



**Faculty of Fisheries and Marine Science  
Universitas Riau**

**ISFM XII**  
**The 12<sup>th</sup> International and National Seminar on Fisheries and Marine Science**  
**Challenges and Strategies for Sustainable Fisheries and Marine Affairs Development to Support The Blue Economy Program**

**Keynote Speakers**

 <b>Prof. Dr. Hj. SRI INDARTI, M.Si</b> <small>Faculty of Universitas Riau</small>	 <b>Prof. Dr. Ir. RIFARDI, M.Sc</b> <small>Dean of Faculty of Fisheries and Marine Science Universitas Riau</small>	 <b>Dr. INDRASUHARMAN, S.Pi, M.Sc</b> <small>Chairman</small>
 <b>Prof. Dr. Ir. Tengku Dahril, M.Sc</b> <small>Universitas Riau, Indonesia</small>	 <b>Dr. Sukree Hajjsamae</b> <small>Prince of Songkla University, Thailand</small>	 <b>Dr. Bui Tran Nu Thanh Viet</b> <small>Nha Trang University, Vietnam</small>
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📍 Hotel Pangeran, 13 September 2023



# ISFM XII

## The 12<sup>th</sup> International and National Seminar on Fisheries and Marine Science

### Challenges and Strategies for Sustainable Fisheries and Marine Affairs Development to Support The Blue Economy Program



#### CONFERENCE TOPICS

Aquaculture - Marine Ecotourism -  
Food Security - Marine Biotechnology and Fisheries -  
Biodiversity - Fisheries Processing Biotechnology -  
Oceanography - Aquatic Ecology and Conservation -  
Ecotoxicology and Water Pollution - Fish Disease -  
Socio-Economic Fisheries - Fishing Technology

#### IMPORTANT DATES

1. Abstract Submission Deadline : August 5, 2023
2. Abstract Submission Notification : August 9, 2023
3. Payment Deadline : August 11, 2023
4. Full Paper Deadline : August 20, 2023
5. Conference Date : September 13, 2023
6. APC Payment Deadline : September 20, 2023



#### REGISTRATION

Online Student : IDR 150.000 (USD 15)  
Online Researcher : IDR 300.000 (USD 25)  
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#### Opening Speech

**Prof. Dr. Ir. Rifardi, M.Sc**  
Dean of Faculty of Fisheries and  
Marine Science, Universitas Riau,  
Indonesia



#### Keynote Speakers

**Prof. Dr. Ir. Tengku Dahril, M.Sc**  
Universitas Riau,  
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**Dr. Sukree Hajisamae**  
Prince of Songkla University,  
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**Title : The 12th International and National Seminar of Fisheries and Marine Science (ISFMXII)**

**Date : September 13-14, 2023**

**Place : Pangeran Hotel Pekanbaru, Indonesia**

Proceedings editor(s):

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**October 26, 2023**

**Dian Iriani, S.Pi.,MP.,M.Sc**

## **Preface**

Dr. Indra Suharman, S.Pi., M.Sc  
*Chairman of Organizing Committee*

Dear Esteemed Participants, Distinguished Speakers, and Honored Guests,

I am privileged to extend a warm welcome to each one of you to the 12th International and National Seminar of Fisheries and Marine Science (ISFM), an annual convocation organized by the Faculty of Fishery and Marine Science, Universitas Riau. This year's seminar is meticulously crafted around the theme - "Challenges and Strategies for Sustainable Fisheries and Marine Affairs Development to Support the Blue Economy Program."

This seminar convenes an assemblage of researchers, academics, policymakers, and industry experts from across the globe to engage in profound discussions and share insights on a multitude of topics central to fisheries, marine, and environmental sciences. The array of topics includes Aquaculture, Biodiversity, Marine Biotechnology and Fisheries, Oceanographic, Fisheries Processing Biotechnology, Functional Food, Aquatic Ecology and Conservation, and many more. Our endeavor is to foster a rich discourse that propels the collective knowledge forward and catalyzes actionable solutions to the pressing challenges that our marine ecosystems face.

I am honored to introduce a distinguished panel of invited speakers, who are the epitome of excellence in their respective fields. Their presence augments the intellectual richness of our seminar, providing us with an invaluable opportunity to garner knowledge and inspiration.

The thorough preparations and concerted efforts of the organizing committee, coupled with the generous support from our sponsors and collaborators, have been instrumental in bringing this seminar to fruition. I am grateful to each individual and institution whose contributions have made this event possible.

This seminar is not merely a congregation of like-minded individuals but a crucible where ideas metamorphose into innovative solutions, partnerships are forged, and a shared vision for a sustainable blue economy is nurtured. It is my sincere hope that the deliberations, technical sessions, and networking opportunities over the course of this seminar will contribute significantly towards the broader objective of sustainable fisheries and marine development.

I am looking forward to the engaging discussions, the exchange of novel ideas, and the camaraderie that will undoubtedly mark the proceedings of the 12th ISFM. I am optimistic that the outcomes of this seminar will resonate far beyond the confines of this venue and contribute to the global discourse on sustainable marine and fisheries development.

Thank you for your participation and contribution towards making the 12th International and National Seminar of Fisheries and Marine Science a platform of meaningful engagement and learning.

Dr. Indra Suharman, S.Pi., M.Sc  
Chairman of the Organizing Committee



## Opening Address

Prof. Dr. Ir. Rifardi., M.Sc

*Dean of Faculty of Fisheries and Marine Science, Universitas Riau*

Ladies and Gentlemen,  
Distinguished Guests and Speakers,  
Esteemed Colleagues and Participants,

Good Morning,

I am profoundly honored to welcome each one of you to the 12th International and National Seminar of Fisheries and Marine Science organized by the Faculty of Fishery and Marine Science, Universitas Riau. It brings me immense pleasure to stand here, not only as the Dean of our cherished Faculty but as a fellow enthusiast of the boundless domain that is our oceans and water bodies.

The theme of our seminar this year, "Challenges and Strategies for Sustainable Fisheries and Marine Affairs Development to Support the Blue Economy Program," resonates with the global urge to harmonize our actions with the natural rhythm of the aquatic ecosystem. It reflects our collective aspiration to ensure that the marine resources, which are a reservoir of biodiversity and an engine of economic growth, continue to thrive for the generations to come.

This seminar serves as a prestigious platform that amalgamates the wisdom, experiences, and innovations from across the globe. The topics we delve into span a wide spectrum of fisheries, marine, and environmental sciences, including, but not limited to Aquaculture, Biodiversity, Marine Biotechnology, Oceanography, and Socio-Economic Fisheries, among others. Through spirited discussions, technical sessions, and interactions, we aim to foster a conducive environment for knowledge exchange, networking, and collaborative learning.

We are privileged to have an illustrious panel of invited speakers who bring with them a wealth of knowledge and expertise. Their distinguished presence enriches our seminar and provides us with an opportunity to learn, innovate, and envision a sustainable future together.

I extend my heartfelt gratitude towards our esteemed speakers, Prof. Dr. Ir. Tengku Dahril, Dr. Zulkarnain, Dr. Christopher Marlowe A. Caipang, Dr. Tan Lik Tong, Dr. Bui Tran Nu Thanh Viet, and Dr. Sukree Hajisamae, for graciously accepting our invitation and enriching this seminar with their invaluable insights.

I also extend my thanks to all the participants, the organizing committee, sponsors, and everyone who has contributed to the fruition of this significant event. Your collective efforts have made this seminar a hallmark of scholarly exchange and a beacon of hope towards achieving sustainable fisheries and marine affairs.

As we embark on this journey of exploration and discovery, I trust that the interactions and deliberations over the next few days will ignite new ideas, foster lasting partnerships, and contribute significantly towards propelling the Blue Economy Program forward.

Thank you, and I wish you all a fruitful and enriching seminar experience.

Prof. Dr. Ir. Rifardi., M.Sc  
Dean, Faculty of Fishery and Marine Science  
Universitas Riau



# CERTIFICATE

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*This Certificate is Proudly Presented to:*

**Dr. Azrita, S.Pi., M.Si**

As a Participant in ISFM XII

"Challenges and Strategies for Sustainable Fisheries and Marine Affairs Development to Support The Blue Economy Program"

September 13, 2023



**Prof. Dr. Ir. Rifardi, M.Sc**

Dean Faculty of Fisheries  
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Faculty of Fisheries and Marine Science  
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## Enrichment of commercial feed with new formula products on the growth, yield, and mortality of the giant gourami *Osphronemus goramy*

To cite this article: H Syandri and Azrita 2022 *IOP Conf. Ser.: Earth Environ. Sci.* **1062** 012007

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# Enrichment of commercial feed with new formula products on the growth, yield, and mortality of the giant gourami *Osphronemus goramy*

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**Abstract.** Background and objective: The giant gurami (*Osphronemus goramy*) is considered the most desirable freshwater species in Indonesia, mainly for food security. This study evaluated the effectiveness of newly formulated products containing water, coconut, palm sugar, and fungus used for enriched commercial feed and their impact on gurami sago's (local strain) growth performance, yield, and mortality. Methods: A total of 100 g of palm sugar are cooked with 1,000 ml of freshwater for fifteen minutes at a temperature of 60 oC. Furthermore was added 2,000 ml of mature coconut water. For every 1,000 ml of a mixture of mature coconut water and palm sap sugar solution was added 2 g of *Aspergillus niger* (called product P1), 2 g of *Rhizopus oligosporus* (product P2), and 2 g of *Saccharomyces cerevisiae* (product P3). Commercial fish feed pellets enriched with P1, P2, and P3 were designated as P1, P2, and P3 diets. At the same time, the commercial feed added with freshwater is called P4 feed (placebo). The dosage of each product is 300 ml/kg of feed. Juvenile sago gourami (initial weight  $50 \pm 2.5$  g and total length  $13.2 \pm 0.4$  cm) were stocked in triplicate (0.5x0.5x0.5 m) in a freshwater concrete pond with a stocking density of 30 individuals. /net, an initial feeding rate of 3% per day for 90 days of the experiment. Results: The weight gain ranged from 172.43 to 215.6%, the specific growth rate increased from 0.60 and 0.75%/day. The coefficient of thermal growth increased from 27.26 to 32.83. At the same time, yield ranging from 14.88 to 21.03 g/L and mortality for 90 days of the experiment decreased from 22.22% to 6.66%. The coefficient of variation in weight was between 0.68% and 1.30%. Conclusion: Giant gourami juvenile survived and grew well in diet P2, moderate growth in diet P3, and diet P1; the lowest growth was recorded in diet P4.

## 1. Introduction

Approximately 70% of aquaculture-based animal production is fed with commercial feeds containing high protein [1,2]. Conversely, some aquaculture fish species' feed conversion ratio (FCR) is still higher [3]. In this background, fish feed ranging from 30 to 40% is released as a waste to the water environment [3-5]. On the other hand, the charge of aquafeed is still an important treatment for aquaculture activities [1,6-10] due to the continued reliance on fish meal, fish oil, and soybean meals as feed raw materials, most of which are imported products. The previous scientist has reported strategies used to improve aquafeed nutrition, like supplementing the aquafeed with fish oil [11,12], soybean oil [13], and the use of probiotics [14]. This method is carried out so that the feed given to





cultured fish is wealthy in nutrients such as amino acids, fatty acids, minerals, and vitamins to meet their needs [10,15,16,17].

Several alternative plant-based protein sources as unconventional ingredients to replace the traditional feed ingredients have been studied in the last decades, aiming to reduce fish meal production and decrease the cost of fish meal [17,18]. Unconventional materials from sustainable natural resources are relatively economical such as sunflower, aquatic weed, and palm seeds. However, this material is limited to aquafeed in its pure form as it contains high fiber anti-nutrients and reduces feed digestibility [18-20].

In addition to the natural resources mentioned above, we hypothesize that coconut water and palm sap sugar by fungal fermentation could increase the nutritional value of commercial feeds. Coconut water contains vitamins, minerals, fatty acids, amino acids, enzymes, and a few phenolic compounds [21-23]. Coconut water has been effectively consumed to cure ailments in humans, such as throat infections, tapeworms, gonorrhoea, digestive problems, influenza, lice, giardia, bronchitis, and cholera [24]. Moreover, palm sap sugar has health profit due to its low glycemic index and antioxidants, vitamins, and minerals [25]. Based on the previous, the current study evaluated the commercial feed enriched with different new formation products and their effects on growth rates, feed efficiency use, and mortality rate of gurami sago juveniles.

## 2. Methods

### 2.1. Preparation of product formulated

We prepared 2,000 ml of mature coconut water (*Cocos nucifera* L.). Then 100 g of palm sugar is cooked in 1,000 ml of fresh water at 60 °C for 15 minutes; after that, it was cooled for 20 minutes in an open space. Furthermore, mature coconut water (2,000 ml) and palm sap sugar (1,000 ml) were mixed until they became 3,000 ml. A total of 3,000 ml of the newly formulated product is divided into 1,000 ml. The first part of the new product formulation added 2 g of *Aspergillus niger* (called P1 product), the second part added 2 g of *Rhizopus oligosporus* (called P2 product), and the third part added 2 g of *Saccharomyces cerevisiae* (called P3 product). Each serving (1,000 ml) is fermented in a continuous aeration process for 48 hours in a jerry can (2,000 ml). The prepared solution was stored in a cool air-conditioned room for 10 minutes, away from direct sunlight. The products P1, P2, and P3 were used to supplement the nutrition of commercial feeds (781-2, PT. Japfa Comfeed Indonesia, Tbk) called P1, P2, and P3 diets. The aquafeed added fresh borehole water is called the P4 feed (placebo).

### 2.2. Preparation of experiment diets

They are floating commercial aquafeed 781-2 containing proximate composition (dry weight %), 10.66% water content, 30.10% crude protein, 4.09% crude fat, 45.35% total carbohydrates, 2.5% ash, and 9.18% crude fiber. The feed is enriched by-products P1, P2, P3, and P4, each of which is 300 ml/1 kg of feed. Each product is poured into each tube, then sprayed evenly into one kilogram of commercial aquafeed, then evaporated in the open air for thirty minutes. After that, the fish gave the aquafeed experimental.

### 2.3. Experimental procedures and sampling

We used 360 fish seeds of gurami sago for this study. The average weight was  $35.5 \pm 0.25$  g, and the length was  $13.2 \pm 0.07$  cm. The AD-600i scales with 0.001 g accuracy were used to measure weight fish, while a meter ruler with 1 mm accuracy was used for the body length. Twelve nets framed with size 0.5×0.5×0.5 m PVC pipe (75 L capacity) were placed inside two freshwater concrete ponds with the size 18-m<sup>3</sup> (6×2×1.5 m). Each net was stocked with 30 fish, consist four treatments and three replicates. They were fed feed of P1, P2, P3, and P4 were conducted three times a day at 08.00 AM, 12.00, and 05.00 PM, at a proportion 3% body weight rate per day until the experiment was completed. Fish samples were collected every 30 days for length and weight measurements. Fish were put through a fasting phase for 24 hours before sampling to empty the intestinal contents. Thirty fish per net framed were collected and anesthetized orally using clove oil. Then, the length and weight were measured.

#### 2.4. Measurements parameters

The following parameters were calculated to determine the animal experiment's growth performance: body weight gain (%), specific growth rate (SGR, %/day), and absolute growth rate. Thermal growth coefficient (TGC), Fulton's condition factor, yield (g/ L), Mortality Rate (%), coefficient of variation (CV) of weight (%), coefficient of variation (CV) of length (%), feed conversion ratio (FCR) and feed conversion efficiency (FCE). The parameters were analyzed according to formulas:

Parameter	Formula
Weight gain (%)	$\frac{\text{Final weight (g)} - \text{Initial weight (g)}}{\text{Initial weight (g)}} \times 100$
Daily weight gain(mg)	$\frac{\text{Final weight (g)} - \text{Initial weight (g)}}{\text{Duration of rearing period (days)}}$
Specific growth Rate (%/day)	$\frac{[\text{Ln}(\text{Final weight (g)}) - \text{Ln}(\text{Initial weight (g)})]}{\text{Duration of rearing period (days)}} \times 100$
Thermal growth coefficient (TGC)	$\frac{[(\text{Final weight (g)})^{1/3} - (\text{Initial weight (g)})^{1/3}]}{\text{Mean water temperature (}^\circ\text{C)} \times \text{duration of rearing period (days)}} \times 1000$
Fulton s condition factor	$\frac{\text{Weight of the juvenile (g)}}{\text{Length of juvenile (cm)}^3} \times 100$
Yield (g/L)	$\frac{\text{Final weight (g)} - \text{Number of survived juvenile}}{\text{Water volume (liter)}}$
Mortality rate (%)	$\frac{\text{Number of juvenile stocked} - \text{Number of survived juvenile}}{\text{Number of juvenile stocked}} \times 100$
Survival rate (%)	$\frac{\text{Number of survive juvenile}}{\text{Number of juvenile stocked}} \times 100$
Coefficient of variation (CV) of weight (%)	$\frac{\text{Standart deviation of weight}}{\text{Mean weight (g)}} \times 100$
Coefficient of variation (CV) of length (%)	$\frac{\text{Standart deviation of length}}{\text{Mean lenght (cm)}} \times 100$
Feed conversion ratio (FCR)	$\frac{\text{Fed feed (g dry weight)}}{\text{Weight gained (g)}}$
Feed conversion efficiency (FCE)	$\frac{1}{\text{FCR}}$

#### 2.5. Water quality parameters

This study monitored water quality parameters such as temperature, dissolved oxygen, and pH in an animal's reared net frame every week. The temperature was measured with a thermometer (Celsius scale). The pH values were determined with a pH meter (digital mini pH meter, 14pH, IQ Scientific, Chemo-science Thailand Co., Ltd, Thailand). The DO reading was measured using an oxygen meter (YSI model 52, Yellow Spring Instrument Co., Yellow Springs, OH, USA). Total alkalinity, total hardness, and nitrate were monitored monthly for all the nets frame by standard methodology based on formulas [26].

### 2.6. Data analyses

Statistical data analysis was carried out with SPSS 16.0 software package (SPSS; Chicago, IL). Normality was subjected to Kolmogorov-Smirnov test. Homogeneity was checked using the absolute residuals according to Levene's test. Effect of treatment was carried out using one-way ANOVA, followed by post-hoc Duncans multiple range tests [27]. Differences were considered significant at the 95% confidence level ( $P < 0.05$ ). All mean are given with standard deviation ( $\pm$ SD).

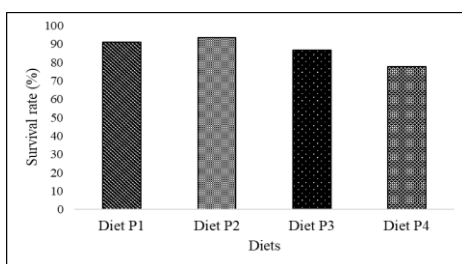
### 3. Results

Biometric performance: Table 1 represents the growth rate, yield, mortality, and coefficient variation (CV) of length (%) and weight (%). The weight gain varied between 172.43 and 201.82%, with specific growth rates ranging from 0.60 and 0.75%. On the other hand, thermal growth coefficients were between 27.26 and 32.83. Juvenile mortality for 90 days experiment ranged between 6.66 and 22.22%, with the coefficient of weight variation varying from 0.60 to 1.31%. Several parameters from the data on survival, yield harvested, FCR, and FCE are shown in Figures 1 to 4.

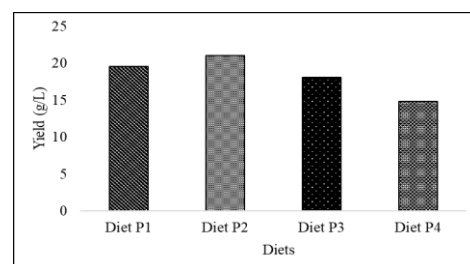
**Table 1.** Growth performance and mortality rate of gurami sago (mean  $\pm$  s.d.) for 90 days of the experimental period.

	Diet P1	Diet P2	Diet P3	Diet P4
Weight gain (%)	201.83 $\pm$ 3.20 <sup>a</sup>	215.36 $\pm$ 2.18 <sup>b</sup>	200.26 $\pm$ 1.11 <sup>ac</sup>	172.43 $\pm$ 2.90 <sup>d</sup>
Specific growth rate (%/ day)	0.71 $\pm$ 0.01 <sup>a</sup>	0.75 $\pm$ 0.01 <sup>b</sup>	0.70 $\pm$ 0.01 <sup>c</sup>	0.61 $\pm$ 0.01 <sup>d</sup>
Daily weight gain (mg)	0.80 $\pm$ 0.01 <sup>a</sup>	0.85 $\pm$ 0.01 <sup>b</sup>	0.77 $\pm$ 0.01 <sup>c</sup>	0.67 $\pm$ 0.01 <sup>d</sup>
Thermal growth coefficient (TGC)	31.10 $\pm$ 0.41 <sup>a</sup>	32.83 $\pm$ 0.24 <sup>b</sup>	30.23 $\pm$ 0.18 <sup>c</sup>	27.26 $\pm$ 0.41 <sup>d</sup>
Fulton's condition factor	4.68 $\pm$ 0.05 <sup>a</sup>	4.38 $\pm$ 0.10 <sup>b</sup>	4.39 $\pm$ 0.27 <sup>c</sup>	4.16 $\pm$ 0.07 <sup>d</sup>
Coefficient of variation (CV) of weight (%)	1.19 $\pm$ 0.01 <sup>a</sup>	0.69 $\pm$ 0.01 <sup>b</sup>	0.60 $\pm$ 0.00 <sup>c</sup>	1.31 $\pm$ 0.02 <sup>c</sup>
Coefficient of variation (CV) of length (%)	0.53 $\pm$ 0.00 <sup>a</sup>	0.80 $\pm$ 0.01 <sup>b</sup>	0.32 $\pm$ 0.02 <sup>c</sup>	0.66 $\pm$ 0.00 <sup>d</sup>
Mortality rate (%)	8.89 $\pm$ 3.85 <sup>a</sup>	6.67 $\pm$ 0.00 <sup>b</sup>	13.33 $\pm$ 6.67 <sup>c</sup>	22.22 $\pm$ 3.85 <sup>d</sup>

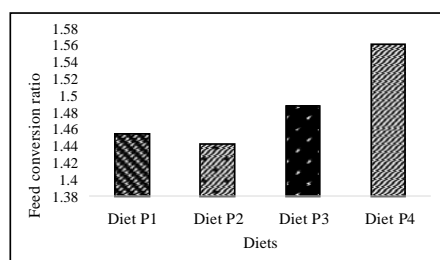
a b c d - significant differences in rows, Analytical replicates n= 3



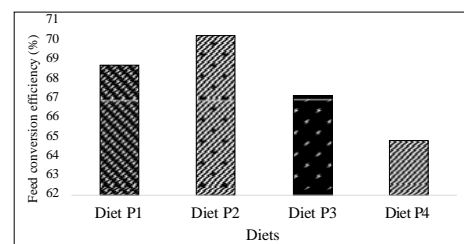
**Figure 1.** The survival rate of gurami sago under diets experiment for 90 days



**Figure 2.** The yield of gurami sago under diets experiment for 90 days



**Figure 3.** Feed conversion ratio (FCR) of gurami sago under diets experiment for 90 days



**Figure 4.** Feed conversion efficiency (FCE) of gurami sago under diets experiment for 90 days



Water quality parameters: We recorded the reading of the parameters in the net's frame during juvenile rearing. The water temperature in the juvenile nursed ranges from 28.0 °C to 30.0 °C. The dissolved oxygen fluctuated between 5.2 and 5.4 mg L<sup>-1</sup>, and the pH was 7.2 and 7.4. Total alkalinity ranged from 51 mg L<sup>-1</sup> to 56 mg L<sup>-1</sup> as CaCO<sub>3</sub>, hardness varies between 62 mg L<sup>-1</sup> and 66 mg L<sup>-1</sup> as CaCO<sub>3</sub>, while Nitrite-Nitrogen (NO<sub>2</sub>-N) was between 0.01 mg L<sup>-1</sup> and 0.03 mg L<sup>-1</sup> (Table 2).

**Table 2.** Water quality parameters in juvenile gurami sago reared

	Mean±SD	Range
Water temperature (°C)	28.83±0.83	28-30
Dissolved oxygen (mg/L)	5.30±0.07	5.2-5.4
Alkalinity (mgL <sup>-1</sup> as CaCO <sub>3</sub> )	53.4±2.07	52- 56
Hardness (mg L <sup>-1</sup> as CaCO <sub>3</sub> )	64.2±1.48	62-66
pH	7.28±0.07	7.2-7.4
Nitrite-Nitrogen (mg L <sup>-1</sup> )	0.018±0.0083	0.01-0.03

### 3.1. Discussion

The level of contrast between food and variation of aquaculture systems is an essential condition during juvenile rearing for better growth performance [5]. The growth performance is not only associated with cultivation conditions but also depends on cruising speed and active hours of the feed habits[4] but also diet composition [28] and feed nutrition [12,13,29]. In the present study, the growth performance of juvenile gurami sago was significantly influenced by commercial feed enriched with various formulation products. The fish reared with P2 feed showed better growth performance, i.e., specific growth rate (%/ day), daily weight gain (mg), and thermal growth coefficient (TGC) compared to other feeds. At the same time, Fulton's condition factor showed better in the diet P1. This factor may be due to differences in the nutritional content of the feed supplemented by the formulated product, which increases the visibility of the diet in the reared animals, resulting in better food consumption, lower food conversion ratios, and higher weight gain. Several researchers have been reported similar results in other species like Nile tilapia, *Oreochromis niloticus* [12-13], largemouth bass, *Micropterus salmoides* [29], and common carp, *Cyprinus carpio* [30].

The present study recorded moderate growth in diet P3, followed by diet P1, while the lowest growth was recorded in the P4 diet. These factors may be due to the deficient nutrition in diet P4, i.e., fatty acids levels in the FUFAs group, like EPA, DHA, and LA. According to [31], two essential fatty acids (EFA), linoleic acid (LA, 18:2 n-6) and linolenic acid (LNA, 18:3 n-3), must be included in the fish feed because this type of fatty acids is required for increased growth and disease resistance. The juvenile of giant gourami increased their weight more than three-fold over the 90-days feeding trial with very low mortality. Diet P1 had the second-highest growth after diet P2, and diet P2 shows the higher survival rate of 93.33%, followed by diet P1, P3, and P4, with 91.11%, 86.67%, and 77.78% survival rate, respectively (Figure 1). Thus, it can be concluded that differences in mortality rates are generally affected by inadequate diet.

Moreover, the mortality rate is probably one of the critical physiological parameters in aquaculture studies [32]. Juvenile growth of gurami sago was related to yield production of each diet; higher yield showed by diet P2 was 21.03 g L<sup>-1</sup>, whereas the lowest was in diet P4 is 14.90 g L<sup>-1</sup> (Figure 2). These data indicated that the P2 formulated product supplemented with *Rhizopus oligosporus* during fermentation, their feed was richer in nutrients compared to the P4 diet. However, diets P1 and P3 may also be rich in nutrition due to growth performance and better feed efficiency than diet P4 based on Specific growth rate (%/ day), daily weight gain (mg), and Fulton's condition factor. In this study, how the composition of fatty acids and amino acids in feed enriched with new formula products (coconut water, palm sugar water, and various mushrooms) is still poorly understood.

Furthermore, the fungus used in the new formula products enriched in commercial feeds has shown differences in feed conversion and efficiency ratios (Figures 3 and 4). Sago gourami fed with P1, P2, P3, and P4 for 90 experimental days showed FCR values were 1.45, 1.44, 1.48, and 1.56, respectively.

At the same time, FCE values were 68.76%, 69.40%, 67.22%, and 64.68%, respectively. Based on the FCE value of each experimental diet, we conclude that each 1 kg of feed yields harvested fish were between 0.64 and 0.68 kg; conversely, 0.32 to 0.36 kg of feed are released into water bodies as waste. The FCE values for gurami sago cultivated in earthen freshwater ponds, concrete ponds, and floating cages were 0.46, 0.69, and 0.77, respectively [5]. Several authors reported that feed conversion efficiency (FCE) is related to feeding nutrition, feed characteristics, and feeding rate [10-12], including different aquaculture systems [5], environmental factors, and husbandry factors [32]

#### 4. Conclusion

This study revealed a significant effect of diet supplemented with the new formulation on juvenile gurami sago's growth and feed efficiency. The commercial feed supplemented with P2 products (coconut water and palm sugar solution fermented with *Rhizopus oligosporus*) are more suitable for the growth performance of juvenile giant gourami strain sago and increasing the feed's efficiency used and yield harvested. In addition, the use of diet P2 decreases mortality rates and reduces the load of waste released into the water body. Further studies are required to investigate the effect of feed enrichment with new formula products on time-related changes in the significant digestibility coefficients of gurami sago.

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### **Acknowledgments**

We are grateful to the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia for funding this research under grant number: 170/E4.1/AK.04. P.T./2021