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The Use of Indigofera *Indigofera zollingeriana* (Miquel, 1855) Leaf Meal as Feed Raw Material for Growth of Hoven's Carp Fry *Leptobarbus hoevenii* (Bleeker, 1851)

Penggunaan Tepung Daun Indigofera Indigofera zollingeriana (Miquel, 1855) Sebagai Bahan Baku Pakan pada Pendederan Benih Ikan Jelawat Leptobarbus hoevenii (Bleeker, 1851)

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Abstract

Indigofera leaf meal can be used as an alternative raw material and has high potential as a source of vegetable protein for Hoven's carp fry to reduce the use of imported raw materials. The purpose of this study was to examine the effect of using indigofera leaf meal with different combinations of feed as feed raw materials on growth performance and survival of Hoven's carp (*Leptobarbus hoevenii*) fry. This study was carried out from July to August 2021 at the freshwater aquaculture center (BPBAT) Sungai Gelam Jambi. This study method used a completely randomized design (CRD) with 3 treatments and 3 replications, i.e: control (commercial feed 100%), treatment 1 (commercial feed 50%+ indigofera leaf meal 50%), and treatment 2 (indigofera leaf meal 100%). The data obtained were analyzed by Anova and further tested by Duncan's test. Based on the analysis of variance, the use of *Indigofera zollingeriana* leaf meal had a significant effect ($P<0.05$) on absolute weight growth, absolute length, specific growth rate, and feed conversion ratio, while survival rates were not significantly different ($P>0.05$). The results showed that the increasing proportion of the use of indigofera leaf meal experienced a decrease in the growth performance of Hoven's carp fry.

Keywords: Hoven's carp fry, Indigofera Leaf Meal, Commercial Feed, Growth

Abstrak

Tepung daun Indigofera dapat digunakan sebagai bahan baku alternatif dan berpotensi tinggi sebagai sumber protein nabati pada pakan benih ikan jelawat untuk menggurangi penggunaan bahan baku impor. Tujuan dari penelitian ini adalah mengkaji pengaruh penggunaan tepung daun indigofera dengan kombinasi pakan yang berbeda terhadap kinerja pertumbuhan dan kelangsungan hidup benih ikan jelawat (*Leptobarbus hoevenii*). Penelitian ini dilaksanakan pada bulan Juli sampai dengan Agustus 2021 di Balai Perikanan Budidaya Air Tawar (BPBAT) Sungai Gelam Jambi. Metode penelitian ini menggunakan Rancangan Acak Lengkap (RAL) dengan 3 perlakuan dan 3 ulangan, yaitu: kontrol (pakan komersil 100%), perlakuan 1 (pakan komersil 50% + tepung daun indigofera 50%) dan perlakuan 2 (tepung daun indigofera 100%). Data yang diperoleh dianalisis dengan sidik ragam dan diuji lanjut dengan uji Duncan. Berdasarkan analisis sidik

ragam penggunaan tepung daun *Indigofera zollingeriana* memberikan pengaruh yang berbeda nyata (P<0,05) terhadap pertumbuhan bobot mutlak, panjang mutlak, laju pertumbuhan spesifik, dan rasio konversi pakan, sedangkan tingkat kelangsungan hidup tidak berbeda nyata (P>0,05). Hasil penelitian menunjukkan bahwa semakin meningkatnya proporsi penggunaan tepung daun indigofera mengalami penurunan kinerja pertumbuhan benih ikan jelawat.

Kata Kunci: Benih Ikan Jelawat, Tepung Daun Indigofera, Pakan Komersil, Pertumbuhan

1. Introduction

Hoven's carp (*Leptobarbus hoevenii*) is one type of freshwater fish native to Indonesia spread in several Indonesian waters such as Sumatra and Kalimantan (Kottelat et al., 1993). Many Indonesian people like this fish as a consumption fish because it tastes good and savory (Santosa, 2019). According to Hardjamulia (1992), the high demand for hoven's carp, especially in neighboring countries such as Malaysia and Brunei Darussalam, makes hoven's carp one of the export commodities from Indonesia.

Hoven's carp has the potential to be developed intensively; this is because the market share of Hoven's carp is quite high. Where the price of Hoven's carp consumption size ranges from IDR 35,000-Rp 40,000/kg for the Jambi area (Sutisna et al., 2020). While in Pontianak the price of Hoven's carp can reach IDR 50,000-70,000/kg (Hambali et al., 2019). In aquaculture, feed is the main support for fish growth. According to Nurhayati & Nazlia (2019), feed contributes 60-70% to production costs. The high price of feed raw materials and also still relying on imported products such as fish meal and soybean meal make feed a major problem in fish farming activities (Kamaruddin & Makmur, 2004). Therefore, it is necessary to use local raw materials as alternative ingredients to replace fish meals and soybean meal flour. One of the local plants that can be used as alternative raw materials is the indigofera plant. Indigofera has the potential as an alternative raw material to replace fishmeal and soybean meal because the nutritional content is quite high (Palupi, 2015). According to Akbarillah et al. (2008), indigofera leaf flour contains crude protein 27%, fat 9.96%, and crude fiber 19.94%.

Based on research conducted by Pangentasari (2018), the use of indigofera leaf flour in Hoven's carp fry with a percentage of 20% can provide good growth performance. In Mulyono (2018) with a percentage of 50%, it can provide the best growth performance in Hoven's carp fry. Direct utilization of indigofera leaf flour as feed raw material has never been carried out on Hoven's carp. In addition, according to Kottelat et al. (1993) Hoven's carp fry belong to the omnivorous group but tend to be herbivores, so they can make good use of vegetable feed. The use of indigofera leaves as raw material for feed for fishing Hoven's carp fry is still lacking so it is important to study and it is expected that the use of indigofera leaf meal as feed raw material with different feed combinations in the fishing of Hoven's carp fry can provide growth performance and survival of Hoven's carp fry with effective and efficient production cost suppression.

2. Material and Method

2.1. Time and Place of Research

This research was carried out in July-August 2021 at the Freshwater Aquaculture Fisheries Center (BPBAT) Sungai Gelam, Sungai Gelam Hamlet, Muaro Jambi Regency, Jambi Province.

2.2. Research Method

This study used an experimental method with Complete Randomized Design (CRD) with 3 treatments and 3 repeats. The treatment in this study is:

P0 : 100% commercial feed control (38.86% protein)
P1 : Commercial feed 50% + indigofera leaf meal 50% (protein 31.86%)
P2 : 100% indigofera leaf meal (28.59% protein).

2.3. Procedure

2.3.1. Feed Manufacturing

The feed used is indigofera leaf flour made by BPBAT Sungai Gelam Jambi with a protein content of ±28%. Indigofera leaves that have been harvested are then dried in the sun until the moisture content decreases. After that, the indigofera leaves are separated from the stem and the branches are then mashed until they become flour. After that, it is sifted with a flour sieve and then weighed and proximate analysis tests are carried out to determine the nutritional content of the feed. Feed proximate analysis was carried out at the Test Laboratory of the Sukabumi Freshwater Aquaculture Center, the Testing Laboratory of the Jambi River Gelam Freshwater

Aquaculture Fisheries Center, and at the Nutrition and Animal Feed Laboratory, Department of Animal Husbandry, Faculty of Agriculture, University of Lampung.

2.3.2. Fish Treatment

The test fish used were fish fry from spawning at BPBAT Sungai Gelam Jambi aged 7 days measuring 7-9 mm with a stocking density of 13 fish/m^3 or 1,160 fish/aquarium. Before the fish are put in the maintenance container, acclimatization is carried out for approximately 15 minutes so that the fish do not experience stress. After that, habituation is carried out so that the fish can adapt to the new environment.

Feeding of Hoven's carp fry is carried out by *ad satiation* method with a frequency of feeding 3 times a day in the morning (08.00 AM), afternoon (1.00 PM), and evening (4.00 PM) with duration of maintenance for 30 days. Sampling of the growth of Hoven's carp fry is carried out at the beginning of maintenance then continued sampling every 7 days in the form of measuring the total weight and length of the fish.

2.3.3. Water Quality

Water quality measurements are carried out every day in the morning at 08.00 WIB and afternoon at 16.00 WIB which include temperature and pH. While DO measurements are carried out once a week.

2.4. Parameters

The parameters used in this study include absolute weight, absolute length, and specific growth rate (SGR), feed conversion ratio (FCR), and survival rate which are calculated by the following formula:

The absolute weight growth is calculated concerning Effendie (1997):

$$W=Wt-W0$$

Information:

W = Absolute weight growth (g)
Wt = Average weight at the end of the study (g)
W0 = Average weight at the start of the study (g)

The growth of absolute length is calculated by Effendie (1997):

$$L=Lt-L0$$

Information:

P = Growth in the absolute length of the fish kept (cm)
Lt = Length of fish at the end of rearing (cm)
L0 = Length of fish at the beginning of rearing (cm)

The specific growth rate (SGR) is calculated by Zonneveld et al. (1991):

$$SGR=\frac{LnWt - LnWo}{t} X\ 100\ \%$$

Information:

SGR = Specific growth rate (%/day)
Wt = Average weight of fish at the end of the study (g/fish)
Wo = Average weight of fish at the start of the study (g/fish)
t = Time (length of maintenance)

The feed conversion ratio is calculated by concerning Effendie (1997):

$$FCR=\frac{F}{(Wt-Wo)}$$

Information:

FCR = Feed conversion ratio
F = Amount of feed given
Wt = Final biomass of fish
Wo = Early biomass of fish.

Survival is calculated concerning the following Effendie (1997):

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

Information:

SR = Survival (%)
Nt = Number of final fish (fish)
No = Number of initial fish (fish)

2.5. Data Analysis

Data from various parameters were processed using analysis of variance (ANOVA) at a 95% confidence level using the SPSS application. If there is a real effect, Duncan's further test is carried out. Water quality parameter data are presented in tabular form and analyzed descriptively.

3. Result and Discussion

3.1. Nutritional Content of Test Feed

The test feed used in this study was proximately analyzed to determine the nutritional content in the form of protein content, crude fiber, fat, ash, and water content. The results of the proximate analysis of the test feed are shown in Table 1.

Table 1. Test Feed Proximate Analysis

Treatment	Nutrient content (%)				
	Water content	Ash content	Protein	Fat	fiber
P0 (100% commercial feed)	8,90	11,88	38,86	7,38	1,76
P1 (commercial feed 50% + TDI 50%)	9,05	10,64	31,86	10,05	5,68
P2 (TDI 100%)	9,25	9,33	28,59	4,12	8,96

Description: TDI = Indigofera leaf flour

Based on the results of the proximate analysis carried out, it is known that the nutritional content contained in the test feed is good enough for fishing fish. According to Iskandar & Fitriadi (2017), the optimum protein content for fish growth ranges from 25-50%. The crude fiber content in feed according to Iskandar (2011) ranges from 8 - 12% and can still be tolerated by fish. Good ash content in the feed should be <13% (Gunawan & Khalil, 2015). The moisture content of indigofera leaf meal has a value that is still in a good range for fish. According to Iskandar & Fitriadi (2017), the fat content in fish feed ranging from 4-18% can still be tolerated by fish.

3.2. Absolute Weight Growth

Based on the results of the analysis of variance, shows that the use of indigofera leaf meal as feed raw material has a real effect (P<0.05) on the growth of the absolute weight of Hoven's carp. Further test results showed a noticeable difference (P<0.05) between treatments. From the histogram, it can be seen that the highest absolute weight growth value was obtained in the P0 treatment (control), which was 0.26±0.006 g followed by growth in the P1 and P2 treatments, which was 0.07±0.017 g and 0.03±0.005 g (Figure 1).

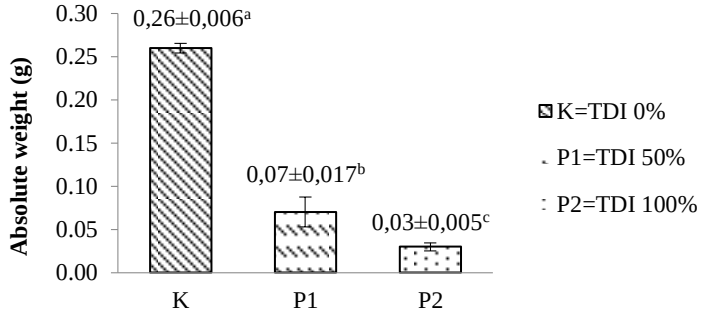

Figure 1. Growth in absolute weight of Hoven's carp fry

With the increasing use of indigofera leaf meal, the growth of Hoven's carp decreases. This is following research conducted by Pangentasari (2018) the increase in the use of fermented TDI by 30% has decreased due to the use of non-optimal feed due to the higher content of tannins and saponins. Based on the results of research by Palupi et al. (2014), indigofera leaf flour contains 0.29% tannins and 0.036 ppm saponin content. In Pangentasari research (2018), the tannin content of fermented indigofera leaf flour reached 0.69%.

Tannins have the property of forming complex compounds with protein peptide bonds and do not dissolve in the digestive tract so they can affect the availability of protein from feed (Akmal & Marizal, 2013). In addition, tannins can cause low body protein accumulation so that the weight of protein for the formation of body tissues is also low (Pangentasari, 2018). Indigofera leaf flour has a weakness in the form of low content of essential amino acids, namely histidine, tryptophan, and methionine. Amino acid deficiency in Hoven's carp is a limiting factor in the use of amino acids in the feed so it can cause a decrease in growth (Palupi, 2015). According to Nurfitasari (2020), the digestibility of protein in fish feed depends on the protein source. The digestibility of

protein derived from animal feed is around 95%, while protein derived from vegetable feed is relatively lower at around 80-90%, or it could be lower depending on the quality.

3.3. Absolute Length Growth

Based on the results of the analysis of variance, it shows that the use of indigofera leaf meal as feed raw material has a real effect (P<0.05) on the growth of the absolute length of Hoven's carp. Further test results showed a noticeable difference (P<0.05) between treatments. From the histogram, it can be seen that the highest absolute length growth value was obtained in the P0 treatment (control) which was 1.84±0.027 cm followed by growth in the P1 and P2 treatments of 1.10±0.038 cm and 0.70±0.082 cm (Figure 2).

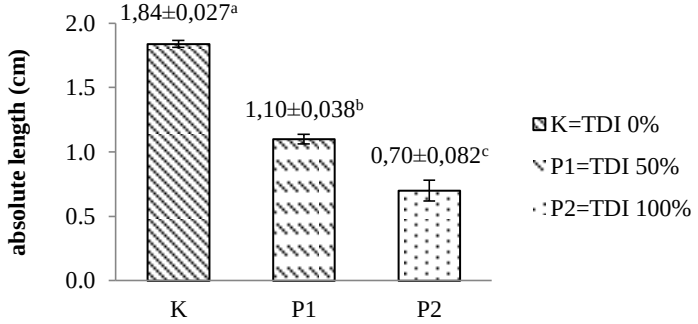

Figure 2. Growth of the absolute length of the hoven's carp fry

With the increasing use of indigofera leaf meal, the growth of Hoven's carp decreases. This can happen because the indigofera leaf meal used still has some antinutrient substances that can inhibit the growth of Hoven's carp fry. According to Yanuartono (2020), indigofera has antinutrient substances such as indospicine, alkaloids, flavonoids, saponins, and tannins. These substances if consumed excessively will hurt animals. In addition, fish fed with vegetable feed generally have 10% slower growth than fishmeal feed (Sonavel, 2020). This is because plant-based feed lacks several important nutrients for fish growth and has antinutrient substances (Kallau, 2018). In addition, in this study, the crude fiber content ranged from 5.68-8.96%. High fiber content can reduce the ability of fish to digest protein and the portion of excretion in fish increases (Wulandari, 2016).

One of the nutrients that are important for fish growth is protein, which contains amino acids as its constituent ingredients. Based on research conducted by Palupi (2015), the essential amino acid index of indigofera shoot flour is 21.53. The value is higher when compared to other legume plants. The digestibility of unfermented indigofera leaf flour in Hoven's carp fry according to research conducted by Pangentasari (2018) is 82.85 lower than fermented indigofera flour which is 85.76.

3.4. Specific Growth Rate

Based on the results of the analysis of variance, it shows that the use of indigofera leaf meal as feed raw material has a real influence (P<0.05) on the specific growth rate of Hoven's carp. Further test results showed a noticeable difference (P<0.05) between treatments. From the histogram, it can be seen that the highest specific growth rate value was obtained in the P0 treatment (control), which was 11.24±0.07%, followed by growth in the P1 and P2 treatments, which was 7.22±0.68% and 5.16±0.35% (Figure 3).

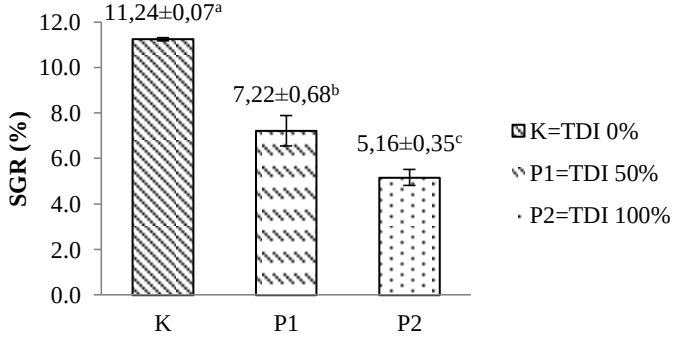

Figure 3. The specific growth rate of Hoven's carp fry

With the increasing use of indigofera leaf meal, the growth of Hoven's carp is declining. This can happen because the indigofera leaf flour used has a lower digestibility due to the absence of fermentation treatment. The digestibility of unfermented indigofera leaf flour in Hoven's carp fry according to research conducted by Pangentasari (2018) is 82.85% smaller than fermented indigofera leaf flour, which is 85.76. So it can be said that Hoven's carp fry can digest 82.85% of the protein of indigofera leaf meal.

The specific growth rate value in this study ranged from 5.16-11.24%, this value was higher than the research conducted by Pangentasari (2018) with the highest specific growth rate value in the use of fermented indigofera leaf flour with a percentage of 10%, which was 1.84%. This is thought to be because the nutritional content used in the feed is sufficient for the growth of Hoven's carp fry. The protein content in all treatments ranged from 28.86-38.86%. According to Palupi (2015), the nutrient content of indigofera leaf flour can be relied upon as a source of protein for animals, because the results of analysis of the non-protein nitrogen (NPN) content of indigofera shoot flour are 1.12%, which shows that indigofera leaf shoot flour contains pure protein of 98.88% which can be utilized by animals. Protein will be broken down into amino acids that are easily digested by fish.

In this study crude fiber found in feed ranged from 5.76-8.96%, of this value according to Iskandar (2011) fish in general can still tolerate crude fiber content between 8% - 12%. This shows that the crude fiber used can still be tolerated by the fry of Hoven's carp which tend to be herbivorous. Herbivorous and omnivorous fish tend to have the ability to utilize other nutrients such as fats and carbohydrates. However, higher fiber content can lead to decreased growth. Nindyanto (2018) stated that fish have relatively fewer digest vegetable sources in feed, this is because there is a strong cell wall, and difficult to break down in the fiber contained in the vegetable material.

3.5. Feed Conversion Rate

Based on the results of the analysis of variance, it shows that the use of indigofera leaf meal as feed raw material has a real influence ($P<0.05$) on the feed conversion ratio. Further test results showed a noticeable difference ($P<0.05$) between treatments. From the histogram, it can be seen that the highest feed conversion ratio was obtained in P2 treatment or test feed with 100% indigofera leaf meal at 4.33±0.45 followed by P2 and P0 treatment at 2.66±0.70 and 1.53±0.12 (Figure 4).

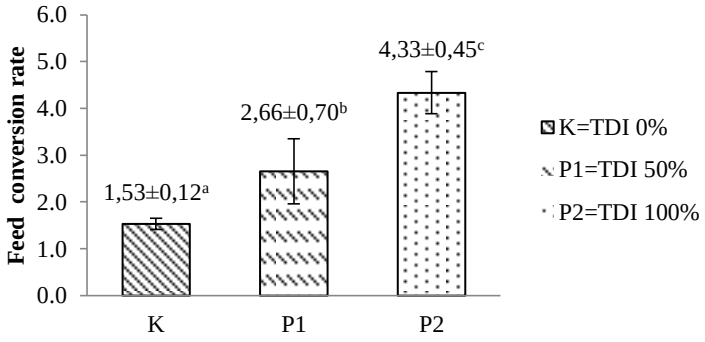

Figure 4. The feed conversion ratio of Hoven's carp fry

In research conducted by Mulyono (2018) with the use of indigofera leaf shoot flour as a substitute for soybean meal, the highest FCR value was in the treatment of giving 100% indigofera leaf shoot flour with a value of 2.07. The high value of FCR in this study, especially in the 100% TDI treatment, is thought to be because the fish is not utilizing feed properly and many are wasted into feces or not eaten by fish. According to Sonavel (2020), the size of the FCR value can be caused by the absorption of different nutrients in Hoven's carp and is also influenced by the amount of feed and feeding time. In addition, there are still high antinutrients in indigofera leaf meal feed, and also no fermentation process makes the feed difficult to digest by Hoven's carp fry. The FCR value obtained in the control treatment and 50% TDI is still appropriate according to Ferdiana (2012) who states that a good feed conversion value is less than 3, where the smaller the value of FCR, the better the feed quality. In addition, according to Sulawesty et al. (2014), the lower FCR value indicates that the feed given can be utilized optimally, and the better feed quality

3.6. Survival Rate

Based on the results of the study showed that the test feed given did not have a real effect ($P>0.05$) on the survival rate of Hoven's carp fry (Figure 5). Deaths that occur during the rearing period are thought to be due to the fry of hoven's carp do not accept environmental conditions that are not suitable for their life. In general, hoven's carp are given in concrete ponds or earthen ponds. Rusliadi et al. (2015) stated that the factor of high stocking density also affects fish's will compete for space to move feed and oxygen needs. In addition, in this study, the death of Hoven's carp can be caused by the age factor of the fish. Larvae aged 7 days are susceptible to stress and death. According to Jaroszweska & Dabrowski (2011), the critical period of Hoven's carp larvae occurs during the transition period, which is after the yolk preparation runs out. From the results of this study, the survival value of Hoven's carp fry ranged from 55.20-63.25%. The value is still quite good. According to Mulyani et al. (2014) which states that the survival rate of an organism is good if it is >50%, while it is in the range of 30-50% and not good if it is < 30%.

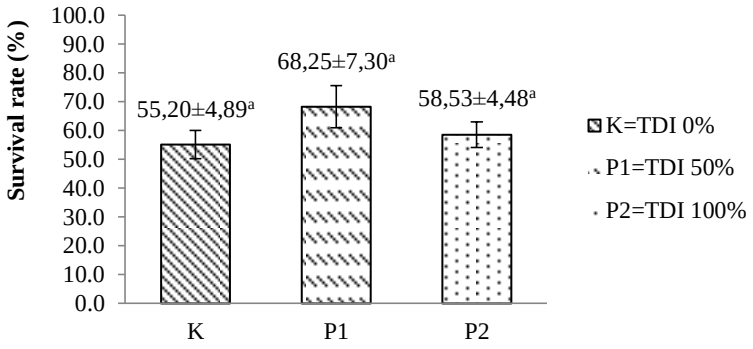

Figure 5. The survival rate of Hoven's carp fry

3.7. Water Quality

In this study, the measured water quality includes temperature, pH, and DO. Of all the water quality parameters measured, all parameters indicate the optimum range for Hoven's carp growth (Table 3). According to Puslitbangkan (1992), the optimal water temperature for Hoven's carp ranges from 29-30℃ and a good oxygen range for the growth of Hoven's carp is 3-6 mg/l. pH measurements during the maintenance period show that the pH of the water used for hatchery activities is still supportive. This is following the opinion of Herawati et al. (2018) who states that the pH range for Hoven's carp rearing is 6.5-7.5. Water quality during the study is presented in Table 2.

Table 2. Water Quality Measurement

Treatment	Parameters		
	Temperature (°C)	pH	DO (mg/l)
P0	26-30	6,3-7,5	6,6-10,21
P1	25-30	6,3-7,5	6,58-10,08
P2	26-30	6,3-7,5	6,71-10,67
Reference	29-30*****	6,5-7,5******	Min. 3*****

4. Conclusions

Based on the results of research that has been conducted, it can be concluded that the increasing proportion of the use of indigofera leaf meal has decreased growth performance and there is no real effect on the survival of Hoven's carp fry (*Leptobarbus hoevenii*).

5. Suggestion

Based on the results of this study, it is recommended not to use indigofera leaf meal as feed raw material in the breeding of Hoven's carp fry (*Leptobarbus hoevenii*).

6. References

Akbarillah, T., Kususiyah., Kaharuddin, D., Hidayat. (2008). Kajian Tepung Daun Indigofera sebagai Suplemen Pakan terhadap Produksi dan Warna Yolk Puyuh. *Jurnal Sain Peternakan Indonesia*, 3 (1): 20-23.

Akmal., & Marizal. (2013). Performa Broiler yang diberi Ransum Mengandung Daun Sengon (*Albizzia falcataria*) yang Direndam dengan Larutan Kapur Tohor (CaO). *Jurnal Peternakan Indonesia*. 15 (1): 1-6.

Effendie, M.I. (1997). *Biologi Perikanan*. Yayasan Pustaka Nusatama.Yogyakarta. p 163.

Ferdiana, M.F. (2012). *Pengaruh Penambahan Tepung Kulit Singkong Hasil Fermentasi dalam Pakan Buatan Terhadap Laju Pertumbuhan Benih Nilem (Osteochilus hasselti).* Fakultas Perikanan dan Ilmu Kelautan. Universitas Padjajaran. Bandung.

Gunawan., & Khalil, M. (2015). Analisa Proksimat Formulasi Pakan Pelet dengan Penambahan Bahan Baku Hewani yang Berbeda. *Acta Aquatica*, 2 (1): 23-30.

Hardjamulia, A. (1992). *Informasi Teknologi Budidaya Ikan Jelawat* (*Leptobarbus hoeveni* Blkr). Balai Penelitian Perikanan Air Tawar. Bogor. p 62.

Hambali., Dewantoro, E., Prasetio, E. (2019). Efektivitas Ekstrak Daun Mengkudu (*Morinda citrifolia)* Sebagai Pengobatan Ikan Jelawat (*Leptobarbus hoevenii*) yang Diinfeksi dengan Bakteri *Aeromonas hydrophila. Borneo Akuatika*, 1 (19): 58-69.

Herawati, H., Yulianti, R., Zahidah., Sahidin, A. (2018). Pengaruh Padat Tebar untuk Meningkatkan Produktivitas Budidaya Ikan Nilem (*Osteochiluss hasselti*) dengan Penggunaan Batu *Aerasi High Oxy*. *Jurnal Airaha*, 7 (1): 15.

Iskandar, R., & Fitriadi, S. (2017). Analisa Proksimat Pakan Hasil Olahan Pembudidaya Ikan di Kabupaten Banjar Kalimantan Selatan. *Ziraa'ah*. 42 (1): 65-68.

Iskandar, A.S. (2011). *Pengaruh Pemberian Pakan Buatan dengan Kandungan Protein Berbeda Terhadap Pertumbuhan dan Retensi Protein Benih Patin Pasupati*. Fakultas Perikanan dan Ilmu Kelautan. Universitas Padjajaran. Bandung.

Jaroszweska, M., & Dabrowski, K. (2011). *Utilization of Yolk: Transition From Endogenous to Exogenous Nutrition in Fish. Larva Fish Nutrition.* Wiley-Blackwell. Oxford.

Kallau, M. (2018). Peningkatan Bioavaibilitas Pakan Ikan Berbasis Nabati dengan Agen Fermentasi. *Partner*. 23 (1): 463-475.

Kamaruddin., & Makmur. (2004). Peluang Pengembangan Bahan Baku Lokal untuk Pakan Ikan di Sulawesi Selatan. *Warta Penelitian Perikanan Indonesia*, 10 (4): 14-18.

Kottelat, M., Whitten, A.J., Kartikasari S.N., Wirjoatmodjo S. (1993). *Freshwater fishes of Western Indonesia and Sulawesi*. Periplus Edition. Singapore.

Mulyono, M.A. (2018). *Kajian Penggunaan Tepung Pucuk Daun Indigofera zollingeriana sebagai Substitusi Tepung Kedelai untuk Pakan Ikan Gurame Osphronemus gourami (Lacepede,1801).* Fakultas Pertanian. Universitas Lampung. Lampung.

Mulyani, Y.S., Yulisman., Fitriani, M. (2014). Pertumbuhan dan Efisiensi Pakan Ikan Nila (*Oreochromis niloticus*) yang Dipuasakan Secara Periodik. *Jurnal Akuakultur Rawa Indonesia*. 2 (1): 01-12.

Nindyanto, R.W. (2018). *Substitusi Tepung Kedelai dengan Tepung Pucuk Daun Indigofera zollingeriana terhadap Pertumbuhan Ikan Nila Oreochromis niloticus.* Universitas Lampung. Lampung.

Nurhayati., & Nazlia, S. (2019). Aplikasi Penggunaan Tepung Daun Gamal (*Gliricidia sepium*) yang Difermentasi Sebagai Penyusun Ransum Pakan terhadap Laju Pertumbuhan Ikan Nila (*Oreochromis niloticus*). *Jurnal Ilmiah Samudra Akuatika*. 3 (1): 6-11.

Nurfitasari, I., Palupi, F.I., Sari, O.C., Munawaroh, S., Yuniarti, N.N., Ujilestari, T. (2020). Respon Daya Cerna Ikan Nila terhadap Berbagai Jenis Pakan. *Nectar Jurnal Pendidikan Biologi*, 1 (2): 21-28.

Palupi, R., Abdullah, Astuti D.A., Sumiati. (2014). Potensi dan Pemanfaatan Tepung Pucuk *Indigofera* sp. sebagai Bahan Pakan Substitusi Bungkil Kedelai dalam Ransum Ayam Petelur. *Jurnal Ilmu Ternak dan Veteriner*. 19 (3): 210-219.

Palupi, R. 2015. *Substitusi Protein Bungkil Kedelai dengan Protein Tepung Pucuk Indigofera zollingeriana untuk Menghasilkan Telur Fungsional Tinggi Antioksidan.* Sekolah Pasca Sarjana Insitut Pertanian Bogor. Bogor.

Pangentasari, D. (2018). *Penggunaan Tepung Daun Indigofera zollingeriana Fermentasi sebagai Substitusi Bungkil Kedelai dalam Pakan Benih Ikan Jelawat (Leptobarbus hoevenii).* Sekolah Pasca Sarjana Insitut Pertanian Bogor. Bogor.

Puslitbangkan. 1992. *Teknik Pembesaran Ikan Jelawat (Leptobarbus hoevenii Blkr) Secara Terkontrol*. Departemen Pertanian. Badan Litbang Pertanian. 11 p.

Rusliadi., Putra, I., Syafriandi. (2015). Pemeliharaan Benih Ikan Jelawat (*Leptobarbus hoeveni* Blkr) dengan Padat Tebar yang Berbeda pada Sistem Resirkulasi dan Akuaponik. *Berkala Perikanan Terubuk*, 43(2): 1-13.

Santosa, A. (2019). *Pertumbuhan Ikan Jelawat (Leptobarbus hoevenii (Bleeker, 1851) pada Jenis Kolam Berbeda.* Fakultas Pertanian. Universitas Lampung. Lampung.

Sonavel, N.P. (2020). Pengaruh Tingkat Pakan Buatan terhadap Performa Ikan Jelawat (*Leptobarbus hoevenii*). Fakultas Pertanian. Universitas Lampung. Lampung.

Sutisna, E., Affandi, R, Kamal, M.M, & Yulianto, G. (2020). Penilaian Status dan Penyusunan Strategi Pengelolaan Perikanan Budidaya Ikan Jelawat (*Leptobarbus hoevenii*, Bleeker, 1851) Berkelanjutan di Kota Jambi. *Journal of Natural Resources and Environmental Management.*10 (3): 524-532.

Sulawesty, F., Tjandra, C., Endang, M. (2014). Laju Pertumbuhan Ikan Mas (*Cyprinus carpio* L) dengan Pemberian Pakan Lemna (*Lemna perpusilla* Torr) Segar pada Kolam Sistem Aliran Tertutup. *Jurnal Limnotek*, 21(2): 177-184.

Wulandari, E.T. (2016). *Kajian Tingkat Kecernaan Pakan Ikan Berbasis Tepung Biji Lamtoro (Leucaena Leucocephala) Terfermentasi pada Ikan Nila Gift (Oreochromis sp).* Universitas Lampung. Lampung.

Yanuartono., Purnmananingsih, H., Indarjulianto, S., Nururrozil, A., Raharjo, S. (2020). Dampak Negatif *Indospicine* dalam *Indigofera* sp. pada Ternak. *Jurnal Ilmu dan Tekonologi Peternakan Tropis*, 7(2): 91-100.

Zonneveld, N., Huisman, E.A., Boon, J.H. (1991). *Prinsip-Prinsip Budi Daya Ikan*. Gramedia Pustaka Utama. Jakarta. p 318.