Fisheries Journal, 16 (4), 2251-2260 (2026)
http://doi.org/10.29303/jp.v16i4.2546

THE EFFECT OF SALINITY DIFFERENCES ON THE SURVIVAL RATE OF MILKFISH (*Channos channos*) LARVAE IN CLOSED SYSTEM WET TRANSPORTATION

Pengaruh Perbedaan Salinitas Terhadap Tingkat Kelangsungan Hidup Benih Ikan Bandeng (*Channos channos*) pada Transportasi Basah Sistem Tertutup

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(Received June 16th 2026; Accepted August 6th 2026)

ABSTRACT

Closed-system wet transport is increasingly utilized in fisheries operations due to its efficiency, practicality, and effectiveness in maintaining aquatic environmental quality during transit. Additional advantages of this system include reduced water loss and lower stress levels in fish, facilitated by a more controlled environment (Sari et al., 2021). Nevertheless, salinity remains a critical parameter during transport, as drastic changes in salt levels can affect the osmoregulation and physiological functions of milkfish fry (Nurfadilah et al., 2023). This study aims to examine the effect of varying salinity levels on the survival rate of milkfish (*Chanos chanos*) fry during closed-system wet transport. The transport process lasted approximately 2 hours and 30 minutes, covering the route from Probolinggo to Surabaya. This research is significant for establishing a scientific basis for standard operating procedures regarding the long-distance transport of milkfish fry, thereby supporting the sustainability of the aquaculture industry. An experimental method employing a Completely Randomized Design (CRD) was used, involving five salinity treatments (15 ppt, 20 ppt, 25 ppt, 30 ppt, and 35 ppt) with five replicates each (totaling 25 experimental units). The fry used measured approximately 2–3 cm in length, with a stocking density of 100 individuals per liter. Survival data were analyzed using ANOVA, followed by the Least Significant Difference (LSD) test where significant differences (Sig. < 0.05) were observed. Additionally, water quality parameters—specifically salinity, dissolved oxygen (DO), and temperature—were measured before and after transport, as these factors play a crucial role in maintaining the fish's physiological stability during the transportation process. Salinity affects osmoregulation and bioenergetics, whereas temperature influences metabolic rate and energy balance in fish. The findings of this study are expected to serve as a reference for determining the optimal salinity for milkfish fry transport, thereby enhancing the efficiency and success of fry distribution on an industrial scale.

Keyword: Closed System; Milkfish Fry; Salinity; Wet Transportation

ABSTRAK

Sistem transportasi basah dengan metode tertutup kini semakin banyak diaplikasikan dalam kegiatan perikanan karena efisiensi, kepraktisan, serta efektivitasnya dalam menjaga kualitas lingkungan perairan selama perjalanan. Keunggulan lain dari sistem ini adalah berkurangnya risiko kehilangan air serta rendahnya tingkat stres pada ikan berkat lingkungan yang lebih terkontrol (Sari *et al.*, 2021). Kendati demikian, salinitas tetap menjadi parameter kunci dalam proses transportasi, sebab perubahan drastis dalam kadar garam dapat memengaruhi osmoregulasi dan fungsi fisiologis benih ikan bandeng (Nurfadilah *et al.*, 2023). Penelitian ini bertujuan untuk mengkaji pengaruh perbedaan salinitas terhadap tingkat kelangsungan hidup benih ikan bandeng (*Chanos chanos*) selama transportasi basah sistem tertutup. Transportasi dilakukan selama ±2 jam 30 menit pada rute dari Probolinggo ke Surabaya. Penelitian ini penting untuk memberikan dasar ilmiah bagi standar operasional pengiriman benih ikan bandeng jarak jauh guna mendukung keberlanjutan industri budidaya. Metode yang digunakan adalah eksperimen dengan Rancangan Acak Lengkap (RAL), melibatkan lima perlakuan salinitas (15 ppt, 20 ppt, 25 ppt, 30 ppt, dan 35 ppt) dengan masing-masing lima kali ulangan (total 25 unit percobaan). Benih ikan yang digunakan berukuran ±2–3 cm dengan kepadatan 100 ekor/L. Data kelangsungan hidup dianalisis menggunakan ANOVA dan dilanjutkan dengan uji Beda Nyata Terkecil (BNT) apabila terdapat perbedaan yang signifikan (Sig. < 0,05). Selain itu, parameter kualitas air seperti salinitas, oksigen terlarut (DO), dan suhu diukur sebelum dan sesudah transportasi karena ketiganya berperan penting dalam menjaga kestabilan fisiologis ikan selama proses pengangkutan. Salinitas memengaruhi osmoregulasi dan bioenergetik, sedangkan suhu memengaruhi laju metabolisme serta keseimbangan energi ikan. Hasil penelitian ini diharapkan menjadi acuan dalam menentukan salinitas optimal untuk transportasi benih ikan bandeng, sehingga dapat meningkatkan efisiensi dan keberhasilan distribusi benih dalam skala industri.

Kata kunci: Benih Bandeng; Salinitas; Sistem Tertutup; Transportasi Basah.

INTRODUCTION

Supported by abundant and diverse natural resources, Indonesia possesses immense potential in the aquaculture sector. A wide variety of fishery commodities are cultivated in the country, ranging from milkfish, catfish, and giant gourami to tiger prawns and mud crabs. Among these, milkfish is a highly popular species, widely found in Indonesian waters. Beyond its significant economic value, it is also considered a promising raw material for processed food products. Its flesh is delicious and rich in essential nutrients—such as protein, omega-3 fatty acids, vitamins, and minerals—that are beneficial for health. Due to its high protein content, milkfish stands out as an excellent choice for consumption (Rambu et al., 2023).

Stable market demand has made milkfish a reliable commodity for fish farmers. Meeting the demand for milkfish fry requires appropriate handling strategies to minimize the risk of mortality during transport. The rapid growth of the aquaculture sector in Indonesia has made transportation technology for broodstock, eggs, and fry increasingly important (Nurhasan et al., 2023). In practice, however, the distribution of fry between regions often leads to a decline in immunity due to stress, which can increase mortality rates. The survival of fry during transit is heavily influenced by the condition of the water medium; therefore, water quality parameters—such as salinity, temperature, pH, and dissolved oxygen—must be maintained within optimal ranges.

A "wet" transport system using a closed method is now widely applied in the fisheries sector, as it is considered efficient, practical, and effective at maintaining the quality of the aquatic environment throughout the journey. Additional advantages of this system include a reduced risk of water loss and lower stress levels for the fish, thanks to a more controlled environment (Sari et al., 2021). Nevertheless, salinity remains a key parameter during the

transportation process, as drastic changes in salt levels can affect the osmoregulation and physiological functions of milkfish fry (Nurfadilah et al., 2023).

To date, studies on the impact of varying salinity levels during the closed-system wet transport of milkfish fry remain scarce. This research is necessary to identify the ideal salinity range during transport, with the goal of significantly improving the survival rate of milkfish fry.

RESEARCH METHODS

Place and Time

In August 2025, milkfish will be transported from Probolinggo Regency to the city of Surabaya, covering a distance of approximately 130 km with a travel time of about 2.5 hours.

Tools and Materials

This research requires the following tools and materials: 25 polyethylene (PE) plastic bags, a hand refractometer, an electrochemical DO (dissolved oxygen) meter, a pH meter, a thermometer, rubber bands, a pickup truck, water, milkfish fry, an oxygen gas cylinder, and activated carbon.

Test Animals

Milkfish fry measuring 0.8–1 mm were used as test subjects in this study. A stocking density of 100 individuals per liter was applied, resulting in a total requirement of 2,500 individuals, which corresponds to 25 bags, each containing 100 individuals.

Research Media

This study utilized 25 polyethylene (PE) plastic containers, each filled with 1 liter of water. Five salinity treatments (15 ppt, 20 ppt, 25 ppt, 30 ppt, and 35 ppt) were applied, with five replicates for each treatment. The selection of this salinity range is based on the capacity of milkfish fry—as euryhaline organisms—to adapt to a broad range of salinities. According to Syahrir (2020), the ideal range for the growth and survival of milkfish fry is 20–30 ppt, while Jamal (2019) reported that the optimal salinity for the rearing medium is between 31–32 ppt.

Research methods

In this study, an experimental approach was employed to evaluate the effect of salinity on the survival rate of milkfish (Chanos chanos) fry—specifically those at the "glondongan" (juvenile/fingerling) stage—during wet transport using a closed system. A Completely Randomized Design (CRD) was utilized, consisting of five treatment groups with five replicates each, resulting in a total of 25 experimental units. The calculations in this study follow the methodology proposed by Kusriningrum (2010), using the following formula:

$$(t-1)\,(n-1) \geq 15$$

Note :
t = number of treatments
n = number of treatments
example: $(t-1)\,(n-1) \geq 15$
$(5-1)\,(n-1) \geq 15$
$4\,(n-1) \geq 15$
$4n - 4 \geq 15$
$4n \geq 19$
$n \geq 4{,}75$
with the nearest rounding to n = 5

Based on the experimental design, this study employs a minimum of five replicates. The details of the treatments are as follows:

A. Treatment A = with a salinity of 15 ppt, replicated 5 times.
B. Treatment B = with a salinity of 20 ppt, replicated 5 times.
C. Treatment C = with a salinity of 25 ppt, replicated 5 times.
D. Treatment D = with a salinity of 30 ppt, replicated 5 times.
E. Treatment E = with a salinity of 35 ppt, replicated 5 times.

Research Procedure

Research Preparation Stages

Before entering the implementation phase, the research begins with the preparation of various tools and materials necessary to ensure the activities proceed smoothly. This preparation process is carried out in stages, as follows:

a) Preparation of Research Containers
- Preparing PE plastic bags as containers for the research
- Preparing a styrofoam box
- Preparing an oxygen gas cylinder
- Preparing rubber bands
- Prepare an amount of ice cubes equal to 10% of the water volume, and place them in a corner of the Styrofoam container.

b) Preparation of Research Media (Water)
- Preparing seawater and freshwater
- Preparing water with five different salinity levels—15 ppt, 20 ppt, 25 ppt, 30 ppt, and 35 ppt—as measured using a refractometer.

Regarding the formula for determining the target salt concentration, according to Khaitun (2020), the formula is as follows:

$$V1 \times M1 = V2 \times M2$$

Note :
V1 : Volume of seawater to be diluted (L)
M1 : Salinity of the seawater to be diluted (ppt)
V2 : Volume of water with the desired salinity (L)
M2 : Desired salinity (ppt)
With a calculation example as follows:

$V1 \times M1 = V2 \times M2$
$V1 \times 35\ ppt = 1000\ ml \times 10\ ppt$
$V1 = \frac{10.000}{35}$
$V1 = 285{,}7\ L$

c) Preparation of Milkfish Fry

- The initial phase of the study began with the preparation of 2,500 milkfish fry. Each bag contained 1 liter of water and 100 fry—a density based on the findings of Mas Bayu et al. (2019), which indicated that 100 fry per liter is the most effective density for the transport of milkfish fry.
- Milkfish fry are first acclimatized to the specified salinity and fasted for 24 hours. This procedure ensures the fry do not excrete feces during transport (Hayomi, 2023).

Stages of Research Implementation

To achieve optimal research results, the study is conducted in stages; the following is an explanation of these research stages:

a) Prepare 25 PE plastic bags, labeling each one according to the specific treatment and replicate, to serve as containers for the study.

b) Each plastic bag is filled with 1 liter of seawater, with the salinity level adjusted according to the predetermined treatments and replicates: 15 ppt, 20 ppt, 25 ppt, 30 ppt, and 35 ppt.
c) Checking of quality parameters for each plastic bag.
d) Preparing milkfish fry in a basin for packaging.
e) In each plastic bag, 100 milkfish fry were placed for each respective treatment.
f) Each plastic bag is filled with pure oxygen, with a water-to-oxygen ratio of approximately 1 to 2, adjusted according to the size of the plastic bag.
g) Each plastic bag is then tied tightly using a rubber band.
h) Each plastic bag is placed into a Styrofoam box, following a pre-designed layout.
i) Ice cubes are added to the corners of the Styrofoam box, amounting to approximately 10–15% of the total weight of the water.
j) Once the plastic bags have been properly arranged, the Styrofoam box is sealed tightly using adhesive tape.
k) The transportation process is carried out by placing styrofoam boxes containing milkfish fry onto a pickup truck, covering a journey of approximately 2.5 hours from Probolinggo Regency to the city of Surabaya.
l) Upon arrival at the destination, the temperature, dissolved oxygen level, and salinity in each plastic bag were measured again.
m) The number of milkfish in each plastic bag is counted to assess the survival rate of the fry during transport.

Survival Rate

The survival rate (SR) of the fish serves as one of the primary data points in this study. Linayati et al. (2021) explain that the SR acts as an indicator for determining the percentage of fish that successfully survive throughout the rearing period. The following formula is used to calculate the SR:

$$\boldsymbol{SR = \frac{Nt}{N0}\ X\ 100\%}$$

Note :
SR : Survival rate (%)
Nt : Total number of fish that remained alive until the end of the study
N0 : Total number of fish at the start of the study

Data Analysis

Based on the research design, which consists of 5 treatments and 5 replicates, a total of 25 experimental units were obtained. Data from all experimental units were recorded in an observation table according to their respective treatment groups. Subsequently, a homogeneity test was conducted to determine whether the data followed a normal distribution. Furthermore, an analysis of variance (ANOVA) was performed to ascertain whether there were any differences among the treatments.

RESULT

Survival Rate of Milkfish Fry

The research results indicate that treatment E yielded the highest survival rate, as shown below:

Table 1. Average survival rate of milkfish fry at different salinity levels during transport in a closed system

Treatment	Range	Average	Standard deviation
A : 15 ppt	75 – 80	77,6	2,302173
B : 20 ppt	82 – 85	83,6	1,140175
C : 25 ppt	87 – 89	88,4	0,894427

D : 30 ppt	90- 96	94,0	2,345208
E : 35 ppt	99- 100	99,6	0,547723

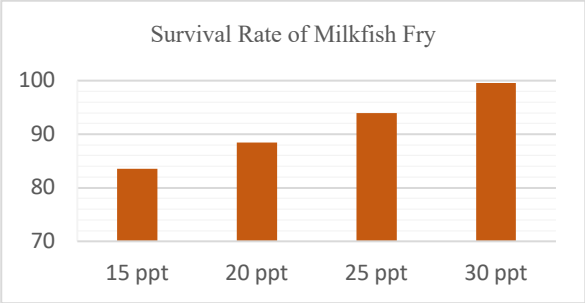


Figure 1. Bar Chart of Milkfish Fry Survival Rates

To examine the effect of salinity concentration on the survival of milkfish fry, a normality test was conducted using the Kolmogorov-Smirnov test. The results of this normality test are presented in Table 2 below:

Table 2. Results of the Normality Test Using the Kolmogorov-Smirnov Test

One-Sample Kolmogorov-Smirnov Test		
N		25
Normal Parameters	Mean	.0000000
	Std. Deviasi	.22156635
Most Extreme	Absolute	.115
Diffrence	Positive	.082
	Negative	-.115
Test Statistic		.115
Asymp. Sig (2-tailed)		.200

A one-way analysis of variance (One-Way ANOVA) was conducted to examine the effect of salinity on the survival of milkfish fry. The results are presented in Table 3 below:

Table 3. ANOVA Test Results Using One-Way ANOVA

ANOVA					
	Sum of Square	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	1572.640	4	393.160	236.843	.000
Within Groups	33.200	20	1.660		
Total	1605.840	24			

Further analysis using Duncan's Multiple Range Test (DMRT) was conducted to determine differences between treatments. The results of the DMRT are presented in Table 4 below:

Table 4. Results of Further Analysis Using Duncan's Multiple Range Test

Treatment	**N**	**Subset for alpha = 0,05**				
		1	**2**	**3**	**4**	**5**
A	5	77.6000				
E	5		83.6000			
D	5			88.4000		
B	5				95.2000	

C	5					99.8000
Sig.		1.000	1.000	1.000	1.000	1.000

Water Quality Parameters

Dissolved Oxygen

To determine whether the dissolved oxygen data are homogeneous, a homogeneity test was conducted using Levene's statistic. The results of the homogeneity test are presented in Table 5 below:

Table 5. Dissolved Oxygen Data Homogeneity

Test of Homogenity of Variance					
		Levene Statistic	Df1	Df2	Sig.
Dissolved oxygen prior to transport	Based on Mean	1.067	4	20	.399
Dissolved oxygen after transportation	Based on Mean	.595	4	20	.399

In addition, an analysis of variance (ANOVA) was conducted to examine the effect of salinity levels on milkfish fry under various treatment conditions—both before and after transport—with respect to dissolved oxygen levels. The results are presented in Table 6 below:

Table 6. ANOVA Test Results for Dissolved Oxygen

ANOVA						
		Sum of Square	Df	Mean Square	F	Sig.
Dissolved oxygen after transportation	Between Groups	.006	4	.001	.538	.709
	Within Groups	.052	20	.003		
	Total	.058	24			
Dissolved oxygen prior to transport	Between Groups	.002	4	.001	.231	.918
	Within Groups	.052	20	.003		
	Total	.054	24			

pH

To ensure the homogeneity of the acidity data, a homogeneity test was performed using Levene's statistic. The results of the homogeneity test are presented in Table 7 below:

Table 7. Data on the Homogeneity of Acidity (pH)

Test of Homogenity of Variance					
		Levene Statistic	Df1	Df2	Sig.
pH before transport	Based on Mean	.899	4	20	.483
pH after transport	Based on Mean	.892	4	20	.387

Next, an analysis of variance (ANOVA) was conducted to examine the effect of changes in acidity levels on the pH of milkfish fry under various treatment conditions before and after transportation. The results are presented in Table 8 below.

Table 8. ANOVA Results for Acidity Level (pH) Data

ANOVA						
		Sum of Square	Df	Mean Square	F	Sig.

pH after transport	Between Groups	.018	4	.004	.786	.538
	Within Groups	.112	20	.006		
	Total	.130	24			
pH before transport	Between Groups	.032	4	.008	1.481	.245
	Within Groups	.108	20	.005		
	Total	.140	24			

Temperature

To determine whether the temperature data are homogeneous, a homogeneity test is conducted using Levene's statistic. The results of the homogeneity test are presented in Table 9 below.

Table 9. Temperature Homogeneity Data

Test of Homogenity of Variance					
		Levene Statistic	Df1	Df2	Sig.
Temperature before transport	Based on Mean	1.198	4	20	.342
Temperature after transport	Based on Mean	.872	4	20	.498

Next, an analysis of variance (ANOVA) was conducted to examine the effect of changes in pH levels on temperature for each treatment, both before and after the transport of milkfish fry. The results are presented in Table 10 below.

Table 10. ANOVA Test Results for Temperature Data

ANOVA						
		Sum of Square	Df	Mean Square	F	Sig.
Temperature after transport	Between Groups	.016	4	.004	.645	.637
	Within Groups	.124	20	.006		
	Total	.140	24			
Temperature before transport	Between Groups	.012	4	.003	.147	.962
	Within Groups	.408	20	.020		
	Total	.410	24			

DISCUSSION

The research results indicate that the survival data for the fry follow a normal distribution ($P = 0.200 > 0.05$) and exhibit homogeneity of variance ($P > 0.05$). Based on a one-way analysis of variance (ANOVA), salinity has a significant effect on the survival of milkfish (Chanos chanos) fry during a 2.5-hour transport period using a closed, wet transport system ($F = 236.843$; $Sig = 0.000 < 0.05$). These findings are consistent with the research of Pebrianti and Affandi (2014) and Ningsih (2024), which state that variations in water salinity within a closed, wet transport system significantly influence the survival rate of the fry.

Duncan's test, conducted at a 5% significance level, revealed significant differences among all treatments (A, B, C, D, and E). Treatment E (35 ppt salinity) yielded the highest survival rate, with an average of 99.60%. This was followed by treatment D (30 ppt) at 94.00%, treatment C (25 ppt) at 88.40%, and treatment B (20 ppt) at 83.60%, while the lowest survival rate was observed in treatment A (15 ppt) at 77.60%.

The salinity level of the medium during transport is a crucial factor affecting the survival of milkfish fry, as it is directly related to the osmotic pressure of the water and the mechanisms of osmoregulation. According to Yusneri et al. (2021) and Karolina et al. (2020), fish perform osmoregulation to balance the concentration of their body fluids with that of the surrounding environment. At excessively low salinity levels (such as in the 15 ppt treatment), the osmotic pressure gradient between the body fluids and the transport medium becomes too large. This forces the fry to expend extra energy to balance their internal ion concentrations, which can trigger physiological osmotic stress. In their early developmental stages, milkfish fry possess organs and osmoregulatory systems that are not yet fully developed, rendering them less capable of tolerating the osmotic pressure associated with very low salinity.

Rinao and Teodora (1994) and Ningsih (2024) explain that a salinity of 35 ppt corresponds to the natural conditions of the open ocean—the spawning grounds and native habitat of milkfish fry—thereby establishing an iso-osmotic state that most closely aligns with the fish's natural physiological equilibrium. This condition minimizes the energy expenditure required for osmoregulation during transport, allowing for a high survival rate of up to 99.60%. Consequently, determining an optimal salinity—such as the 35 ppt used in this treatment—is crucial for balancing high survival rates with the efficiency of fry distribution.

Based on Levene's test for homogeneity, the water quality parameters before and after transport exhibited homogeneous variances ($P > 0.05$). The ANOVA results indicate no significant differences in the mean values among treatments for dissolved oxygen—both before ($F = 0.538$; $P = 0.709$) and after ($F = 0.231$; $P = 0.918$) transport—as well as for pH (before: $F = 0.786$, $P = 0.548$; after: $F = 1.481$, $P = 0.245$) and temperature (before: $F = 0.645$, $P = 0.637$; after: $F = 0.147$, $P = 0.962$) ($P > 0.05$). This suggests that variations in the salinity of the medium did not affect the stability of other physicochemical water parameters during the transport process. The observed ranges for all water quality parameters during transport (dissolved oxygen: 5.94–5.98 mg/L; pH: 7.46–7.54; and temperature: 25.72–25.80 °C) remained well within the ideal tolerance limits for supporting the survival of milkfish fry.

CONCLUSION

Based on the results of research regarding the effect of salinity differences on the survival rate of milkfish (Chanos chanos) fry during transport using a closed system, several conclusions can be drawn, such as:

1. The results of the study showed that variations in salinity in closed system wet transport affected the survival rate of milkfish seeds (Channos channos).
2. The most suitable salinity level for the closed-system wet transport of milkfish (*Chanos chanos*) fry is approximately 35 ppt, which yields the highest survival rate of 99.6%. As the salinity level approaches the 35 ppt range, the survival rate of the milkfish fry tends to increase. Conversely, at excessively low salinity levels—below 20 ppt—the survival rate of the milkfish fry decreases.

ACKMOWLEDGEMENT

All praise and gratitude are offered to Allah SWT for His blessings and guidance, which have enabled the completion of this thesis, titled "The Effect of Salinity Differences on the Survival Rate of Milkfish (Chanos chanos) Fry During Closed-System Wet Transport."

The author expresses sincere appreciation to Dr. Kejora Handarini, S.TP., M.P. (Dean of the Faculty of Agriculture, Dr. Soetomo University), Ir. Sri Oetami Madyowati, M.Kes. (Head of the Aquaculture Study Program), as well as the thesis supervisors, Ir. Maria Agustini, M.Si. (Supervisor I) and Ir. Sumaryam, M.Si. (Supervisor II), for their time, guidance, direction, and invaluable input.

Deepest gratitude and affection are dedicated to my beloved parents, Mr. Hendriatno

and Mrs. Sri Utami, for their constant prayers, care, and unwavering support. The author also extends thanks to the milkfish fry supplier in Probolinggo Regency for providing facilities during the research, and to fellow students of the Aquaculture Study Program at Dr. Soetomo University for their mutual support throughout the completion of this thesis. May this work contribute to the advancement of scientific knowledge and the aquaculture sector.

REFERENCES

Ahmad, H., Madyowati, S. O., Agustini, M., & Kusyairi, A. (2023). Pengaruh Salinitas yang Berbeda Terhadap Kelangsungan Hidup Benur Vaname (*Litopenaeus vannamei*) PL 9 pada Transportasi dengan Sistem Basah Tertutup. *Juvenil: Jurnal Ilmiah Kelautan dan Perikanan*, *4*(4), 359-365.

Bagarinao, T. (1994). The Natural Life History of Milkfish. *SEAFDEC Asian Aquaculture*, *16*(3), 3-6.

Jamal, K. (2019). Pengaruh Pengkayaan Rotifer dan Artemia dengan Beta Karoten Pada Pemeliharaan Larva Rajungan (*Portunus pelagicus*). *Skripsi*. Universitas Hasanuddin.

Karolina, A., Anggoro, S., & Supriharyono, S. (2020). Profil Osmotik Gelondongan Ikan Bandeng (*Chanos chanos* Forsskal) Selama Proses Kultivasi di Tambak Bandeng Desa Wonorejo Kabupaten Kendal. *Jurnal Perikanan Tropis*, *7*(2), 145-154.

Linayati, L., Prasetyo, T. A., & Mardiana, T. Y. (2021). Performa Laju Pertumbuhan Ikan Bandeng (Chanos chanos) yang Diberikan Pakan dengan Pengkayaan Probiotik. *Jurnal Litbang Kota Pekalongan*, *19*(1), 64-71.

Mukhlis, A., Ilmi, A. K., Rahmatullah, S., Ilyas, A. P., & Dermawan, A. (2020). Penyuluhan Teknologi Pembenihan Ikan Bandeng untuk Mendorong Kemandirian Produksi Benih Ikan Bandeng di Kabupaten Bima Provinsi Nusa Tenggara Barat. *Jurnal Gema Ngabdi, 2*(2), 124-132.

Ningsih, K. (2024). Teknik Pembenihan Ikan Bandeng (*Chanos chanos*) di Balai Besar Perikanan Budidaya Air Payau (BBPBAP) Jepara Provinsi Jawa Tengah. *South East Asian Aquaculture*, *2*(1), 25-34.

Nurhasan, N., Tang, U., & Syawal, H. (2023). Efektivitas Penggunaan Larutan Daun Pepaya (*Carica papaya* L.) Terhadap Respons Stres pada Benih Ikan Nila (*Oreochromis niloticus*) dalam Transportasi. *Ilmu Perairan (Aquatic Science)*, *11*(3), 211-217.

Pebrianti, N. L. M., & Affandi, R. I. (2024). Performa Reproduksi Ikan Bandeng (*Chanos chanos* Forsskal) Skala Hatchery. *Jurnal Ganec Swara*, *18*(1), 322-332.

Syamsunarno, M. B., Maulana, M. K., Indaryanto, F. R., & Mustahal, M. (2019). Kepadatan Optimum untuk Menunjang Tingkat Kelangsungan Hidup Benih Ikan Bandeng (*Chanos chanos*) pada Transportasi Sistem Tertutup. *Jurnal Biologi Tropis*, *19*(1), 70-78.