the invasive Banded jewel cichlid *Hemichromis elongatus* (Guichenot, 1861) (Teleostei: Cichlidae) on Bangka Island, Indonesia. IOP Conference Series: Earth and Environmental Science., 1392(1): 012030.

Islamy R.A.; Valen F.S.; Alfian R.A. and Hasan V. (2025). First Record of *Xiphophorus helleri* (Heckel, 1848) (Cyprinodontiformes: Poeciliidae) from the Bangka Island, Indonesia. Egyptian Journal of Aquatic Biology and Fisheries., 29(2): 1055 – 1065

Jatayu, D.; Insani, L.; Valen, F.S.; Ramadhanu, D.; Hafidz, A.M.; Susilo, N.B.; Swarlanda.; Sabri, A.; Islamy, R.A.; Tamam, M.B. and Hasan, V. 2023. Range expansion of Red devil cichlid *Amphylopus labiatus,* (Günther, 1864) (Actinopterygii: Cichlidae) in Bangka Island, Indonesia (2023) IOP Conference Series: Earth and Environmental Science., 1267(1): 012100

Jerikho, R.; Akmal, S.G.; Hasan, V.; Yonvitner.; Novák, J.; Magalhães, A.L.B.; Maceda-Veiga, A.; Tlusty, M.F.; Rhyne, A.L.; Slavík, O. and Patoka, J. (2023). Foreign stingers: South American freshwater river stingrays *Potamotrygon spp*. established in Indonesia. Scientific Reports., 13(1): 7255.

Lagunes, M.J.; Berline, L.; Di Stefano, M. and Rossi, V. (2025). Impact of environmental conditions on fish early-life stages, an individual-based model approach. Ecological Modelling., 501: 111023.

Mahayothee, B.; Koomyart, I.; Khuwijitjaru, P.; Siriwongwilaichat, P.; Nagle, M. and Müller, J. (2016). Phenolic compounds, antioxidant activity, and medium chain fatty acids profiles of coconut water and meat at different maturity stages. International Journal of Food Properties., 19(9): 2041-2051.

Mahayothee, B.; Koomyart, I.; Khuwijitjaru, P.; Siriwongwilaichat, P.; Nagle, M. and Müller, J. (2016). Phenolic compounds, antioxidant activity, and medium chain fatty acids profiles of coconut water and meat at different maturity stages. International Journal of Food Properties., 19(9): 2041-2051.

Masprawidinatra, D.; Helmizuryani. and Elfachmi, (2015). Pengaruh Penggunaan Air Kelapa Dengan Lama Perendaman Yang Berbeda Terhadap Maskulinisasi Ikan Nila *Oreochromis niloticus.* Fiseries., 4 (1): 13-16.

Nazran.; Syofriani.; Ulfauza.; Valen, F.S.; Oktaviandi, D.; Prayoga, A.; Ilmia, M.; Czech, M.; Kamarudin, A.M. and Hasan, V. (2025). DNA Barcoding of *Rasbora sp.* from Bangka Island: A Genetic Identification Basis and Its Potential Application in Aquaculture. Egyptian Journal of Aquatic Biology & Fisheries., 29(3): 213 – 22

Ofori-Darkwah, P.; Adjei-Boateng, D. and Edziyie, R.E. (2023). The water quality, incubation period and fecundity of the prawn *Macrobrachium vollenhovenii*. Egyptian Journal of Aquatic Research., 49(1): 121-128.

Park, J.W.; Yoo, H.K.; Jung, H.K.; Park, H.J.; Bae, K.M.; Kang, C.K. and Lee, C.I. (2024). Effects of water temperature changes on the early life stages (egg and larvae) of walleye Pollock (*Gadus chalcogrammus*)–Laboratory experiments and field applications. Journal of Experimental Marine Biology and Ecology., 571, 151980.

Ponglowhapan, S.; Essén-Gustavsson, B.; Linde and Forsberg, C. (2004). Influence of glucose and fructose in the extender during long-term storage of chilled canine semen. Theriogenology., 62(8): 1498-517.

Rahmawati, N.; Diniarti, N. and Affandi, R.I. (2023). The effect of coconut (Cocos nucifera) water for male genital direction in swordtail fish (*Xiphophorus helleri*). Jurnal Mina Sains. 1 (2).

Ramadhanu, D.; Tamam, M.B.; Valen, F.S. and Hasan, V. (2024). New records of the Non-native Amazon sailfin catfish *Pterygoplichthys pardalis* (Castelnau, 1985) in Bangka Island Indonesia. IOP Conference Series: Earth and Environmental Science., 1392(1): 012021

Robin.; Insani, L.; Swarlanda.; Prananda, M. and Valen, F.S. (2022). Range extension of Spanner barbs, *Barbodes lateristriga* (Valenciennes, 1842) (Cypriniformes: Cyprinidae) to Bangka Island, Indonesia. Iranian Journal of Ichthyology., 9(3): 149 – 157

Robin.; Valen, F.S.; Nomleni, A.; Turnip G., Luhulima M.Y., Insani L. (2023). Presence of non-native freshwater fish in Indonesia: A review-Risk and ecological impacts. AACL Bioflux., 16(1): 66 – 79

Schmidt, N.; Garate-Olaizola, M. and Laurila, A. (2024). Acclimatizing laboratory-reared hatchling cod (Gadus morhua) to salinity conditions in the Baltic Sea. Aquaculture., 579: 740255.

Serdiati, N.; Insani, L.; Safir, M.; Rukka, A.H.; Mangitung, S.F.; Valen, F.S.; Tamam, M.B. and Hasan V. (2020). Range expansion of the invasive Nile tilapia *Oreochromis niloticus* (Perciformes: Cichlidae) in Sulawesi Sea and first record for Sangihe Island, Tahuna, North Sulawesi, Indonesia. Ecology, Environment and Conservation., 27(1): 168 – 171

Serdiati, N.; Islamy, R.A.; Mamat, N.B.; Hasan, V. and Valen, F.S. (2024). Nutritional Value of Alligator Weed (*Alternanthera philoxeroides*) and Its Application for Herbivorous Aquaculture Feed. International Journal of Agriculture and Biosciences., 13 (3): 318 - 324

Shahbazian, N.; Ebrahimzadeh, M.H.; Soltani, M.; Khosravi, A.R.; Mirzargar, S. and Sharifpour, I. (2010). Fungal contamination in rainbow trout eggs in Kermanshah province propagations with emphasis on Saprolegniaceae.

Shi, S.; Wang, W.; Wang, F.; Yang, P.; Yang, H.; He, X. and Liao, X. (2025). Research Progress in Coconut Water: A Review of Nutritional Composition, Biological Activities, and Novel Processing Technologies. Foods., 14: 1503.

Slembrouck, J.; Arifin, O.Z.; Pouil, S.; Subagja, J.; Yani, A.; Kristanto, A.H. and Legendre, M. (2019). Gender identification in farmed giant gourami (*Osphronemus goramy*): A methodology for better broodstock management. Aquaculture., 498: 388-395.

Sulistyo, D.G., Susilowati, T. and Windarto, S. (2021). The Effect of Immersion Doses of Hybrid Coconut Water on Guppy (*Poecillia reticulata*) to Increase the Male Larvae Percentage. Sains Akuakultur Tropis : Indonesian Journal of Tropical Aquaculture., 5(1): 34-40.

Syarif, A.F.; Valen, F.S.; Czech, M.; Islamy, R.A.; Hafidz, A.M.; Yusnandar, F.; Kamarudin A.S. and Hasan V. (2025). The Existence of the Non-Native Western Mosquitofish *Gambusia affinis* (Baird & Girard, 1853) (Cyprinodontiformes: Poeciliidae) on Belitung Island, Indonesia. Egyptian Journal of Aquatic Biology and Fisheries., 29(1): 2795 – 2804

Valen, F.S.; Anugerah, P.; Maharani, M.D.K.; Pamungkas, A.; Anwar, S.; Nomleni, A.; Jatayu, D.; Insani, L. and Swarlanda. (2023). First record of Siamese fighting fish, *Betta splendens* (Regan, 1910) (Anabantiformes: Osphronemidae), in Bangka Island, Indonesia. AACL Bioflux., 16 (5): 2671 – 2677

Valen, F.S.; Soemarno.; Widodo, M.S.; Wiadnya, D.G.R. and Hasan V. (2020). Contemporary distribution records of yellow finned barb *mystacoleucus marginatus* (Valenciennes, 1842) in brantas basin, Indonesia. Ecology, Environment and Conservation., 26: S40 - S4

Wenzel, L.C.; Strauch, S.M.; Eding, E.; Presas-Basalo, F.X.; Wasenitz, B. and Palm, H.W. (2021). Effects of dissolved potassium on growth performance, body composition, and welfare of juvenile african catfish (*Clarias gariepinus*). Fishes., 6(2): 11.

Warni, R.E.; Imlani, A.; Ismi, S.; Masithah, E.D. and Budi, D.S. (2024). Mass induction of tiger barb (Puntius tetrazona) spawning via hormone immersion technique. Egyptian Journal of Aquatic Research. , 50(2), 267-271.

Wungkana, J.; Son, R.H.; Jonathan, S.R.; Indrata, M.; Liwu, S.L.; Muzaiyanah, S. and Rindengan, B. (2024). Exploring the potential of dwarf coconut: physicochemical properties and sensory evaluation of several coconut varieties. In IOP Conference Series: Earth and Environmental Science., 1377(1): 012041).

Yoshinaga, H.; Matsunari, H.; Furuita, H.; Miura, M.; Ozawa, R.; Okazaki, T.; ... and Yamamoto, T. (2022). Effects of nutritional conditioning during first feeding and selective breeding with a low fish meal diet on the growth performance of juvenile rainbow trout Oncorhynchus mykiss. Aquaculture Science, 70(1): 23-34.