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Effects of dietary coffee husk fermented on the growth performance and feed utilization in Striped Catfish (*Pangasianodon hyphophthalmus*)

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ABSTRACT

Coffee husk fermented (CHF) might be utilized as other preference plant protein source. This research focused on evaluating the effects of dietary supplementing CHF for striped catfish on growth and fed application. This study consisted of five grade levels of CHF. The treatments were P0 (without the addition of CHF) P1 (addition of 6% CHF), P2 (addition of 12% CHF), P3 (addition of 18% CHF), P4 (addition of 24% CHF). The results determined that a weight growth of striped catfish in the P0 was 12.58 g ± 1.63, P1 13.68 g ± 0.34, P2 13.24 g ± 1.17, P3 13.31 g ± 0.55 and P4 was 13.34 g ± 0.63, the feed efficiency value in the P0 was 89.10 % ±10.57, P1 95.54 % ±2.16, P2 92.11 % ±7.87, P3 92.15 % ±3.96 and P4 92.23 % ±4.57, the value of protein retention in the P0 was 34.78 % ±6.68, P1 45.45 % ±3.99, P2 30.84 % ±5.24, P3 30.80 % ±1.61 and P4 31.83 % ±2.63. The use of CHF up to 24% in the feed formulation was still acceptable to applied and did not negative effect of striped catfish although which results in growth rate, feed efficiency and survival that are not different (P>0.05).

Keyword: feed, striped catfish, coffee husk fermented, growth

INTRODUCTION

Striped catfish is a valuable freshwater species with high economic importance, playing a significant role in boosting aquaculture production thus it included among the most widely cultivated species (Hoque *et al*. 2021). The value of catfish production from 2019-2023 has risen by an average of 4.17% each year (Ministry of Fisheries and Marine Affairs, 2024). Globally, catfish has also ranked as the ninth massive freshwater fish production around the globe (FAO, 2022). Increasing catfish production based on the high demand of the world society for animal protein sources in human nutritional needs which continues to grow as the world's population grows. An attempt to fulfill this demand has encouraged the development of catfish culture such as the application of intensive farming systems. On the other hand, the problem in the application of intensive farming systems will also improve the nutritional needs as well as feed as one of the aspects in the successfully of aquaculture (Zannat *et al*. 2023). Diet is an essential component in the growth rate and survival of fish. Furthermore, nearly 60% of the total production cost is devoted to feed (Daniel, 2018). Currently, protein as the main nutrient component in the diet is still highly dependent on fishmeal and soybean flour, which have relatively more expensive prices (Putri *et al*. 2012; Ahmad *et al*. 2020).

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Attempts to reduce feed costs are by using alternative feed ingredients. These ingredients generally are derived from materials that are not utilized by humans but have nutritional content for fish stuff. One of these alternative feed ingredients is coffee husk, which is the waste from processing coffee fruit (Afriansyah *et al*. 2023; Nuraisah *et al*. 2013).

The utilization of coffee husk as a fish feed ingredient was grounded by the potential of coffee plantations in South Sumatra, which has a land area of 254.374 hectares with coffee production of 147.090 tons per year (Directorate General of Plantations, 2015). Coffee husk is a by-product of coffee bean which if not handled further will cause pollution and has not been utilized properly yet (Diniyah *et al*. 2013). Coffee bean processing produces 65% coffee beans and 35% husk waste, thus providing considerable potential to be utilized (Iriondo-Dehond *et al*. 2020). Coffee husk containing micronutrient and macronutrient essential for diet. (Bondesson, 2015; Esquivel & Jiménez, 2012). Besides, there are also phytochemical compounds of the polyphenol class that act as antioxidants that help improve the health status of fish (Blinová *et al*. 2017; Rahimnejad *et al*. 2015; Ameca *et al*. 2018; Hoseini *et al*. 2021; Van Doan *et al*. 2021; Van Doan *et al*. 2022). Murib *et al*. (2016) explained that the protein content of coffee husk was around 11.18%, while the results of proximate tests at the Fish Nutrition Laboratory of IPB University obtained the nutritional value of coffee husk, which were protein of 9.03%, fat of 1.6%, BETN of 41.34% and crude fiber of 34.96%. The high crude fiber is a weakness in the use of coffee husk. This weakness can be overcome through prior processing, namely the fermentation process (Nuraisah, 2013; Fitria *et al*. 2020; Siddik *et al*. 2024; Yafetto *et al*. 2023).

A fermentation is a biological processing, which utilizes microorganisms which produce enzymes to make changes to complex molecules such as proteins, carbohydrates and fats into simpler and easily digestible molecules (Nuraisah, 2013). These natural microorganisms in EM4 used for fermentation are divided into four main groups: photosynthetic bacteria, fermentation fungi, lactic acid bacteria and Actinomycetes sp, all of which contribute to the breakdown of lignocellulosic bonds, namely releasing lignin and cellulose that proteolytic microbes will produce protease enzymes which function to break down proteins into amino acids (Winedar *et al*., 2006; Al Barru *et al*., 2022). 2022). The implemented of this study for look forward the influences of CHF in striped catfish. The benefit of this research was expected to provide information on the utilization of CHF into feed stuff.

MATERIALS AND METHODS

Preparation of coffee husk fermented

The coffee husk derived from the local plantation of Buay Rawan Disctrict, South Sumatra, Indonesia. The coffee husk was sun-dried for approximately 7 hours and then ground using a disk mill.. Fermentation of coffee husk flour was carried out in refer to Warasto *et al*. (2013) by first making a fermentation solution by mixing commercial probiotics brand EM_4 into water in a ratio of 1:100. Then, 150 grams of sugar was added as a carbon source. Next, the coffee husk flour was mixed evenly with the fermentation solution. The mixing ratio is 3 ml of fermentation solution for 10 grams of coffee husk flour. The results of the mixing were then put in a plastic bag and stored at room temperature for seven days.

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Experimental diets

The diet used in this study consisted of 5 types of diet, namely: P0 (0% CHF), P1 (6% CHF), P2 (12% CHF), P3 (18% CHF), P4 (24% CHF) which were arranged in a feed formulation with a protein content of 30%. (Table 1). Association of Official Analytical Chemists (AOAC, 2012) used for analysis of proximate.

Experimental design

Striped catfish acquired from local farm of Indralaya, Ogan Ilir Regency. they were kept in a hapa 2x2x1 m^3 for one week to adapt to the research environment. Then, the hapa used in this study was 50x50x50 cm^3. It was installed in a 4x4x1 m^3 concrete pond. A total of 300 catfish were distributed into 15 hapa with 3 replicates using a completely randomized design (CRD). Fish rearing was conducted for 6 weeks and during rearing, treatment feeding was applied at satiation 3 times daily at 08.00 a.m, 12.00 a.m and 16.00 p.m.

Absolute weight growth

Absolute weight growth determined based on (Effendie, 1997):

$$W = Wt - Wo$$

Specific growth rate

Specific growth rate calculated based on (Afriansyah *et al*. 2023):

$$SGR = \left(\sqrt[t]{\frac{Wt}{Wo}} - 1\right) \times 100$$

Feed efficiency

Feed efficiency calculated based on NRC (1993), namely:

$$FE = \frac{(Wt + Wd) - Wo}{F} \times 100$$

Survival rate

The survival rate calculated refers to (Mulchlisin *et al*., 2016).

$$SR = \frac{Nt}{No} \times 100$$

Protein Retention

The protein retention determined refers to (Zehra and Khan, 2016).

$$PR = \frac{F - I \times 100}{P}$$

Water quality measurement

The water quality has a significant influence on fish survival and growth. Water quality parameter monitoring was carried out to examine water environment. The parameters observed were water pH, dissolved oxygen, ammonia and temperature.

Data analysis

Data analysis determined by analysis of variance (ANOVA), and treatments that exhibited significant differences were further examined using Duncan test with a 95% confidence interval through the SPSS 22.0 software

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Table 1. Diet formulation of five grade levels CHF

Ingredients (%)	Treatments of diet				
	P0	P1	P2	P3	P4
Coffee husk fermented	0	6	12	18	24
Fish meal	43	43	43	43	43
Soybean meal	18	17	16	15	14
Rice bran	23	18	13	8	3
Wheat flour	10	10	10	10	10
Vitamin mix	2	2	2	2	2
Fish oil	3	3	3	3	3
Diet proximate contents (%)					
Protein	29.82	30.16	30.89	30.90	30.05
Lipid	15.11	14.49	13.84	14.84	13.94
Moisture	8.50	9.48	8.71	8.97	8.26
Ash	12.96	12.50	7.88	7.26	11.57
Crude fiber	6.80	7.21	7.28	10.90	9.94
NFE)*	26.82	26.15	31.39	27.11	26.23
GE* (kcal/kg diet)	487.96	481.33	476.89	468.41	455.12

* NFE = nitrogen free extract; * GE = Gross energy (Watanabe, 1988).

RESULTS AND DISCUSSIONS

Results

Growth Performance and Feed Utilization

The results indicated that an adition of CHF no effect significantly different impact on specific growth rate, an absolute weight growth and survival rate of striped catfish (P>0.05). While CHF in the diet did not result in a significantly different affect on feed intake and feed efficiency (P>0.05), the addition of 6% CHF in the diet significantly for protein retention (P<0.05) compared to the other treatments. On the other hand, P2, P3, and P4 treatments not significant difference from P0 (P>0.05). All data regarding growth performance and feed utilization are listed in Table 2.

Water Quality

The results determined that water quality during the rearing of catfish was in normal conditions that could be tolerated to support fish survival. Water quality results are presented in Table 3

Tabel 2 Growth and feed utilization after rearing

Parameter	Treatments of diet				
	P0	P1	P2	P3	P4
Wo (g)	5,31±0,34^{a}	5,33±0,09^{a}	5,48±018^{a}	6,17±0,19^{a}	5,43±0,13^{a}
Wt (g)	12,58±1,63^{a}	13,68±0,34^{a}	13,24±1,178^{a}	13,31±0,55^{a}	13,34±0,63^{a}
FI (g)	843,30±1,51^{a}	859,43±0,78^{a}	862,51±0,61^{a}	866,76±0,63^{a}	866,68±0,11^{a}
SGR(%)	4,04±0,38^{a}	4,24±0,03^{a}	4,09±0,13^{a}	3,83±0,14^{a}	4,08±0,22^{a}
FE (%)	89,09±8,63^{a}	95,54±1,76^{a}	92,11±6,43^{a}	92,15±3,23^{a}	92,23±3,73^{a}
PR (%)	34,62±5,24^{a}	45,45±3,25^{b}	30,84±4,28^{a}	30,80±1,31^{a}	31,49±2,25^{a}
SR (%)	100,00±0,00^{a}	100,00±0,00^{a}	100,00±0,00^{a}	100,00±0,00^{a}	98,33±2,89^{a}

Note: different superscript letters on the same line, show a significant difference (P<0.05). Wo = Initial weight, Wt = Final weight, FI = Feed intake, SGR = Specific growth rate, FE = Feed efficiency, PR = Protein retention, SR = Survival rate.

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Tabel 3 Water quality during rearing of striped catfish

Parameter	Results of measurement	Optimal range
Temperature (°C)	29,5-29,9	27-30 (SNI, 2002)
pH	6,0-7,9	6,5-8,5 (SNI, 2009)
Dissolved oxygen (mg.L^{-1})	3,97-6,66	>3 (SNI, 2009)
Ammonia (mg.L^{-1})	0,03-0,19	<0,1 (SNI, 2009) <0,2 (Ananda *et al.*, 2015)

Discussion

CHF may be utilized as a fish stuff. Experimental results showed that the use of CHF up to 24% was not significantly different from the control treatment (P0) on growth rate. This was thought to be due to the fact that CHF was acceptable as a fish stuff for fish diet. This was evident from the increase in the amount of feed consumption containing CHF. The increased amount of feed consumption is thought to be due to the flavor of coffee that catfish like, causing fish to increase their appetite. According to Nuraisah *et al*. (2013) the increased amount of feed intake due to the palatability of the feed both in terms of aroma and texture that fish like.Feed consumed by fish will be converted into energy. The greater the available energy, the better it can meet maintenance requirements, with the remaining energy being utilized for growth (Afriansyah *et al*. 2023). The amount of feed given will produce growth if the feed can be consumed and digested by catfish. The same results of Nuraisah *et al*. (2013), the use of fermented coffee skin flour up to 20% in feed produces growth that is not significantly different from the control treatment in tilapia. Lovell (1989) explains that, the energy would be used for maintenance and for growth, so it can be ascertained that would be able to meet of fish maintenance needed. Likewise, in the treatment of P1 (6% CHF), P2 (12% CHF) and P3 (18% CHF) in the feed formulation, it is still able to be digested properly so that it is sufficient for catfish growth. Growth performance showed no significant difference across treatments, it concluded that the use of fermented CHF has the potential to be used as an alternative raw material to substitute bran and soy flour. This can be seen from the results of the study showing that feed containing CHF up to a level of 24% in feed formulations is still acceptable to catfish and for improving growth performmance of striped catfish.

Feed efficiency refers to growth and the amount of feed consumed. Feed efficiency provides an overview of the utilization of feed given so as to increase fish growth (Nuraisah *et al*. 2013). High feed efficiency values indicate it will be absorbed and converted into meat. The use of CHF up to 24% (treatment P4) resulted in feed efficiency that was not different from the control (P0). This is suspected because the fermentation results could reduce crude fiber in CHF from 33.80% to 25.52%, so that the use of CHF up to 24% in feed can still be digested and produce growth in catfish. Crude fiber in the control treatment feed is 6.80%, while crude fiber in feed containing coffee husk ranges from 7.21-10.90%.

Protein retention reflects protein saved in the body. The protein retention value in the P1 treatment (45.45%) was significantly higher compared to the P0, P2, P3, and P4 treatments (P<0.05). The higher the RP value, shown the more protein in the body from diet prrotein (Suprayudi *et al*. 2014). This is thought to be due to the contribution of energy derived from higher non-protein which makes fish able to digest and absorb feed sourced from high energy for maintenance and growth

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needs (Van Doan *et al*. 2022; Giri *et al*. 2016). As stated by Handayani et al. (2014), high protein retention occurs when the protein content in the diet is efficiently utilized by the fish. Halver (1989) explains if the energy in the diet exceeds of fish requirements, it would be full quickly and may not utilize the protein effectively. Conversely, if the energy in the feed is insufficient for the fish's needs, the energy source from protein allocated for biological functions maintenance.

Based on the study, overall water quality as long as the experiment was optimal and within tolerable range for the fish. Water temperature ranged from 29.5-29.9 ºC, water pH during catfish rearing ranged from 6.0-7.9. Dissolved oxygen content during rearing ranged from 3.97-6.70 mg.L^{-1} and ammonia values during rearing ranged from 0.03-0.19 mg.L^{-1}. According to the Indonesian National Standard (2002), a good water temperature for striped catfish rearing ranges from 25-30ºC. According to the Indonesian National Standard (2009) the pH of good water for striped catfish rearing ranges from 6.5-8.5 and ammonia value <0.01 mg.L^{-1}. The range of ammonia optimal for fish life is <0.2 mg.L^{-1}(Ananda *et al*. 2015; Tanbiyaskur *et al*. 2024). According to the Indonesian National Standard (2000), for an optimal dissolved oxygen of catfish is 3-8 mg.L^{-1}.

CONCLUSION

The inclusion of up to 24% CHF in feed formulations could serve as an alternative feed ingredient without negatively on the growth performance and feed utilization in striped catfish.

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AUTHORS' CONTRIBUTIONS

Each author's contribution includes among others, AA: collecting data, conceptualization, software, experimental design, data curation, manuscript writing; MA: conceptualization, software, manuscript writing, data curation; ADS: conceptualization, software, experimental studies, manuscript writing, data curation; SHD: conceptualization, software, experimental studies, manuscript writing, data curation; TBY: conceptualization, software, experimental studies, manuscript writing, data curation.

CONFLICT OF INTEREST

All authors declare that there are no conflict of interests are reported

REFERENCES

Afriansyah, A., Setiawati, M., Suprayudi, M.A., & Fauzi, I.A. (2023). Evaluation of dietary coffee Coffee canephora husk supplementation on the growth, blood chemicals, and antioxidative activity of red Nile tilapia *Oreochromis* sp, Jurnal Akuakultur Indonesia, Vol 22, No 1, hh 18-26. DOI: 10.19027/jai.22.1.18-26.

Ahmad N, Siddiqui PJA, Khan MK, Ali A, Tahir M, Akbar NU, Amin M, Attaullah M, Boneri ID. (2020). Effects of partial substitution of fishmeal by soybean mealin Nile tilapia Oreochromis niloticus diet. The Journal of Animal and Plant Sciences. 30: 364–370.

Al Barru N. A., S. Y. Lumbessy &. D. P. Lestari. (2022). The Composition Test Of Tilapia Feed *(Oreochromis Niloticus)* With Addition Of Flour E. Cottonii Fermented Using Tape Yeast and EM-4. AQUASAINS (Jurnal Ilmu Perikanan

pISSN 2550-0910; eISSN 2579-4817
Available online at https://e-journal.unair.ac.id/JoAS

dan Sumberdaya Perairan), 11 (1): 1159 -1166

Ameca GM, Cerrilla MEO, Córdoba PZ, Cruz AD, Hernández MS, Haro JH. (2018). Chemical composition and antioxidant capacity of coffee pulp. Cienc. e Agrotecnologia. 42(3):307–313.

Ananda T, Rachmawati, D dan Samidjan, I. (2015). Pengaruh papain pada pakan buatan terhadap pertumbuhan ikan patin (*Pangasius hypopthalmus*). Jurnal of Aquaculture Management and Technology. 4(1): 47-53.

[AOAC] Association of Official Analytical Chemists. (2012). Official method of analysis of AOAC Intl. 19th Ed. Marylands (US): Association of Official Analytical Chemists

Bondesson E. (2015). A nutritional analysis on tea by- product coffee husk and its potential utilization in food production. Fac. Nat. Resour. Agric. Sci. - Dep. Food Sci. A.(415):1–25.

Blinová L, Sirotiak M, Bartošová A, Soldán M. (2017). Review: Utilization of waste from coffee production. Res. Pap. Fac. Mater. Sci. Technol. Slovak Univ. Technol. 25(40):91–101.

Craigh S dan Helfrich LA. (2002). Understanding Fish Nutrition Feeds and Feeding. Virgia Tech.

Daniel N. (2018). A review on replacing fish meal in aqua feeds using plant protein sources. International Journal of Fisheries and Aquatic Studies. 6 (2): 164– 179.

Diniyah N., Maryanto., Nafi A., Sulistia D dan Subagio A. (2013). Ekstraksi dan karakterisasi polisakarida larut air dari kulit kopi varietas rabika (*Coffea arabica*) dan robusta (*Coffea canephora*). Jurnal Teknologi Pertanian. 14(2): 73-78.

Directorate General of Plantations . 2015. Statistik Perkebunan Indonesia Komoditas Kopi 2013-2015. Ditjenbun. Jakarta

Esquivel P, Jiménez VM. (2012). Functional properties of coffee and coffee by-products. Food Research International, 46: 488–495.

[FAO] Food and Agriculture Organization (2022) The State of World Fisheries and Aquaculture 2022. FAO, Romehttps://doi.org/10.4060/cc0461en.

Fitria, P. D., Amin, M., Lokapirnasari, W. P., & Lamid, M. (2020). Supplementation of fermented coffee-peel flour to increase high-density lipoprotein (HDL) cholesterol, docosahexaenoic acids (DHA) and eicosapentaenoic acids (EPA) deposition in tilapia fillet. Biocatalysis and Agricultural Biotechnology, 101502. https://doi.org/10.1016/j.bcab.2020.101502

Giri, S.S., J.W. Jun, V. Sukumaran, S.C. Park. (2016). Dietary administration of banana (*Musa acuminata*) peel flour affects the growth, antioxidant status, cytokine responses, and disease susceptibility of rohu, Labeo rohita, J. Immunol. Res. 4086591.

Halver JE. (1989). Fish Nutrition. Scound Edition. Washington. Academy Press

Handayani I., Nofyan E dan Wijayanti M. (2014). Optimasi tingkat pemberian pakan buatan terhadap pertumbuhan dan kelangsungan hidup ikan patin jambal (*Pangasius djambal*). Jurnal Akuakultur Rawa Indonesia. 2(2): 175-187

Hoque MS, MM Haque, M Nielsen, Badiuzzaman, MT Rahman, MI Hossain, S Mahmud, AK Mandal, M Frederiksen and EP Larsen. (2021). Prospects and challenges of yellow flesh pangasius in international markets: secondary and primary evidence from Bangladesh. Heliyon 7: e08060.

Hoseini M, Cocco S, Casucci C, Cardelli V, Corti G. 2021. Coffee by-products

pISSN 2550-0910; eISSN 2579-4817
Available online at https://e-journal.unair.ac.id/JoAS

derived resources. A review. *Biomass and Bioenergy*. 148(January):106009

Iriondo-Dehond A, Iriondo-Dehond M, Del Castillo MD. (2020). Applications of compounds from coffee processing by-products. *Biomolecules* 10: 1–20

Kementerian Kelautan dan Perikanan. 2024. Laporan Kinerja Kementerian Kelautan dan Perikanan. (2023). Volume 1, 296 hlm; Jakarta

Lovell T. 1989. *Nutrition and Feeding of Fish*. An A VI Book. Published by Van Nostrand Reinhold, New York.

Muchlisin, Z. A., Arisa, A. A., Muhammadar, A. A., Fadli, N., Arisa, I. I., & Siti-Azizah, M. N. (2016). Growth performance and feed utilization of keureling () fingerlings fed a formulated diet with different doses of vitamin E (alpha-tocopherol). Fisheries & Aquatic Life, 24(1), 47-52.

Murib S., Najoan M., Bagau B dan Untung IM. (2016). Pengaruh substitusi dedak halus dengan tepung kulit kopi dalam ransum terhadap performa broiler. Jurnal Zootek. 36(1): 218-225.

Nuraisah ASR., Andriani Y dan Liviawaty E. (2013). Penggunaan kulit kopi hasil fermentasi jamur Aspergillus niger pada pakan terhadap laju pertumbuhan benih ikan nila (*Oreochromis niloticus*). Jurnal Perikanan dan Kelautan. 4(3): 21-34.

NRC. (1993). Nutrient Requirement of Warm Water Fishes and Shelfish. Nutritional Academy of Sciences, Washington D.C. 102 p.

Putri FS., Hasan Z dan Haetami, K. (2012). Pengaruh pemberian bakteri probiotik pada pelet yang mengandung kaliandra (*Calliandra calothyrsus*) terhadap pertumbuhan benih ikan nila (*Oreochromis niloticus*). Jurnal Perikanan dan Kelautan. 3(4): 283-291.

Rahimnejad S, Choi J, Lee SM. (2015). Evaluation of coffee ground as a feedstuff inpractical diets for olive flounder (*Paralichthys olivaceus*). Fish. Aquat. Sci.18(3):257–264.

Siddik, M. A., Julien, B. B., Islam, S. M., & Francis, D. S. (2024). Fermentation in aquafeed processing: Achieving sustainability in feeds for global aquaculture production. Reviews in Aquaculture.

Standar Nasional Indonesia. (2002). Produksi benih ikan patin siam (*Pangasius hypopthalmus*) kelas benih sebar. No 01-6483.4-2002. Badan Standarisasi Nasional. Jakarta.

Standar Nasional Indonesia. (2000). Produksi kelas pembesaran di kolam ikan patin siam (*Pangasius hypothalmus*). No 01-6483.5-2000. Badan Standarisasi Nasional. Jakarta.

Standar Nasional Indonesia. (2009). Ikan djambal- bagian 5: kelas pembesaran di kolam. No 7471.5:2009. Badan Standarisasi Nasional. Jakarta.

Suprayudi MA, Faisal B, Setiawati M. (2014). The growth of red tilapia fed on organic-selenium supplemented diet. Jurnal Akuakultur Indonesia. 12(1): 48–53. https://doi.org/10.19027/jai.12.48-53

Tanbiyaskur, Lopez, J.P., Taqwa, F. H., Afriansyah, A., & Dwinanti, S, H. (2024). Pemanfaatan minyak cengkeh sebagai bahan anestesi untuk transportasi ikan tambakan (*Helostoma temminckii*). Jurnal Riset Akuakultur, *19*(2), 97-107.

Watanabe T. (1988). Fish nutrition and mariculture. The General Aquaculture Course, Department of Agriculture Bioscience, Tokyo University of Fisheries, Japan, 233 p

Warasto., Yulisman dan Fitrani M. 2013. Tepung kiambang (*Salvinia molesta*) terfermentasi sebagai bahan pakan ikan nila (*Oreochromis niloticus*). Jurnal Akuakultur Rawa Indonesia. 1(2): 173-183.

Winedar HS., Listiyawati dan Sutarno. (2006). Daya cerna protein pakan, daging dan

pISSN 2550-0910; eISSN 2579-4817
Available online at https://e-journal.unair.ac.id/JoAS

pertambahan berat badan ayam broiler setelah pemberian pakan yang di fermentasi dengan *Effective Microorganism* (EM4). Bioteknologi., 3(1): 14- 19.

Van Doan H, Lumsangkul C, Hoseinifar SH, Harikrishnan R, Balasundaram C, Jaturasitha S. (2021). Effects of coffee silverskin on growth performance, immune response, and disease resistance of Nile tilapia culture under biofloc system. Aquaculture. 543 (2021) 736995.

Van Doan H, Lumsangkul C, Hoseinifar SH, Jaturasitha S, Tran HQ, Chanbang Y, Ringø E, Stejskal V. (2022). Influences of spent coffee grounds on skin mucosal and serum immunities, disease resistance, and growth rate of Nile tilapia (Oreochromis niloticus) reared under biofloc system. Fish Shellfish Immunol. 120(July 2021):67–74.

Yafetto, L., Odamtten, G. T., & Wiafe-Kwagyan, M. (2023). Valorization of agro-industrial wastes into animal feed through microbial fermentation: A review of the global and Ghanaian case. Heliyon, *9*(4), e14814. https://doi.org/10.1016/j.heliyon.2023.e14814

Zannat, M. M., Hossain, F., Rahman, U. O., Rohani, M. F., & Shahjahan, M. (2023). An overview of climate-driven stress responses in striped catfish (*Pangasianodon hypophthalmus*)–prospects in aquaculture. Asian Journal of Medical and Biological Research, *9*(3), 70-88.

Zehra, S., & Khan, M. A. (2016). Dietary threonine requirement of fingerling Indian major carp, Catla catla (Hamilton) estimated by growth, protein retention efficiency, threonine deposition, haematological parameters and carcass composition. Aquaculture Research, *47*(1), 253–265. https://doi.org/10.1111/are.12487

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