Journal of Aquaculture and Fish Health Vol. 13(2) - June 2024
P-ISSN: 2301-7309 / E-ISSN: 2528-0864
doi : 10.20473/jafh.v13i2.48826

Utilization of Nipa Leaves Meal (*Nypa fruticans* Wurmb) as a Substitute for Rice Bran of Striped Catfish Feed (*Pangasius hypophthalmus*

Retno Cahya Mukti[1], Mohamad Amin[1*], Yulisman[1], Tanbiyaskur[1], Melia Intan Sari[1] and Su Nyun Pau Suriyanti[2]

[1]Program Study of Aquaculture, Faculty of Agriculture, Universitas Sriwijaya, Jl. Al Gazali Mosque, Bukit Lama, Kec. Ilir Bar. I, Palembang City, South Sumatra 30128, Indonesia

[2]Department of Earth Sciences and Environment, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, Bangi 43600, Malaysia

*Correspondence :
mohamadamin@fp.unsri.ac.id

Received : 2023-08-18
Accepted : 2024-05-13

Keywords :
Striped catfish, Nipa leaves, Rice bran

Abstract

Feed is one of the important components of aquaculture. This study aims to determine the effect of using nipa leaves meal to replace rice bran in feed formulations and to examine the best percentage of nipa leaves meal on the growth and survival of striped catfish. This study used a completely randomized design (CRD) which consisted of 5 treatments (P) with three replications, namely P0 (0% nipa leaves meal: 20% rice bran), P1 (5% nipa leaves meal: 15% rice bran), P2 (10% nipa leaves meal: 10% rice bran), P3 (15% nipa leaves meal: 5% rice bran), and P4 (20% nipa leaves meal: 0% rice bran). The size of fish used in this study was 4±0.5 cm with a stocking density of 1 fish/L. The rearing of the study was 42 days. Research results show that using nipa leaves meal as a substitute for rice bran significantly affects the growth of absolute weight, absolute length, feed efficiency, and protein efficiency ratio. Research results show that the treatment with a percentage of 20% nipa leaves meal: 0% rice bran is the best result with absolute weight growth (2.70 g), absolute length growth (3.35 cm), feed efficiency (85.88%), protein efficiency ratio (2.66%), and survival (100%). Water quality obtained during rearing is temperature 25.2–31.2°C, pH 6.9–8.7, and dissolved oxygen (DO) 5–6.1 mg/L.

INTRODUCTION

Indonesia is a driving force in the aquaculture sector. Aquaculture production increased from 2.4 million tonnes in 2010 to 6.4 million tonnes in 2019. Based on data from the Ministry of Maritime Affairs and Fisheries, Republic of Indonesia (2020), the average growth in aquaculture production in Indonesia was 16% per year during 2000-2019. One of the important commodities in freshwater fisheries is striped catfish (*Pangasius hypophthalmus*). Striped catfish is a freshwater fish in great demand by the people of Indonesia. This is shown by the high value of striped catfish production in 2020, which is 426.475 tons (Ministry of Marine and Fisheries Affairs, Republic of Indonesia, 2020).

Cite this document as Mukti, R.C., Amin, M., Yulisman, Tanbiyaskur, Sari, M.I. and Suriyanti, S.N.P., 2024. Utilization of Nipa Leaves Meal (*Nypa fruticans* Wurmb) as a Substitute for Rice Bran of Striped Catfish Feed (*Pangasius hypophthalmus*). *Journal of Aquaculture and Fish Health*, *13*(2), pp.293-301.

Therefore, striped catfish farming still has enough potential to be developed. In cultivation, one of the things that must be considered is feed. One of the fish feed ingredients that can be used is rice bran. The availability of rice bran in Indonesia still depends on the harvest season, namely the rainy season, from November to March. Although outside the harvest season, the availability of rice bran is still there, the amount is small, and the price is more expensive. Therefore, it is necessary to use alternative ingredients to reduce production costs originating from feed ingredients (Mukti *et al*., 2021). One of the ingredients that can be used as a substitute for rice bran is nipa leaves. Nipa (*Nypa fructicans* Wurmb.) is a wild plant that grows in mangrove forests along lowland and coastal areas (Theerawitaya *et al*., 2014; Tomlinson, 2016). Nipa plants normally grow in areas where the river and seawater meet. Nipa grows well in brackish environments near mangrove forests (Rozainah and Aslezaeim, 2010).

Nipa originated in Asia and spread to Europe, Africa, and the Americas (Dransfield *et al*., 2008). The nipa plant is widely distributed in South Asia, Southeast Asia, and Oceania (Tsuji *et al*., 2011). Indonesia's largest natural Nipa forest area is estimated to be approximately 700.000 ha. Afdal *et al*. (2020) morphologically, the Nipa plant looks similar to the oil palm or coconut tree, having long fronds with sticky leaves. Nipa does not have a visible stem above the ground; instead, it possesses an underground stem named a rhizome. Almost all parts of the Nipa plant can be used (Hermanto *et al*., 2020). Nipa leaves contain nutrients, namely carbohydrates (Nitrogen-Free Extract 49.99% and crude fiber 20.58%), protein 14.23%, lipid 2.44%, and ash content 12.88% (Mukti *et al*., 2020).

The high carbohydrate content in nipa leaves causes nipa leaves to be used as a carbohydrate source to replace rice bran in fish feed. The nutritional content in nipa leaves causes nipa leaves meal to replace rice bran, which is not much different. Rice bran meal is one source of carbohydrates in fish feed because it contains high carbohydrates, namely 28.62%. In addition, rice bran also contains 12.0% protein, 12.1% lipid, 10.5% ash content, and 26.46% crude fiber (Mathius and Sinurat, 2001).

Rice bran meal has been used as a fish feed ingredient. Liti *et al*. (2006) reported that using rice bran meal in feed resulted in tilapia growth of 0.42 g/day. Abidin *et al*. (2015) reported that using 30% rice bran in feed formulation results in catfish growth of 1.4%/day. According to Hien *et al*. (2020), rice bran meal can be used as snakehead fish feed at a dose of 30%. However, research has not been conducted on using nipa leaves as a striped catfish feed ingredient. Therefore, it is necessary to research the use of nipa leaves meal as a substitute for rice bran in the formulation of striped catfish. This study aimed to determine the percentage of nipa leaf meal as a substitute for rice bran in feed formulations on the growth and survival of catfish. The results of this study are expected to show that nipa leaves meal can be used as a substitute for rice bran in striped catfish feed formulations.

METHODOLOGY

Ethical Approval

Not applicable.

Place and Time

This research was conducted at the Aquaculture Laboratories and Experimental Ponds, Aquaculture Study Program, Faculty of Agriculture, Sriwijaya University. This research was conducted in March – April 2022.

Research Materials

The materials used in this study were striped catfish with a size of 4±0.5 cm, a fish meal with a protein content of 62.65%, soybean meal with a protein content of 37%, nipa leaves meal with a protein content of 14%, with a protein content of 0.5%, rice bran with a protein content of 13%, fish oil, corn oil, premix, fish oil, and water. Striped catfish were obtained from fish farmers in Ogan Ilir, South Sumatra, and nipa leaves

Cite this document Mukti, R.C., Amin, M., Yulisman, Tanbiyaskur, Sari, M.I. and Suriyanti, S.N.P., 2024. Utilization of Nipa Leaves Meal (*Nypa fruticans* Wurmb) as a Substitute for Rice Bran of Striped Catfish Feed (*Pangasius hypophthalmus*). *Journal of Aquaculture and Fish Health*, *13*(2), pp.293-301.

were obtained from Pulau Rimau District, Banyuasin, South Sumatra, and other feed ingredients such as fish meal, soybean meal, and rice bran were obtained from Bogor, West Java.

The tools used in this study were an aquarium measuring 30x30x30 cm, a pH meter (ATC digital tester®) with an accuracy of 0.1 pH units, thermometer (Oxygen meter®) with an accuracy of 0.1°C, DO meter (Oxygen meter®) with an accuracy of 0.01 mg/L, spectrophotometer (Thermo scientific Genesys 150®) (Oxygen meter®) with an accuracy of 0.001mg/L, UV-VIS spectrophotometer (Unico®) with a wavelength of 200-750 nm, a digital scale (Mini Digital Platform Scale I-2000®) with an accuracy of 0.01 g, centrifuge (Backman coulter®) with speed control ±50 rpm, measuring cup with an accuracy 1 mL, blender (Miyako BL-152 GF®) with a capacity 1,5 L, sieve with size 40-60 mesh, basin with volume 10 L, pellet machine (Mincer Manual VIPOO-A12®) with a capacity of 5 kg, aerator (Amara®), and oven (Memret®) with maximum temperature ±70°C.

Research Design

This study used a Completely Randomized Design (CRD) consisting of 5 treatments with three replications. The treatment given was the percentage of the combination of nipa leaves meal and rice bran in the formulation for striped catfish. The formulation and proximate results of the feed used are presented in Table 1.

Table 1. Formulation and proximate results of the feed used.

Ingredients	Treatments (%)				
	P0	P1	P2	P3	P4
Nipa leaves meal	0	5	10	15	20
Rice Bran	20	15	10	5	0
Soy Bean meal	30	30	30	30	30
Fish meal	38	38	38	38	38
Tapioca meal	7	7	7	7	7
Vitamin mix	2	2	2	2	2
Fish oil	3	3	3	3	3
Total (%)	100	100	100	100	100
Protein (%)	30.75	31.10	31.58	31.70	32.23
Lipid (%)	11.11	10.50	10.20	9.98	9.50
Nitrogen-Free Extract (NFE) (%)	28.38	28.54	29.54	30.73	32.16
Ash (%)	9.90	10.78	10.38	10.15	9.43
Crude fiber (%)	10.85	10.79	10.47	9.68	8.95
Water content (%)	9.00	8.29	7.83	7.76	7.73
GE* (Kcal/100 g)	392.99	389.87	393.84	397.32	401.64
GE/P*(Kcal/g protein)	12,78	12.53	12.47	12.53	12.46

Note: *Gross energy (GE) calculated based on; protein 5.6 kcal/g, lipid 9.4 kcal/g, NFE 4.1 kcal/g (NRC, 2011).

Work Procedure

Nipa Leaves Meal Preparation

Nipa leaves were obtained from the sub-district Pulau Rimau, district Banyuasin, South Sumatra. The leaves used are dark green leaves. The middle part of the nipa leaves is removed and then washed thoroughly and dried in the sun to dry completely for seven days (pre-study results). The dried leaves are then mashed using a blender until they become a meal and sieve.

Feed Manufacture

The feed raw materials used are weighted according to the feed formulation. The raw materials with the least amount are mixed first, followed by many ingredients (Mukti *et al*., 2019). The raw materials are given warm water evenly until it is smooth in

Cite this document Mukti, R.C., Amin, M., Yulisman, Tanbiyaskur, Sari, M.I. and Suriyanti, S.N.P., 2024. Utilization of Nipa Leaves Meal (*Nypa fruticans* Wurmb) as a Substitute for Rice Bran of Striped Catfish Feed (*Pangasius hypophthalmus*). *Journal of Aquaculture and Fish Health*, *13*(2), pp.293-301.

the basin. The smooth materials are then printed into a pellet printer and dried in the sun until completely dry. Determine the nutritional content contained in the feed.

Media Preparation

The striped catfish-rearing container used is an aquarium that has been cleaned before and disinfected using potassium permanganate at a dose of 2 mg/L for 24 hours (Rejeki *et al*., 2018). Then, the aquarium is rinsed and dried. After the aquarium is clean, it is filled with 20 L of water with a water height of 23 cm. Then, an aerator is installed in each aquarium and left for 24 hours. The top of the aquarium is given a net or cover to avoid the entry of predators. Each aquarium was assigned a treatment code at random.

Fish Rearing

The striped catfish seeds used were 4±0.5 cm in size. The fish were acclimatized for three days to adjust to the new environment and adapted to the feed for seven days. Then, the fish were weighed and measured, and their body length was used as initial data. Each aquarium was filled with striped catfish fry with a stocking density of 1 fish/L (Darmawan *et al*., 2016). The rearing of the test fish was carried out for 42 days. During rearing, fish are fed thrice daily at 08.00, 12.00, and 16.00 WIB at satiation (Yespus *et al*., 2018).

Fish sampling was carried out at the beginning and the end of rearing. Fish that died during rearing were weighed. Siphon is carried out every three days, and water is added according to the volume of wasted water. Water quality is temperature measured using a thermometer, pH is measured using a pH meter, and dissolved oxygen (DO) is measured using a DO meter. Temperature and pH were measured every morning and evening during rearing. Meanwhile, DO was measured at the beginning of rearing, day 10, day 20, day 30, and day 42.

Parameters

Absolute Length Growth

The absolute length growth of striped catfish is calculated using the formula:

$L = L0 - Lt$

Information:

L : Growth in absolute length (cm)
Lt : Fish length at the end of rearing (cm)
L0 : Fish length at the beginning of rearing (cm)

Absolute Weight Growth

The absolute weight growth of striped catfish is calculated using the formula:

$W = W0 - Wt$

Information:

W : Absolute weight growth (g)
Wt : Fish weight at the end of rearing (g)
W0 : Fish weight at the beginning of rearing (g)

Feed Efficiency

Feed efficiency is calculated using the formula according to NRC (2011):

$$FE = \frac{(Wt + D) - Wo}{f} x100$$

Information:

FE : Feed efficiency (%)
Wt : Fish biomass at the end of rearing (g)
W0 : Fish biomass at the beginning of rearing (g)
D : Dead fish biomass during rearing (g)
F : Feed consumed (g)

Protein Efficiency Ratio

Calculation of protein efficiency ratio (PER) using the formula:

$$\text{Protein efficiency ratio} = \frac{Wt - Wo}{Pi}$$

Information:

Wt : Fish biomass at the end of rearing (g)
W0 : Fish biomass at the start of rearing (g)
Pi : Weight of feed protein consumed (g)

Survival

The survival of striped catfish is calculated using the formula:

$$\text{Survival}(\%) = \frac{Nt}{No} x\ 100$$

Information:

Nt : Number of live fish at the end of rearing (fish)
N0 : Number of fish at the beginning of rearing (fish)

Cite this document Mukti, R.C., Amin, M., Yulisman, Tanbiyaskur, Sari, M.I. and Suriyanti, S.N.P., 2024. Utilization of Nipa Leaves Meal (*Nypa fruticans* Wurmb) as a Substitute for Rice Bran of Striped Catfish Feed (*Pangasius hypophthalmus*). *Journal of Aquaculture and Fish Health*, *13*(2), pp.293-301.

DOI : 10.20473/jafh.v13i2.48826

Water Quality

The water quality of the striped striped catfish rearing media measured included temperature, dissolved oxygen (DO), pH, and ammonia. Temperature (ºC) was measured daily, and dissolved oxygen (mg/L), and pH were measured once every ten days. Ammonia was measured at the beginning and end of rearing.

Data Analysis

Data growth, feed efficiency, protein efficiency ratio, and survival of striped catfish obtained were analyzed statistically using analysis of variance. If it is significantly different, the Least Significant Difference Test (LSD) will be continued with a 95% confidence interval. Data on the physical quality of feed and water quality in temperature, pH, and DO were analyzed descriptively.

RESULTS AND DISCUSSIONS

Growth, Feed Efficiency, and Protein Efficiency Ratio

Data on the growth, feed efficiency, and protein efficiency ratio of striped catfish during rearing are listed in Table 2.

Table 2. Data on striped catfish's growth, feed efficiency (FE), and protein efficiency ratio (PER).

Treatments	Absolute Growth		FE (%) LSD (α 0.05 = 5.92)	PER LSD(α 0.05 = 0.19)
	Weight (g) LSD (α 0.05 = 0.16)	Long (cm) LSD (α 0.05 = 0.18)		
P0	1.16 ± 0.04^{a}	2.00 ± 0.10^{a}	61.91 ± 3.02^{a}	2.02 ± 0.09^{a}
P1	1.43 ± 0.12^{b}	2.29 ± 0.11^{b}	70.59 ± 5.40^{b}	2.27 ± 0.17^{b}
P2	1.69 ± 0.05^{c}	2.43 ± 0.10^{b}	76.07 ± 1.32^{bc}	2.41 ± 0.04^{bc}
P3	1.92 ± 0.10^{d}	2.81 ± 0.05^{c}	80.94 ± 3.01^{cd}	2.55 ± 0.09^{cd}
P4	2.70 ± 0.10^{e}	3.35 ± 0.11^{d}	85.88 ± 1.97^{d}	2.66 ± 0.06^{d}

Note: Different superscripts in the same column show significant differences ($p < 0.05$).

Table 2 shows that using nipa leaves meal as a substitute for rice bran with different percentages significantly affects the growth of absolute weight, absolute length, feed efficiency, and protein efficiency ratio. The Least Significant Difference Test (LSD) showed that the growth of absolute weight, length, feed efficiency, and protein efficiency ratio in P4 was significantly higher than in other treatments.

Protein functions to replace damaged tissue and form new tissue (Hidayat *et al.*, 2013). Based on the research results, the highest growth of striped catfish is in the P4 treatment, with a 20% nipa leaves meal percentage compared to 0% rice bran. This is because the P4 protein content was higher than in other treatments. It is suspected that 32.23% (P4) feed protein is the best protein for striped catfish growth. This is in accordance with the research of Suhenda *et al.* (2005), which reported that the growth of striped catfish fry fed with a different protein content of 30%, 35%, and 40%, the best weight growth results in protein content of 35% (3.82±0.15 g).

Protein is an organic compound composed of amino acids. Dietary amino acids are needed for growth and maintenance (Cowey, 1994). The P4 treatment resulted in high fish growth, presumably because the amino acid content in nipa leaf meal was higher than the amino acids in rice bran flour. The higher the percentage of nipa leaves, the higher the catfish growth. This is in accordance with the NRC (2011), which states that the completeness and adequacy of amino acids can influence fish growth.

Nipa leaves also contain flavonoids, phenolics, anthocyanins, and carotenoids. These compounds are active compounds that function as antioxidants (Gazali *et al.*, 2019). Flavonoids are phenolic compounds in secondary compounds that stimulate the immune system, increase the immune system, and increase appetite in fish. The

Cite this document Mukti, R.C., Amin, M., Yulisman, Tanbiyaskur, Sari, M.I. and Suriyanti, S.N.P., 2024. Utilization of Nipa Leaves Meal (*Nypa fruticans* Wurmb) as a Substitute for Rice Bran of Striped Catfish Feed (*Pangasius hypophthalmus*). *Journal of Aquaculture and Fish Health*, *13*(2), pp.293-301.

antioxidant content in feed can protect body cells from free radicals, where these free radicals can be bacteria that inhibit fish growth and survival. Growth will also be seen from the value of feed efficiency.

Growth is directly proportional to the feed consumed, and the feed efficiency value is obtained. The growth rate will also be more significant if the feed efficiency value is higher. P4 has the highest feed efficiency value. This is also suspected of causing higher P4 growth. The value of striped catfish feed efficiency obtained for P4 treatment was higher than the results of the study of Kurniawan *et al.* (2020), which resulted in the highest efficiency of striped catfish feed, namely 82.93% given to pellets that were given herbal supplements at a dose of 200 mL/kg. In addition to feed efficiency, a factor affecting growth is the protein efficiency ratio.

The low value of the protein efficiency ratio in treatment P0 was thought to be because, in this treatment, the feed consumed by fish had a lower protein content than in treatments P1, P2, P3, and P4. The higher the protein content digested by the fish, the higher the growth will be. The efficiency of feed protein consumed by fish for growth can be seen using the protein itself. This study showed that the lowest protein was found in treatment P0, 30.75%, and the highest was in treatment P4, 32.23% (Table 1). If referring to the research of Ananda *et al.* (2015), striped catfish fed artificial feed with a protein content of 31% resulted in the highest feed protein efficiency ratio of 1.68±0.04%. Hence, all treatments from this study had higher numbers. Using nipa leaves meal as a substitute for rice bran significantly affects the protein efficiency ratio for striped catfish.

Survival

Data survival rates of striped catfish are presented in Table 3.

Table 3. Survival rate (SR) of striped catfish during rearing.

Treatments	SR (%)
P0	100
P1	100
P2	100
P3	100
P4	100

Based on Table 3, it can be seen that the survival rate of striped catfish is the same, namely 100%. The Least Significant Difference Test (LSD) showed that all treatments were not significantly different. This means that striped catfish have a high tolerance for feed and the environment. According to Baßmann *et al.* (2017), striped catfish are classified as fish with a high tolerance for environmental and water conditions. Therefore, the survival value of striped catfish in all treatments was considered very good. The use of nipa leaves meal as a substitute for rice bran did not significantly affect the survival of striped catfish.

Water Quality

The water quality of striped catfish rearing is presented in Table 4.

Table 4. Water quality for striped catfish rearing.

Treatments	Temperature (°C)	pH	Dissolved Oxygen (mg/L)
P0	25.2–31.2	6.9–8.7	5–6.1
P1	25.3–31.0	6.9–8.7	5–6
P2	25.3–31.1	6.9–8.7	5–6
P3	25.2–31.2	6.9–8.7	5.1–6

Cite this document Mukti, R.C., Amin, M., Yulisman, Tanbiyaskur, Sari, M.I. and Suriyanti, S.N.P., 2024. Utilization of Nipa Leaves Meal (*Nypa fruticans* Wurmb) as a Substitute for Rice Bran of Striped Catfish Feed (*Pangasius hypophthalmus*). *Journal of Aquaculture and Fish Health*, *13*(2), pp.293-301.

P4	25.2–31.2	6.9–8.6	5-6

The water quality of striped catfish rearing follows the life needs of striped catfish; namely, the temperature ranges from 25.2 to 31.2°C, the pH of the water ranges from 6.9 to 8.7, and the dissolved oxygen content in the water ranges from 5 to 6.1 mg/L. According to Minggawati and Saptono (2012), the optimal temperature range for striped catfish is 25–32°C. Temperatures that are too high and too low cause low growth in fish. According to Rohim *et al.* (2022), the pH range of water for striped catfish is 6.5–9.0. Dissolved oxygen (DO) is 3–7 mg/L. The range of water quality during rearing is within the normal range, which is one of the factors for the high survival of striped catfish. Prasetio *et al*. (2019) also added that using nipa leaf extract to prevent infection with *Aeromonas hydrophila* bacteria in tengadak fish obtained water quality values with a temperature range of 26.00-26.33°C, pH 6.22-6.67, and DO 4.93-4.97 mg/L.

CONCLUSION

Using nipa leaves meal as a substitute for rice bran with different percentages significantly affected the growth of absolute weight and length, feed efficiency, and protein efficiency ratio to striped catfish. However, it has no significant effect on the survival of striped catfish. The best treatment in this study was nipa leaves meal, with a percentage of 20% compared to 0% rice bran (P4).

CONFLICT OF INTEREST

The authors declare there is no conflict of interest.

AUTHOR CONTRIBUTION

The contribution of each author is as follows: Retno Cahya Mukti participated in the conception and experimental design; Mohamad Amin drafted and manuscript preparation; Meilia Intan Sari collected and analyzed data; Yulisman and Tanbiyaskur revised the manuscript.

ACKNOWLEDGMENT

Thanks to the Research and Community Service Institute at Sriwijaya University with grant number 0110/UN9.3.1/SK/2022 and all parties who have assisted in this research.

REFERENCES

Abidin, Z., Junaidi, M., Cokrowati, N. and Yuniarti, S., 2015. The growth and feed consumption of walking catfish fed diets with local ingredients. *Depik Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan*, *4*(1), pp.33-39. https://doi.org/10.13170/depik.1.1.2360

Afdal, M., Kaswari, T., Fakhri, S. and Suryani, H., 2020. The physical and chemical properties of nipah (Nypa fructicans) frond as an alternative feed for ruminants in Indonesia. *Biodiversitas Journal of Biological Diversity*, *21*(10), pp.4714-4718. https://doi.org/10.13057/biodiv/d211034

Ananda, T., Rachmawati, D. and Samidjan, I., 2015. Effect of papain in artificial feed on growth of catfish (*Pangasius hypopthalmus*). *Journal of Aquaculture Management and Technology*, *4*(1), pp.51-52. https://ejournal3.undip.ac.id/index.php/jamt/article/view/7964

Baßmann, B., Brenner, M. and Palm, H.W., 2017. Stress and welfare of African catfish (*Clarias gariepinus* Burchell, 1822) in a coupled aquaponic system. *Water*, *9*(7), 504. https://doi.org/10.3390/w9070504

Cowey, C.B., 1994. Amino acid requirements of fish: a critical appraisal of present values. *Aquaculture*, *124*(1-4), pp.1-11. https://doi.org/10.1016/0044-8486(94)90349-2

Darmawan, J., Tahapari, E. and Pamungkas, W., 2016. Seed

Cite this document Mukti, R.C., Amin, M., Yulisman, Tanbiyaskur, Sari, M.I. and Suriyanti, S.N.P., 2024. Utilization of Nipa Leaves Meal (*Nypa fruticans* Wurmb) as a Substitute for Rice Bran of Striped Catfish Feed (*Pangasius hypophthalmus*). *Journal of Aquaculture and Fish Health*, *13*(2), pp.293-301.

performance of striped catfish *Pangasianodon hypophthalmus* Sauvage, 1878 and pasupati (*Pangasius* sp.) with different stocking density on the nursery recirculation system. *Jurnal Iktiologi Indonesia, 16*(3), pp.243-250. https://doi.org/10.32491/jii.v16i3.23

Dransfield, J., Uhl, N.W., Asmussen, C.B., Baker, W.J., Harley, M.M. and Lewis, C.E., 2008. *Genera Palmarum: The Evolution and Classification of Palms*. Royal Botanic Gardens, Kew. p.732.

Gazali, M., Nufus, H., Nurjannah and Zuriat, 2019. The exploration potency of bioactive compounds of leaves extract nipah (*Nypa fruticans* Wurmb) from the coast of west aceh as antioxidant. *Jurnal Pengolahan Hasil Perikanan Indonesia, 22*(1), pp.155-157. https://doi.org/10.17844/jphpi.v22i1.25892

Hermanto, H., Mukti, R.C. and Pangawikan, A.D., 2020. Nipah (*Nypa fruticans* Wurmb.) fruit as a potential natural antioxidant source. *IOP Conference Series: Earth and Environmental Science, 443*, 012096. https://doi.org/10.1088/1755-1315/443/1/012096

Hidayat, D., Sasanti, A.D. and Yulisman, 2013. Survival rate, growth and feed efficiency of snake head (*Channa striata*) was feid by golden apple snail (*Pomaecea* sp.) flour. *Jurnal Akuakultur Rawa Indonesia, 1*(2), pp.167-168. http://dx.doi.org/10.36706/jari.v1i2.1736

Hien, T.T.T., Be, T.T., Lee, C.M. and Bengtson, D.A., 2015. Development of formulated diets for snakehead (*Channa striata* and *Channa micropeltes*): can phytase and taurine supplementation increase use of soybean meal to replace fish meal/ soybean meal diet. *Aquaculture*, *448*, pp.334-340. https://doi.org/10.1016/j.aquaculture.2015.06.020

Kurniawan, R., Syawal, H. and Effendi, I., 2020. Effectiveness of herbal supply addition in pellet on growth and survival rate of striped catfish (*Pangasius hypophthalmus*). *Jurnal Ruaya*, *8*(1), pp.72-75. http://dx.doi.org/10.29406/jr.v8i1.1613

Liti, D.M., Mugo, R.M., Munguti, J.M. and Waidbacher, H., 2006. Growth and economic performance of Nile tilapia (*Oreochromis niloticus* L.) fed on three brans (maize, wheat and rice) in fertilized ponds. *Aquaculture Nutrition*, *12*(3), pp.239-245. https://doi.org/10.1111/j.1365-2095.2006.00397.x

Mathius, I.W. and Sinurat, A.P., 2001. Utilization of inconventional feedstuffs for animal production. *WARTAZOA. Indonesian Bulletin of Animal and Veterinary Science*, *11*(2), pp.21-28. https://doi.org/10.14334/wartazoa.v11i2.754

Minggawati, I. and Saptono, 2012. Water quality parameters for cage culture of patin fish (*Pangasius pangasius*) in the Kahayan River, Palangka Raya City. *Jurnal Ilmu Hewani Tropika*, *1*(1), pp.28-29. https://unkripjournal.com/index.php/JIHT/article/view/12

Ministry of Marine Affairs and Fisheries Replubic of Indonesia, 2020. *Revision of Strategic Plan of Ministry of Marine Affairs and Fisheries Year 2020-2024.*

Mukti, R.C., Amin, M. and Yulisman, 2021. Utilization of alternative ingredients as combination feed on the growth of catfish (*Clarias* sp.). *IOP Conference Series: Earth and Environmental Science, 819*, 012005. https://doi.org/10.1088/1755-1315/819/1/012005

Mukti, R.C., Yonarta, D. and Pangawikan, A.D., 2019. The use of *Indigofera zollingeriana* leaves as feed ingredient

Cite this document Mukti, R.C., Amin, M., Yulisman, Tanbiyaskur, Sari, M.I. and Suriyanti, S.N.P., 2024. Utilization of Nipa Leaves Meal (*Nypa fruticans* Wurmb) as a Substitute for Rice Bran of Striped Catfish Feed (*Pangasius hypophthalmus*). *Journal of Aquaculture and Fish Health*, *13*(2), pp.293-301.

of patin (*Pangasius* sp.). *DEPIK Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan*, *8*(1), pp.18-25. http://dx.doi.org/10.13170/depik.8.1.13056

Mukti, R. C., Amin, M. and Sari, M.I., 2020. Nutrition content and antioxidant activities of nipah leaves (*Nypa fruticans* Wurmb) as aquafeed. *Media Akuatika*, *5*(3), pp.106-114. https://ojs.uho.ac.id/index.php/JMA/article/view/13247

NRC (National Research Council), 2011. *Nutrient Requirements of Fish and Shrimp*. The Nasional Academies Press., Washington, DC.

Prasetio, E., Hastiadi, H. and Zainuddin, S.M., 2019. The effect of nipah (*Nypa frutican*) leaves exstract as an immunostimulan on the pathogenicity of tengadak fish (*Barbonymus schwanenfeldii*) in Aeromonas bacterial infections. *Jurnal Borneo Akuatika*, *1*(2), pp.111-112. http://dx.doi.org/10.29406/jba.v1i2.1831

Rejeki, M.S., Sasanti, A.D. and Taqwa, F.H., 2018. Utilization of *Leucas lavandulaefolia* powder to treat of aeromonas hydrophila infection for catfish (*Pangasius* sp.). *Jurnal Akuakultur Rawa Indonesia*, *6*(2), pp.167-168. https://doi.org/10.36706/jari.v6i2.7160

Rohim, A.M., Cahyono, E. and Iswari, R.S., 2022. Development of tools growth catfish based on the Internet of Things (IoT). *Physics Education Research Journal*, *4*(2), pp.51-56. https://doi.org/10.21580/perj.2022.4.2.12178

Rozainah, M.Z. and Aslezaeim, N., 2010. A demographic study of a mangrove palm, *Nypa fruticans*. *Scientific Research Essays*, *5*(24), pp.3896-3902. http://eprints.um.edu.my/id/eprint/11669

Suhenda, N., Setijaningsih, L. and Suryanti, Y., 2005. The Growth of Pangasius djambal Fingerlings Fed with Different Dietary Protein Levels. *Berita Biologi*, *7*(4), pp.194-195. http://dx.doi.org/10.14203/beritabiologi.v7i4.1048

Theerawitaya, C., Samphumphaung, T., Cha-um, S., Yamada, N. and Takabe, T., 2014. Responses of Nipa palm (*Nypa fruticans*) seedlings, a mangrove species, to salt stress in pot culture. *Flora - Morphology, Distribution, Functional Ecology of Plants*, *209*(10), pp.597-603. https://doi.org/10.1016/j.flora.2014.08.004

Tomlinson, P.B., 2016. *The Botany of Mangroves*. 2nd ed. Cambridge University Press, Cambridge, UK.

Tsuji, K., Sebastian, L.S., Ghazalli, M.N.F., Ariffin, Z., Nordin, M.S., Khaidizar, M.I. and Dulloo, M.E., 2011. Biological and ethnobotanical characteristics of nipa palm (*Nypa fructicans* Wurmb.): A review. *Sains Malaysiana*, *40*(12), pp.1407-1412. https://www.ukm.my/jsm/english_journals/vol40num12_2011/vol40num12_2011pg1407-1412.html

Yespus, Amin, M. and Yulisman, 2018. The effect of substitute bran with fermented coconut pulp flour on the growth and feed efficiency of catfish (*Pangasius* sp). *Jurnal Akuakultur Rawa Indonesia*, *6*(1), pp.65-76. https://doi.org/10.36706/jari.v6i1.7150

Cite this document Mukti, R.C., Amin, M., Yulisman, Tanbiyaskur, Sari, M.I. and Suriyanti, S.N.P., 2024. Utilization of Nipa Leaves Meal (*Nypa fruticans* Wurmb) as a Substitute for Rice Bran of Striped Catfish Feed (*Pangasius hypophthalmus*). *Journal of Aquaculture and Fish Health*, *13*(2), pp.293-301.