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Growth of Nile Tilapia (*Oreochromis niloticus*) With Extended Fermentation of Coconut-Based Feed Supplements

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Abstract

This study aimed to investigate the impact of fermentation time on coconut dregs using yeast in tilapia (*Oreochromis niloticus*) feed. The study utilized absolute length, absolute weight, specific growth rate (SGR), Feed Conversion Ratio (FCR), feed efficiency (FE), and Survival Rate (SR) as measures. The research followed a completely randomized design (CRD) with 5 treatments and 4 replications. The treatments included A (coconut dregs without fermentation), B (2-day fermentation), C (4-day fermentation), D (6-day fermentation), and E (8-day fermentation). The tested fish, tilapia fry, were reared for 40 days with feeding times at 08.00 WIB, 13.00 WIB, and 18.00 WIB. The length of fermentation of coconut dregs significantly influenced the growth of tilapia, including absolute length, absolute weight, SGR, FCR, and FE, but did not have a significant impact on SR. Treatment D yielded the best results with absolute length growth of 2.80 cm, absolute weight of 3.27 g, SGR of 0.082%/day, FCR of 1.06, FE of 94.64%, and SR of 95%.

INTRODUCTION

Tilapia (*Oreochromis niloticus*) is a fast-growing fish species commonly found in rivers, lakes, swamps, and brackish waters. Its dense, delicious, and highly nutritious flesh makes it popular among consumers. Due to the high economic potential in the fisheries sector, the demand for tilapia is increasing annually (Putra *et al*., 2017). The key success in fish farming is feed, which represents 70% of total production. To obtain cost-effective feed, utilizing abundant raw materials with the necessary nutritional value is crucial. Domestic waste such as coconut dregs, which are rich in nutrients, can be used as a raw material for fish feed. Coconut dregs, which can be easily obtained from markets or restaurants, contain 5.6% protein, 38.1% carbohydrates, 16.3% fat, 2.6% ash, 5.5% water, and 31.6% crude fiber (Wulandari *et al*., 2018).

The nutritional value of coconut dregs waste can be enhanced through a fermentation process, which involves the use of microorganisms to transform complex compounds into more simple compounds. Yeast or mold, such as *Saccharomyces cerevisiae* and *Rhizopus* sp, are commonly used in the fermentation process (Munira *et al*., 2016). Fermentation with *Aspergillus oryzae* can reduce the crude fiber content of coconut dregs from 30.40% to 10.15% (Elyana, 2011). The duration of the fermentation process also affects the growth of microorganisms and the depletion of

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nutrients in the organic material (Hidayati *et al.*, 2013).

Fermented feed ingredients will have better quality than unfermented feed ingredients. According to Yespus *et al*. (2018), fermentation of 20% coconut dregs in feed using tapai yeast for 4 days can increase absolute length growth by 0.54%, absolute weight growth by 1.42%, and catfish survival by 87.50%. According to Farizaldi (2017), coconut dregs fermented with baker's yeast for 6 days and added to the feed formulation as much as 20% provide the best performance response in catfish. Tapai is a fermented product obtained by steaming raw materials, inoculating with inoculum, then storing for a certain period at room temperature (Islami, 2018). Based on the description above, researchers would like to know the optimal fermentation time for coconut dregs as a raw material for making feed on the growth and survival of tilapia (*O. niloticus*).

METHODOLOGY

Ethical Approval

The procedures applied in this study followed the Universitas Syiah Kuala guidelines (Code No. 958/2015) regarding the care and use of animals in research.

Place and Time

The research was carried out over 40 days at the Fish Rearing and Breeding Laboratory, Faculty of Marine Affairs and Fisheries, Syiah Kuala University, located in Banda Aceh City. The research was conducted between November and December 2023.

Research Materials

The equipment used included 20 units of 20-liter measuring buckets (Indonesia Bersih Rapi, IDN), aerator (Surya Duta International, IDN), aeration stone (Poly Stamino Indonesia, IDN), aeration hose (Margacipta Wirasentosa, IDN), digital scale (Yiwu Chaolan Import and Export, RRC), pellet machine (Miao Hsien Enterprise, TPE), thermometer (Shenzhen Bestone Industrial, RRC), pH meter (Shanghai Boqu Instrument, RRC), DO meter (Lutron Electronic Enterprise, TPE), and meat grinder (Texania Houseware Indonesia, IDN). The materials used included 200 individuals of 3 cm tilapia (*O. niloticus*) from Brackish Water Aquaculture Fisheries Center (BPBAP Ujung Batee), coconut dregs from Coconut milk shop at Lambaro main market, tapai yeast from Traditional Tapai yeast maker in Meulaboh, fish meal, tapioca flour, soybean flour, fish oil, and vitamin mix from BPBAP Ujung Batee.

Research Design

The research utilized a Completely Randomized Design (CRD) with five treatments and four repetitions. The treatment factor focused on the time of fermenting coconut dregs in the production of feed formulations, as outlined in Yespus *et al.* (2018). The treatments are A (feed without fermented coconut dregs/control), B (feed containing 2 days fermented coconut dregs), C (feed containing 4 days fermented coconut dregs), D (feed containing 6 days fermented coconut dregs), and E (feed containing 8 days fermented coconut dregs).

Work Procedure

Preparation of containers and maintenance of tested animals

In this research, 20 containers were used, 26 liter plastic buckets. The containers were cleaned first, then dried, filled with 20 liters of water, then the water was treated before the tested fish were added. Fermentation of coconut dregs using tapai yeast refers to research by Yespus *et al.* (2018), which has modified the fermentation method to be anaerobic. The coconut dregs were steamed for 30 minutes, then cooled for 45 minutes before being fermented with yeast. Coconut dregs were fermented using tapai yeast at a dose of 2 grams per kg of coconut dregs. Coconut dregs were fermented according to each treatment. After the last day, the fermented coconut dregs were dried under the burning sunlight and then floured. Each of the coconut dregs, according to the treatment, was tested proximately.

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Feed manufacturing started with weighing the raw materials. Mixing the feed raw materials was carried out in stages, starting from the smallest amount of ingredients to the largest, then stirring evenly. Then, enough water was added and stirred again until a lump was formed. After that, the raw materials of feed were molded. The molded feed was dried and adjusted in size to the mouth opening of the fish using a chopper. Then, the feed was stored in a tightly closed container.

The fries of Tilapia were reared with a stocking density of 2 fish/liter measuring 3 cm with a weight of 0.5-1 g. The total fries were 200 individuals. The fries were acclimatized for 3 days before being sown into the tested containers. Fish fries were reared for 40 days. The tested feed was given as much as 5% of the fries biomass per day with a feeding frequency of 3 times/day at 08.00 WIB, 13.00 WIB, and 18.00 WIB. Sampling was carried out once every ten days. Water quality maintenance was carried out by checking water quality parameters, namely temperature and pH, regularly every day and checking DO at the beginning and end of the research. Siphoning and changing the water were performed every three days.

Research parameters

The parameters observed in the study were growth in Absolute Length, Absolute Weight, Specific Growth Rate (SGR), Feed Conversion Ratio (FCR), Feed Efficiency (FE), and Survival (SR). Water quality parameters consist of temperature, pH, and DO.

Data Analysis

The data obtained was analyzed using the Analysis of Variance (ANOVA) test to determine the effect of the treatment given. If different lengths of fermentation treatment for coconut dregs in fish-rearing media show significant results, the calculation continues based on the coefficient of diversity value (Harjosuwono *et al*., 2011). Described and displayed in table form.

RESULTS AND DISCUSSIONS

Based on the results of research carried out during 40 days of rearing, it was found that differences in the fermentation time of coconut dregs in the feed influenced the growth of tilapia (*O. niloticus*), including the growth of Absolute Length, Absolute Weight, Specific Growth Rate (SGR), Feed Conversion Ratio (FCR) and Feed Efficiency (FE). The length of fermentation of coconut dregs in feed does not affect the Survival Rate (SR) of tilapia. The best results for the length of fermentation of coconut dregs in feed were in treatment D (feed containing fermented coconut dregs for 6 days).

Table 1. Average growth values for absolute length, absolute weight, specific growth rate (SGR), feed conversion ratio (FCR), feed efficiency (FE), and survival rate (SR).

Parameter	Treatment				
	A (control)	B (2 days)	C (4 days)	D (6 days)	E (8 days)
Absolute Length (cm)	2.57 ± 0.11^{a}	2.62 ± 0.08^{ab}	2.74 ± 0.12^{ab}	2.80 ± 0.09^{b}	2.74 ± 0.04^{ab}
Absolute Weight (g)	2.82 ± 0.08^{a}	3.01 ± 0.17^{a}	3.04 ± 0.11^{ab}	3.27 ± 0.08^{b}	2.97 ± 0.12^{a}
SGR (%)	0.071 ± 0.002^{a}	0.075 ± 0.004^{a}	0.076 ± 0.003^{ab}	0.082 ± 0.002^{b}	0.074 ± 0.003^{a}
FCR	1.20 ± 0.10^{b}	1.10 ± 0.04^{ab}	1.10 ± 0.01^{ab}	1.06 ± 0.04^{a}	1.16 ± 0.07^{b}
FE (%)	83.89 ± 6.40^{a}	90.62 ± 3.50^{ab}	90.59 ± 0.61^{ab}	94.64 ± 3.23^{b}	86.73 ± 5.09^{a}
SR (%)	87.50 ± 5.00^{a}	92.50 ± 5.00^{a}	92.50 ± 5.00^{a}	95.00 ± 5.77^{a}	90.00 ± 8.16^{a}

Note: Different superscript letters in the table above indicate that there is a significantly different effect between treatments and the ± sign indicates the standard deviation number.

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The physical and chemical parameters of the waters measured were temperature, pH, and dissolved oxygen (DO).

Table 2. Results of water quality measurements.

Parameter	Treatment					Value Standards (SNI, 2009)
	A (control)	B (2 days)	C (4 days)	D (6 days)	E (8 days)	
Temperature	27.9-30.6	28.0-30.6	28.0-30.4	28.0-30.6	28.0-30.5	25-32
pH	7.12-7.78	7.12-7.78	7.13-7.78	7.12-7.78	7.12-7.79	6.5-8.5
DO	14.5-15.0	14.8-15.1	14.9-15.0	14.6-15.0	14.9-15.2	≥3

Table 3. Results of proximate test analysis.

Treatment	Analysis	
	Protein (%)	Crude Fiber (%)
A (Before fermentation)	12.82	11.31
B (After 2 days fermentation)	12.92	10.31
C (After 4 days fermentation)	13.63	10.14
D (After 6 days fermentation)	13.87	9.61
E (After 8 days fermentation)	13.05	9.16

The treatment of adding fermented coconut dregs to the feed on the overall growth of tilapia fish can increase the length and weight of the fish. The results of the study showed that the length and weight of tilapia fish increased with increasing time of rearing the fish (Suryani *et al.*, 2017). Based on the graph of the fish growth, the results showed that on the 10th day, the growth of tilapia was slower than on the 20th to 40th day. It is suspected that the fish were still adapting to the environment and feed provided. From the 20th day until the 40th day, it was seen that the tilapia fish that were fed according to the treatment began to indicate an increase in growth. This shows that the longer the rearing time, the better the tilapia will adapt and accept the feed provided so that the fish can grow optimally. According to Francisca and Muhsoni (2021), tilapia fish that have just been moved to an aquatic environment need some time to adapt to that environment. During the adaptation period, fish growth will slow down (Fadlatul, 2022).

The average absolute growth in this study was higher than the research on the fermentation of coconut dregs with cow rumen by Burhanuddin *et al.* (2022), where tilapia fish fries obtained the highest absolute weight of 1.7 g. This is thought to be because coconut dregs that have been fermented using tapai yeast produce simple sugars, ethanol, carbon dioxide, and energy, which will be utilized by fish, while coconut dregs that have been fermented using cow rumen produce simple sugars, ethanol, and energy, but some of the energy obtained is wasted as heat. fermentation and methane gas. so the quality of coconut dregs cannot meet the nutritional needs of fish growth.

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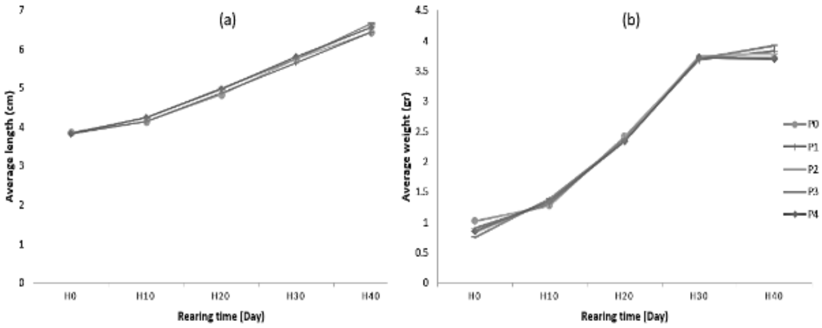

Figure 1. (a) Length growth graph (cm) and (b) weight growth graph (g) of tilapia (*Oreochromis niloticus*) during a 40-day rearing period with 5 treatments and 4 repetitions.

According to Wiadnya *et al*. (2000), the slow growth rate is thought to be caused by the condition of the fish in digesting and utilizing the protein in the feed as well as feed formulations that do not contain appropriate and complete sources of nutrients for the fish. Growth that occurs every 10 days shows that the fish can digest feed and absorb nutrients to stimulate growth. The low growth rate value in treatment A is thought to be due to the absence of fermentation of coconut dregs and the lower protein content compared to other treatments at 12.82%. Apart from the low protein content, the crude fiber content in treatment A is also still high, namely 11.31%, which causes growth to be quite slow because the protein needed for the growth process is not sufficient for the fish, and the high crude fiber also causes the food digestion process to be hampered.

By the statement by Mulqan *et al*. (2017), fish need protein to form and then repair tissue in the fish's body in the growth process. According to Elyana (2011), the fiber contained in feed has several physiological effects, including reducing the fish's ability to digest and utilize the nutrients in the feed. Apart from that, fish are less able to digest fiber completely, so the fish's nutritional intake will decrease and cause low fish growth.

An increase in fish weight greatly influences the specific growth rate value, the specific growth rate value will be greater if there is a greater increase in weight (Sukarman and Ramadhan, 2015). Treatment D had the highest specific growth rate, this is thought to be because feed containing fermented coconut dregs for 6 days is the optimal dose and contains sufficient protein for fish growth, namely 13.87%. This is under the statement by Syaraswati *et al*. (2022) that the most influential nutrient in stimulating fish growth is protein. According to Nisa's research (2023), the highest feed conversion value was found in the combination treatment of 15% fermented coconut dregs with 85% commercial feed, namely 1.63. The length of time for fermentation of coconut dregs will affect the use of feed by fish.

This is because, within a certain period of appropriate fermentation time, the performance of the microbes in tapai yeast will be more optimal and can produce nutrients that can be easily utilized by fish, but if the length of time exceeds the capacity limit. The performance of these microbes will cause an increase in acid and alcohol production, which will lower the pH of the yeast and is not good for fish to consume. Yohanista *et al.* (2018) stated that in the exponential or logarithmic phase, mold utilizes the nutritional content available in the substrate so that its growth and development reach an optimal point and produces many secondary metabolites, one of which produces protease enzymes which play important role in increasing protein content.

The high feed conversion value in treatment A is thought to be due to poor feed utilization levels. Treatment D with the lowest feed conversion value indicates that

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this treatment is the optimal length of coconut dregs fermentation where the feed given can be digested and utilized by fish so that they can grow well. This is in accordance with Farizaldi (2017) research that feed consumption is closely related to the nutritional levels in the feed. Feed consumption will increase if the protein content in the feed also increases so the weight and feed conversion rate will also increase. The low feed conversion value in treatment A is thought to be because coconut dregs have low protein content and high crude fiber content compared to other fermented treatments, so the fish cannot utilize the feed properly.

Yespus *et al.* research (2018) showed that the highest feed efficiency value was found in the treatment of 20% fermented coconut dregs flour in the feed, namely 47.82%, while the lowest was in the treatment of 5% fermented coconut dregs flour in the feed at 15.80%. Elyana's research (2011) showed that the highest feed efficiency value was found in the 100% commercial feed treatment, namely 28%. Warsono *et al*. (2017) stated that the feed efficiency value can be said to be good if the feed efficiency value is above 50%. This shows that the feed efficiency value in treatment D is the best result for the growth of tilapia fish. Treatment D had the lowest feed conversion value and the highest feed efficiency value, indicating that the quality of the feed provided was good and the feed was utilized well for fish growth. This is in accordance with the statement of the National Research Council (2011) that the greater the feed efficiency value, the lower the conversion value of the feed consumed, meaning that the fish feed is being utilized properly for fish growth. Vice versa, the smaller the feed efficiency value, the higher the feed conversion value, meaning that fish feed has not been utilized properly for fish growth.

The survival rate of this study compared with the study by Elyana (2011) was almost the same, where the survival of tilapia fish in that study ranged between 96.67%-98.89%. That value was lower compared with the research by Burhanuddin *et al*. (2022), where the survival rate of tilapia fish fed artificial feed mixed with coconut dregs fermented by cow rumen fluid ranged from 73.33% to 86.66%. The high survival rate of tilapia shows that tilapia can adapt very well to the rearing media and water quality. According to Murjani (2011), fish survival is very dependent on the level of fish adaptation to the environment and food, the health status of the fish, and stocking density. Based on the ANOVA test, it showed that there is no difference in the survival of tilapia in each treatment, this means that the percentage of survival for each treatment is almost the same. This proves that the length of fermentation of coconut dregs in feed does not affect the survival rate of tilapia.

Based on research, the factor that supports the growth and survival of fish is water quality. Water quality needs to be controlled and always monitored so that it is in optimal conditions so that it is suitable for fish habitat (Mulyanto, 1992). Based on the research results, the values of physical and chemical parameters of the water used in the form of temperature, pH, and DO were still within the appropriate range for raising tilapia. This is in accordance with the optimum water quality for raising tilapia based on SNI (2009).

According to Elyana (2011), the water temperature ranges from 26.9 to 30.6°C is still optimal for fish growth. According to Sumule *et al*. (2017), the temperature that can produce optimal growth of tilapia is in the range between 25-30°C. The water temperature during the tilapia rearing period is in the range of 28-30°C is still considered within tolerable limits and will affect optimal tilapia growth (Rahman and Handayani, 2022). According to Gunawan *et al*. (2019), if the water temperature is at optimum temperature conditions, the fish will experience an increase in metabolic rate, and the impact of the metabolic process on dissolved oxygen levels will be low. Meanwhile, if the water temperature is below the optimum temperature, the fish will be susceptible to parasite infection

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because fish are more likely to remain silent when the water temperature is low and their appetite decreases (Maulana *et al.*, 2017).

The pH value in the tilapia research was still within the normal pH range for fish growth. According to Salsabila and Suprapto (2018), a good water pH in tilapia cultivation is between 6 and 8.5. This is confirmed by Swingle (2004) that if the pH value is below 6.5 or exceeds 9-9.5, the growth of tilapia will decrease and will cause death if the pH value is left continuously in non-optimal conditions. According to Romadhona *et al.* (2016), if the pH value of a water area is too high, it will cause high levels of ammonia in that water.

The range of DO levels in fish research is still within the normal range for tilapia fish growth. According to Warasto *et al.* (2013) for the growth of tilapia, the optimal level of Dissolved Oxygen (DO) is between 5.6-7.9 mg/L. The optimal dissolved oxygen level in tilapia cultivation is above 5 mg/L. If DO levels range between 1-3 mg/L, it can cause fish to experience sub-lethal effects on growth and feed utilization, whereas if it is lower, around 0.3-0.8 mg/L, fish will experience death (Bhatnagar *et al.*, 2004). Dissolved oxygen levels in water are one of the important factors that greatly influence tilapia cultivation. According to Dahril *et al.* (2017), in fish farming, if the DO level of a water body is not in optimal conditions, it will cause the fish not to get an adequate oxygen supply, so the fish's body will lack oxygen. Fish that experience a lack of oxygen will become stressed and will even die in some cases.

CONCLUSION

The research results indicate that the duration of fermenting coconut dregs in feed has a substantial impact on the growth of tilapia (*Oreochromis niloticus*), influencing parameters such as absolute length, absolute weight, specific growth rate (SGR), Feed Conversion Ratio (FCR), and feed efficiency while showing no significant effect on survival rate. Notably, Treatment D, which involves fermenting coconut dregs for 6 days, yielded the most favorable growth outcomes. It is suggested that the optimal fermentation period for coconut dregs is 6 days, as the nutritional value tends to decline after the 8th day. Farmers are advised to utilize feed containing fermented coconut dregs for 6 days, with further research recommended to explore the impact on different fish species.

CONFLICT OF INTEREST

The research that has been carried out is true, and there were no conflicts of interest between all authors when writing and publishing the manuscript.

AUTHOR CONTRIBUTION

M conceived and wrote the core sections of the article, including data collection, analysis, and result interpretation. He was responsible for drafting both the initial and final versions of the scientific paper. Additionally, he played an active role in discussions regarding the article's content and incorporated feedback from co-authors. The second author and Corresponding author, IIA, assisted with aspects of the research, including data collection, and contributed to the analysis. She provided valuable scientific advice to enhance the paper’s quality, helped in drafting the article, and offered revisions and feedback. The third author, CDD, contributed to the development of the study’s hypothesis or theoretical framework, as well as assisted in research design and data collection.

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REFERENCES

Bhatnagar, A., Jana, S.N., Garg, S.K., Patra, B.C., Singh, G. and Barman, U.K., 2004. Water quality management in aquaculture. Course Manual of Summer School on Development of Sustainable Aquaculture Technology in Fresh and Saline Waters, CCS

Haryana Agricultural, Hisar (India), 3, pp.203-210.

Burhanuddin, Akmaluddin, Soadiq, S., Haris, A., Malik, A., Ikbal, M. and Saleh, M.S., 2022. Utilization of coconut dregs results from fermented rumen fluid in artificial feed on growth and survival of tilapia (*Oreochromis niloticus*). *Jurnal Ilmiah Ecosystem*, *22*(3), pp.448-455. https://doi.org/10.35965/eco.v22i3.1980

Dahril, I., Tang, U.M. and Putra, I., 2017. The effect of different salinities on the growth and survival of red tilapia (*Oreochromis* sp.) fry. *Berkala Perikanan Terubuk*, *45*(3), pp.67-75. https://festiva.ejournal.unri.ac.id/index.php/JT/article/view/5198

Elyana, P., 2011. The effect of adding fermented coconut dregs from *Aspergillus oryzae* in commercial feed on the growth of tilapia (*Oreochromis niloticus* Linn.). Thesis. Faculty of Mathematics and Natural Sciences, Sebelas Maret University, Surakarta.

Fadlatul, A., 2022. Utilization of fermented seaweed meal (*Eucheuma cottonii*) in tilapia cultivated feed (*Oreochromis niloticus*). Doctoral dissertation, Mataram University.

Farizaldi, F., 2017. Evaluation of coconut dregs fermented with local yeast products and its application in catfish (*Clarias* sp) agribusiness. Doctoral dissertation, Andalas University.

Gunawan, H., Tang, U.M. and Mulyadi, 2019. The Effect Different of Temperature on Growth and Survival Rate of *Kryptopterus lais*. *Jurnal Perikanan dan Kelautan*, *24*(2), pp.101-105. http://dx.doi.org/10.31258/jpk.24.2.101-105

Harjosuwono, B.A., Arnata, I.W. and Puspawati, G.A.K.D., 2011. Theoretical experiment design, SPSS and Excel applications. Malang: Lintas Kata Publishing. p.148.

Hidayati, D., Ba'ido, D. and Hastuti, S., 2013. Growth patterns of tape yeast in cassava skin fermentation. *Agrointek: Jurnal Teknologi Industri Pertanian*, *7*(1), pp.6-10. https://doi.org/10.21107/agrointek.v7i1.2044

Islami, R., 2018. Making yeast tape and tape. *Jurnal Penelitian dan Pengembangan Agrokompleks*, *1*(2), pp.56-63. http://journal-old.unhas.ac.id/index.php/jppa/article/view/6531

Maulana, D.M., Muchlisin, Z.A. and Sugito, 2017. Intensity and prevalence of parasites in Betok fish (*Anabas testudineus*) from North Aceh mainland public waters. *Jurnal Ilmiah Mahasiswa Kelautan dan Perikanan Unsyiah*, *2*(1), pp.1-11. https://jim.usk.ac.id/fkp/article/view/2098

Francisca, N.E. and Muhsoni, F.F., 2021. Growth rate and survival of tilapia (*Oreochromis niloticus*) at different salinities. *Juvenil: Jurnal Ilmiah Kelautan dan Perikanan*, *2*(3), pp.166-175. https://doi.org/10.21107/juvenil.v2i3.11271

Mulqan, M., Rahimi, S.A.E. and Dewiyanti, I., 2017. Pertumbuhan dan Kelangsungan Hidup Benih Ikan Nila Gesit (*Oreochromis niloticus*) Pada Sistem Akuaponik Dengan Jenis Tanaman Yang Berbeda. *Jurnal Ilmiah Mahasiswa Kelautan dan Perikanan Unsyiah*, *2*(1), pp.183-193. https://jim.usk.ac.id/fkp/article/view/2566

Mulyanto, 2012. Environment for fish. Department of Education and Culture, Jakarta.

Munira, Nafiu, L.O. and Tasse, A.M., 2016. Performance of super free-range chickens on feed substituted with fermented rice bran with different fermenters. *JITRO (Jurnal Ilmu dan Teknologi Peternakan Tropis)*, *3*(2), pp.21-29. https://dx.doi.org/10.33772/jitro.v3i2.1683

Cite this document Muslim, Arisa, I.I. and Dewi, C.D., 2025. Growth of Nile Tilapia (*Oreochromis niloticus*) With Extended Fermentation of Coconut-Based Feed Supplements. *Journal of Aquaculture and Fish Health*, *14*(1), pp.142-151.

Murjani, A., 2011. Cultivation of several varieties of swamp catfish (*Trichogaster tricopterus* Pall) using commercial feed. *Fish Scientiae*, *1*(2), pp.214-232. https://doi.org/10.20527/fishscientiae.v1i2.23

National Research Council, Division on Earth, Life Studies, Committee on the Nutrient Requirements of Fish and Shrimp, 2011. Nutrient requirements of fish and shrimp. National academies press, Washington. p.392.

Nisa, S.A., 2023. The effect of a combination of fermented coconut dregs from *Aspergillus oryzae* and commercial feed on the growth of catfish (*Clarias* sp.). Doctoral dissertation, UIN Raden Intan Lampung. http://repository.radenintan.ac.id/id/eprint/28371

Putra, E.M., Mahasri, G. and Sari, L.A., 2018. Ectoparaite Infestation in Tilapia (*Oreochromis niloticus*) Raised Using Aquaponics and Without Aquaponics Systems. *Journal of Aquaculture and Fish Health*, *7*(1), pp.42-49. https://doi.org/10.20473/jafh.v7i1.11242

Rahman, M.G. and Handayani, L., 2022. Case study: identification of ectoparasites in tilapia (*Oreochromis niloticus*) kept in floating net cages. *e-Jurnal Budidaya Perairan*, *10*(2), pp.157-165. https://doi.org/10.35800/bdp.10.2.2022.37623

Romadhona, B., Yulianto, B. and Sudarno, 2016. Fluctuations of Ammonia and Pollution load in Intensive Vannamei Shrimp Pond Harvested Using Partial and Total Method. *Saintek Perikanan: Indonesian Journal of Fisheries Science and Technology*, *11*(2), pp.84-93. https://doi.org/10.14710/ijfst.11.2.84-93

Salsabila, M. and Suprapto, H., 2019. Techniques for rearing tilapia (*Oreochromis niloticus*) at the Pandaan freshwater cultivation installation, East Java. *Journal of Aquaculture and Fish Health*, *7*(3), p.118-123. https://doi.org/10.20473/jafh.v7i3.11260

Standar Nasional Indonesia, 2009. 7550:2009Production of grow-out class tilapia (*Oreochromis niloticus* Bleeker) in still water ponds. ICS 65.120 National Standardization Agency, pp.1-5.

Sukarman and Ramadhan, F., 2015. Utilization of coconut shell as an alternative feed ingredient for tilapia (*Oreochromis niloticus*). *Al-Kauniyah: Jurnal Biologi*, *8*(1), pp.15-20. https://dx.doi.org/10.15408/kauniyah.v8i1.2700

Sumule, J.F., Tobigo, D.T. and Rusaini, R., 2017. Application of probiotics in maintenance media on the growth and survival of red tilapia (*Oreochromis* sp.). *Jurnal Ilmiah AgriSains*, *18*(1), pp.1-12. http://jurnal.untad.ac.id/jurnal/index.php/AGRISAINS/article/view/9928

Suryani, Y., Hernaman, I. and Ningsih, 2017. Effect of adding urea and sulfur to EM-4 fermented bioethanol solid waste on protein and crude fiber content. Integrated *Jurnal Ilmiah Peternakan Terpadu*, 5(1), pp.13-17. http://dx.doi.org/10.23960/jipt.v5i1.p13-17

Swingle, H.S., 2004. Relationship of pH of pond waters to their suitability for fish culture. *Proceedings Pacific Science Congress*, 9(10), pp.72-75.

Syaraswati, M., Suharman, I. and Adelina, 2022. Use of fermented water hyacinth leaf meal as Aspergillus niger in feed for the growth of Nilem fish seed (*Osteochilus hasselti*). *Berkala Perikanan Terubuk*, *50*(1), 1394. http://dx.doi.org/10.31258/terubuk.50.1.1394-1405

Warasto, Yulisman and Fitrani, M., 2013. Fermented kiambang flour (*Salvinia molesta*) as a feed ingredient for

Cite this document Muslim, Arisa, I.I. and Dewi, C.D., 2025. Growth of Nile Tilapia (*Oreochromis niloticus*) With Extended Fermentation of Coconut-Based Feed Supplements. *Journal of Aquaculture and Fish Health*, *14*(1), pp.142-151.

tilapia (*Oreochromis niloticus*). *Jurnal Akuakultur Rawa Indonesia*, *1*(2), pp.173-183. https://ejournal.unsri.ac.id/index.php/jari/article/view/1737

Warsono, A.I., Herawati, T. and Yustiati, A., 2017. Survival and growth of betutu fish (*Oxyeleotris marmorata*) that were given live food and artificial food in floating net cages in Cirata Reservoir. *Jurnal Perikanan Kelautan*, *8*(1), pp.14-25. http://jurnal.unpad.ac.id/jpk/article/view/13880

Wiadnya, D.G.R., Kartikaningsih, H., Hariati, A.M., Suryanti, Y. and Subagyo, 2000. Feeding period of diet containing chitin to accelerate growth and production in giant gouramy, *Osphronemus gouramy* (Lacepede). *Jurnal Penelitian Perikanan Indonesia*, *6*(2), pp.62-67. http://dx.doi.org/10.15578/jppi.6.2.2000.62-67

Wulandari, Yudha, I.G. and Santoso, L., 2018. Study of the use of coconut dregs flour as a feed mixture for dumbo catfish, *Clarias gariepinus* (Burchell, 1822). *e-Journal of Aquaculture Engineering and Technology*, *6*(2), pp.713-718. http://dx.doi.org/10.23960/jrtbp.v6i2.p713-718

Yespus, Amin, M. and Yulisman, Y., 2018. The effect of substituting bran with fermented coconut dregs flour on the growth and feed efficiency of catfish (*Pangasius* sp.). *Jurnal Akuakultur Rawa Indonesia*, *6*(1), pp.65-76. https://ejournal.unsri.ac.id/index.php/jari/article/view/7150

Yohanista, M., Sofjan, O. and Eko, W., 2018. Evaluasi campuran onggok dan ampas tahu terfermentasi *Aspergilus niger*, *Rhizopus oligosporus* dan kombinasi bahan pakan pengganti tepung jagung. *Jurnal Ilmu-Ilmu Peternakan,* *24*(2), pp.72-83. https://jiip.ub.ac.id/index.php/jiip/article/view/177

Cite this document Muslim, Arisa, I.I. and Dewi, C.D., 2025. Growth of Nile Tilapia (*Oreochromis niloticus*) With Extended Fermentation of Coconut-Based Feed Supplements. *Journal of Aquaculture and Fish Health*, *14*(1), pp.142-151.