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EFEKTIVITAS PENGAYAAN *Nigella sativa* PADA PAKAN HIDUP *Tubifex* sp. UNTUK MENINGKATKAN KINERJA LARVA *Hemibagrus nemurus*

Efficacy of Nigella sativa Enrichment of Live Tubifex sp. to Enhance Larval Performance of Hemibagrus nemurus

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ABSTRAK

Pertumbuhan dan kelulushidupan larva ikan baung (*Hemibagrus nemurus*) merupakan faktor penting dalam keberhasilan budidaya, yang sangat dipengaruhi oleh kualitas pakan alami yang diberikan. Penelitian ini mengevaluasi pengaruh pemberian pakan hidup *Tubifex* sp. yang diperkaya dengan larutan *Nigella sativa* terhadap pertumbuhan dan kelulushidupan larva ikan baung. Larva ikan yang berumur 7 hari diberi pakan dengan variasi dosis pengayaan *Nigella sativa* (0; 0,1; 0,2; 0,3; dan 0,4 mg) selama 21 hari menggunakan rancangan acak lengkap dengan tiga ulangan. Parameter yang diamati meliputi bobot mutlak, panjang mutlak, laju pertumbuhan spesifik, dan kelulushidupan. Hasil penelitian menunjukkan bahwa pakan *Tubifex* sp. yang diperkaya larutan *Nigella sativa* memberikan peningkatan signifikan pada semua parameter pertumbuhan dan daya tahan hidup larva, dengan dosis optimal pada 0,2 mg. Peningkatan ini diduga berkaitan dengan kandungan senyawa bioaktif thymoquinone pada *Nigella sativa* yang berfungsi sebagai antioksidan dan imunostimulan, yang mengarah pada peningkatan kemampuan metabolik dan ketahanan larva terhadap stres lingkungan. Temuan ini memberikan alternatif inovatif pakan alami yang lebih bernutrisi dan efektif dalam budidaya ikan baung, sekaligus mendukung praktik akuakultur yang berkelanjutan dan ramah lingkungan.

ABSTRACT

The growth and survival of catfish larvae (Hemibagrus nemurus) are important factors in successful cultivation, which are greatly influenced by the quality of the natural feed provided. This study evaluated the effect of providing live feed Tubifex sp. enriched with Nigella sativa solution on the growth and survival of catfish larvae. Seven-day-old fish larvae were fed with various doses of Nigella sativa enrichment (0; 0.1; 0.2; 0.3; and 0.4 mg) for 21 days using a completely randomized design with three replications. The parameters observed included absolute weight, absolute length, specific growth rate, and survival. The results showed that Tubifex sp. feed enriched with Nigella sativa solution significantly increased all parameters of larval growth and survival, with the optimal dose at 0.2 mg. This increase is thought to be related to the

content of the bioactive compound thymoquinone in Nigella sativa which functions as an antioxidant and immunostimulant, leading to increased metabolic capacity and resistance of larvae to environmental stress. This finding provides an innovative alternative to natural feed that is more nutritious and effective in cultivating catfish, while also supporting sustainable and environmentally friendly aquaculture practices.

Kata Kunci	*Tubifex sp., Nigella sativa, ikan baung, pertumbuhan, kelulushidupan*
Keywords	*Tubifex sp., Nigella sativa, catfish, growth, surviva*
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INTRODUCTION

The catfish (Hemibagrus nemurus) is a native Indonesian freshwater fish with high economic value and significant potential for aquaculture development (Agusnimar et al., 2025). This fish has a delicious meat flavor, resulting in high market demand. Catfish is classified as a first-class freshwater fish. In traditional markets, the selling price of catfish ranges from IDR 70,000 to IDR 110,000 per kilogram, while smoked catfish (smoked catfish) can reach IDR 325,000 to IDR 350,000 per kilogram (Oktavian et al., 2023).

Larval growth and survival during the early stages of development are crucial for successful cultivation, as during this phase, the fish are highly susceptible to environmental conditions and feed quality (Simangunsong et al., 2023). Therefore, selecting appropriate, highly nutritious feed is crucial to support optimal growth and increase the survivability of catfish larvae (Hadi et al., 2024; Rosyadi et al., 2025).

One popular natural feed used in fish larval rearing is Tubifex sp., or silkworms. Tubifex sp. has a relatively high protein content, reaching 50-66% (Rech et al., 2013; Herawati et al., 2016; Febrianti et al., 2020; Agusnaidi, 2020), and is easy to obtain and culture, making it an effective natural feed source in fish farming (Gea et al., 2025). However, the use of Tubifex sp. without nutritional enrichment tends to be suboptimal because it does not meet the essential bioactive requirements of larvae. In other words, Tubifex sp. have deficiencies in providing essential bioactive compounds such as essential fatty acids and antioxidants, which are essential for the growth and survival of fish larvae (Simangunsong et al., 2023).

Enriching natural feed with bioactive ingredients such as Nigella sativa (black cumin) solution is an innovative alternative to improve the nutritional quality of Tubifex sp. Nigella sativa is known to contain active compounds such as thymoquinone, which acts as an antioxidant, immunostimulant, and antibacterial agent, thus improving the health and resistance of fish larvae to stress and pathogens (Awad et al., 2013; Khatun et al., 2015; Khondoker et al., 2016). Various studies also indicate that enriching natural feed with bioactive ingredients can significantly stimulate larval growth and survival (Aryani et al., 2025). Previously, Kartina (2022) conducted research on the effect of administering Nigella sativa oil to Tubifex sp. with a dose range of 0-0.4 mL through a 30-minute soaking, and the best results were obtained at a dose

of 0.1 mL for catfish larvae. Therefore, to optimize the use of Nigella sativa, we are interested in using Nigella sativa powder as an enrichment material. This study aims to evaluate the effect of this enrichment as a more nutritious and effective live feed innovation.

METHODS

This research was conducted at the Fish Seed Center (BBI), Faculty of Agriculture, Riau Islamic University, Pekanbaru. The catfish larvae rearing experiment was conducted for 21 days from February to March 2025.

Experimental Design

This research used an experimental method with a completely randomized design consisting of five treatments: 3 g of Tubifex sp. enriched with Nigella sativa (NS) at doses of 0, 0.1, 0.2, 0.3, and 0.4 mg, with each treatment consisting of three replications.

Preparation of Nigella sativa Solution

The Nigella sativa used was in powder form packaged in capsules. Before use, the Nigella sativa powder was weighed according to the dosage for each treatment and then dissolved in 3 mL of water. The solution was then stirred until homogeneous and ready for use.

Preparation of Experimental Feed

The feed used in this study was Tubifex sp. enriched with Nigella sativa solution. Tubifex sp. were obtained from natural collectors in the Sail River, Pekanbaru City. Before use, the Tubifex sp. were thoroughly washed and weighed, weighing 3 g for each treatment. Afterward, the Tubifex sp. were soaked in 3 mL of Nigella sativa solution according to each treatment and allowed to soak into the Tubifex sp. for 30 minutes. The Tubifex sp. were then ready to be fed to the catfish larvae.

Maintenance and Feed Testing

Seven-day-old catfish larvae, with an average weight of 0.09±0.01 g and a length of 0.80±0.10 cm, were obtained from the Fish Seed Center, Faculty of Agriculture, Riau Islamic University, Pekanbaru. Fifteen 10-liter jars were used as rearing containers. Each container was filled with 5 L of water and equipped with aeration. Fifty catfish larvae were randomly distributed into each container. The fish were fed Tubifex sp. The fortified feed was fed at a rate of 1 g per replication, and feeding was carried out four times daily: at 7:00, 11:00, 15:00, and 19:00 WIB. The feeding trial was conducted for 21 days of maintenance.

Observed Parameters

Several parameters observed in this study, such as absolute weight gain, absolute length gain, specific growth rate, and survival rate, were calculated using the formula used by Rosyadi et al. (2025). Water quality parameters, such as temperature and pH, were measured using a pH meter (H198108, Romania), DO using a DO meter (Lutron PDO-519, Taiwan), and ammonia was analyzed using an ammonia MR (HI715, Romania).

Absolute weight gain (g) = final body weight − initial body weight
Absolute length gain (cm) = final body length − initial body length
Specific growth rate (% day-1) = [(ln final body weight − ln initial body weight)/day] × 100
Survival rate (%) = [final number of fish / initial number of fish] × 100

Data Analysis

All data are presented as mean ± SD. Statistical analysis was performed using one-way analysis of variance (ANOVA) in SPSS version 21.0, followed by Duncan's multiple-range test to compare treatment means. In all cases, differences were considered significant at $P < 0.05$.

RESULT AND DISCUSSION

The results showed that feeding Tubifex sp. enriched with Nigella sativa solution significantly increased the growth and survival of catfish larvae (Hemibagrus nemurus) (Table 1). Larvae fed with a 0.2 mg Nigella sativa enrichment dose (NS-0.2) showed the most optimal increase in final weight and length compared to other treatments ($P<0.05$). Furthermore, the specific growth rate and larval survival in this treatment were also higher (Figures 2 and 3), indicating that feed enrichment with bioactives from Nigella sativa can stimulate the larvae's metabolism and resistance to environmental stress. Water quality measurements during the study were still considered optimal for the growth and survival of catfish larvae (Table 2). These findings underscore the potential use of Nigella sativa solution as a natural feed enrichment agent in fish farming to improve the efficiency of larval growth and survival.

Table 1. Growth of catfish larvae after being fed Tubifex sp. enriched with Nigella sativa solution.

Parameter	NS-0	NS-0,1	NS-0,2	NS-0,3	NS-0,4
Initial weight (g)	0,09±0,01	0,09±0,01	0,09±0,01	0,09±0,01	0,09±0,01
Initial length (cm)	0,80±0,10	0,80±0,10	0,80±0,10	0,80±0,10	0,80±0,10
Final weight (g)	1,39±0,05^{a}	2,08±0,02^{c}	2,80±0,06^{d}	2,07±0,01^{c}	1,96±0,03^{b}
Final length (cm)	2,83±0,04^{a}	3,50±0,04^{c}	4,27±0,01^{d}	3,34±0,04^{b}	3,30±0,02^{b}
Absolute weight (g)	1,30±0,03^{a}	1,99±0,03^{c}	2,71±0,06^{d}	1,98±0,03^{c}	1,87±0,04^{b}
Absolute length (cm)	2,03±0,02^{a}	2,69±0,06^{c}	3,47±0,01^{d}	2,53±0,03^{c}	2,36±0,01^{b}
Specific growth rate (% hari^{-1})	13,03±1,13^{a}	14,95±1,08^{c}	16,37±1,12^{d}	14,93±1,10^{c}	14,67±1,09^{b}
Survival Rate (%)	70,00±2,02^{a}	86,09±2,75^{c}	90,67±0,02^{d}	84,67±1,11^{c}	78,00±0,68^{b}

Note: Mean of replicates (±SD) in the same row with different superscripts indicates significant difference ($P < 0.05$).

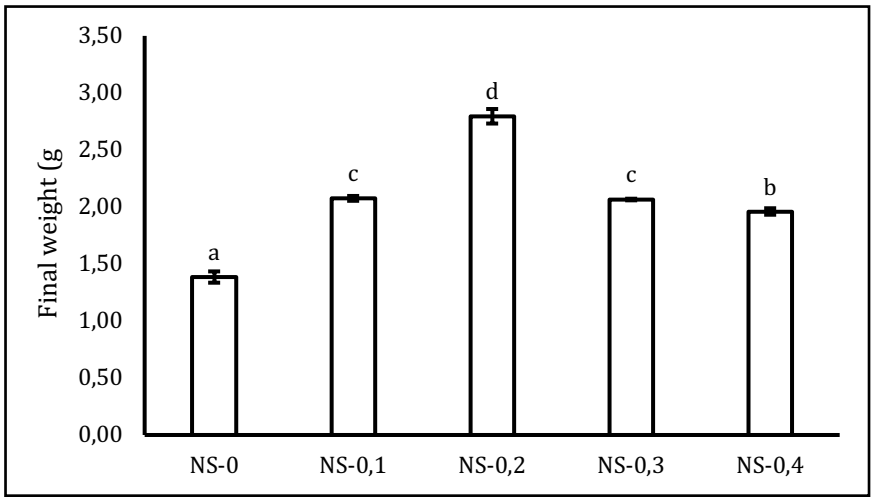

Figure 1. Final weight of catfish larvae after being fed Tubifex sp. enriched with Nigella sativa solution. Different superscript letters indicate significant differences ($P < 0.05$).

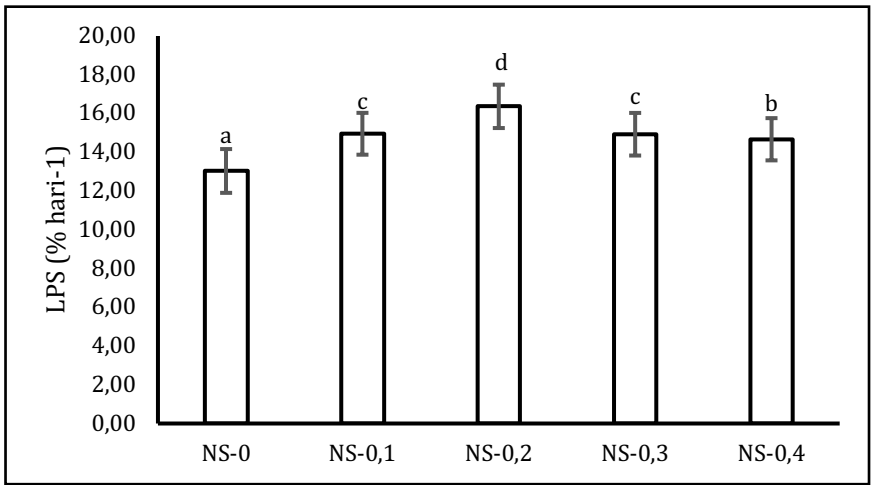

Figure 2. Specific growth rate of catfish larvae after being fed Tubifex sp. enriched with Nigella sativa solution. Different superscript letters indicate significant differences ($P < 0.05$).

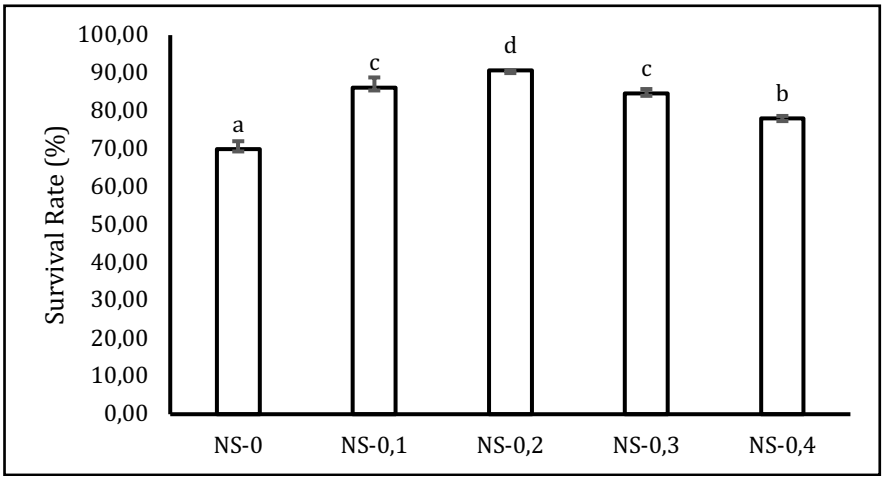

Figure 3. Survival of catfish larvae after being fed Tubifex sp. enriched with Nigella sativa solution. Different superscript letters indicate significant differences ($P < 0.05$).

Table 2. Results of water quality measurements of maintenance media during the study

Water Quality Parameter	Number Range	Optimum range*
Temperatur (^oC)	28-30	27,7-29,8
pH	6	5,32-6,57
Disolved Oksygen(mg L^{-1})	5,7-6,2	5,5-6,4
Ammonia (mg L^{-1})	0,12-0,19	>2

Discussion

Growth Performance

Enrichment of Nigella sativa in Tubifex sp. significantly improved the growth performance of catfish larvae (Hemibagrus nemurus), as reflected in increases in absolute weight, absolute length, and specific growth rate (SGR). The optimal response observed at a dose of 0.2 mg Nigella sativa (NS-0.2) indicates that this concentration provides an adequate supply of bioactive compounds, particularly thymoquinone, which stimulates metabolic activity and improves nutrient utilization efficiency. Thymoquinone has been reported to act as a metabolism enhancer and antioxidant, thereby protecting cells from oxidative stress that can impair protein synthesis and growth (Bektaş et al., 2019; Mahboub et al., 2022).

A similar increase in larval growth was also observed by Aryani et al. (2025), who found that feed enriched with bioactive compounds significantly increased protein deposition and energy conversion efficiency in catfish. These findings are also consistent with Muahiddah and Diniariwisan (2024), who reported that Nigella sativa supplementation stimulated anabolic processes and increased feed conversion in Nile tilapia (Oreochromis niloticus). Therefore, the improvement in growth parameters in this study may be attributed to the synergistic effect of Nigella sativa's antioxidant properties and Tubifex sp. protein content (50–66%), as reported by Gea et al. (2025).

Increase in Absolute Weight and Length

The highest increase in absolute weight (2.71 g) and absolute length (3.47 cm) in the NS-0.2 treatment indicated an optimal balance between nutrient addition and larval absorption capacity. Excessive Tubifex sp. enrichment (≥0.3 mg) resulted in decreased growth performance, likely due to metabolic saturation or oxidative imbalance at higher thymoquinone levels. A similar phenomenon was reported by Kartina (2022), who found that excessive doses of Nigella sativa oil reduced the feeding activity and growth of catfish larvae. The response pattern observed here supports the principle of nutritional thresholds in larval physiology, where optimal nutrient addition maximizes nutrient absorption without inducing oxidative stress.

Specific Growth Rate (SGR)

The specific growth rate (16.37% day-1 at NS-0.2) reported in this study indicates efficient feed utilization and increased metabolic turnover. This increase in SGR correlates with increased gut enzyme activity and nutrient digestibility reported in fish fed a diet enriched with Nigella sativa (Mahboub et al., 2022). According to

Rosyadi et al. (2025), increased SGR is often associated with a balanced amino acid profile and higher bioavailability of essential fatty acids, both of which can be enhanced by Nigella sativa enrichment in Tubifex sp.

Survival Rate

Larval survival rates significantly increased with Nigella sativa enrichment, reaching 90.67% at the NS-0.2 dose. This increase is likely due to the immunostimulant and antimicrobial properties of thymoquinone, which enhances non-specific immune responses and reduces susceptibility to pathogens. Studies on rainbow trout (Oncorhynchus mykiss) by Bektaş et al. (2019) and on Oreochromis niloticus by Mahboub et al. (2022) showed that feeding Nigella sativa increased leukocyte counts, lysozyme activity, and total serum protein, thereby enhancing resistance to bacterial infections. This physiological response is particularly important in the early larval stage, when the immune system is still developing. Furthermore, the antioxidant role of Nigella sativa can prevent oxidative damage caused by environmental stressors such as fluctuations in oxygen or ammonia levels.

Water Quality Parameters

Throughout the experiment, water quality parameters remained within the optimal range for rearing catfish larvae, with a temperature of 28–30°C, pH 6, dissolved oxygen 5.7–6.2 mg L^{-1}, and ammonia levels between 0.32–0.39 mg L^{-1}. This range aligns with the optimal conditions reported by Hadi et al. (2024), who found that the observed increase in growth and survival was primarily influenced by the feeding treatment rather than environmental variability. Maintaining stable water quality is crucial because catfish larvae are highly sensitive to low dissolved oxygen levels and high ammonia concentrations. Therefore, the successful addition of Nigella sativa in enhancing growth and survival was achieved under well-controlled conditions, demonstrating its effectiveness as a nutritional supplement rather than a disruptive environmental factor.

CONCLUSION AND SUGESSTIONS

This study shows that enriching Tubifex sp. feed with Nigella sativa solution significantly improves the growth and survival of catfish larvae (Hemibagrus nemurus). The optimal dose of 0.2 mg of Nigella sativa solution (NS-0.2) was shown to increase the weight, length, and growth rate of larvae, as well as survival. The use of Nigella sativa as an immunostimulant opens up opportunities for innovation in more sustainable and efficient fish farming, utilizing local resources such as Tubifex sp.

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