Sys Rev Pharm 2020; 11(1): 529 – 535
A multifaceted review journal in the field of pharmacy

Combination of Hermetia illucens L Maggot Flour with Fish Feed Against Growth of Sangkuriang Catfish (Clarias sp.)

Meitiyani*, Excel Ratika, Agus Pambudi Dharm, Ranti Annisa
Department of Biology Education, Universitas Muhammadiyah Prof. Dr. Hamka, Jakarta, Indonesia
*E-mail: meitiyani@uhamka.ac.id

Article History: Submitted: 22.10.2019 Revised: 19.12.2019 Accepted: 15.01.2020

ABSTRACT

Background: The nutritional content of maggot Hermetia illucens L. is very good as a potential source of animal protein as an alternative to natural fish feed. Therefore maggot Hermetia illucens L. is very potential as a substitute for fish meal which is currently the main raw material for fish pellets. Our study sought to determine the effect of a combination of maggot flour and fish meal on the growth of Sangkuriang catfish (Clarias sp.). This research is a continuation of research that has been done in 2017 using fresh maggot as catfish feed and freshwater pomfret.

Methods: Data were performed using a completely randomized design (CRD) technique with 4 replications and 6 treatments of catfish seeds, namely giving maggot concentrations of 10% (P1), 20% (P2), 30% (P3), 40% (P4), 50% (P5), control treatment (without maggot) and analyzed using ANAVA.

Results: The percentage of maggot 30% and 70% fish meal provide increased growth and good survival for Sangkuriang catfish (Clarias sp.). Statistical tests at a significant level of 5% showed that feeding maggot flour significantly (P> 0.05) on absolute length, relative weight and relative length but did not significantly influence the absolute weight and feed efficiency ratio.

Conclusions: Giving maggot flour can increase the growth rate of Sangkuriang catfish (Clarias sp.) On growth parameters.

Keywords: Fish Flour; Maggot (Hermelia illucens L.); Seed; Sangkuriang Catfish (Clarias sp.)

Correspondence:
Meitiyani
Department of Biology Education, Universitas Muhammadiyah Prof. Dr. Hamka
Jakarta, Indonesia
E-mail: meitiyani@uhamka.ac.id

DOI: 10.5530/srp.2020.1.66

INTRODUCTION

Public awareness to consume fish as meeting the needs of animal protein for the body is increasing, this has resulted in fish needs also increasing in line with high demand. The high price of raw materials for making fish feed is the main reason for the increase in the price of fish feed. The main protein sources of commercial fish feed are fish meal, meat meal, chicken farm by-product flour, and soy flour which still relies on imports. Protein requirements in fish range between 20% - 60% (Department of Maritime Affairs and Fisheries, 2015).

Catfish is a type of freshwater fish that has high economic value. Sangkuriang catfish (Clarias sp.) Contains 15.6 grams of protein and can meet the needs of amino acids in the human body (Renita & Suriana, 2016). The advantages of Sangkuriang (Clarias sp.) Catfish cultivation are its adaptability is quite high, its growth is relatively fast, has high nutritional value, can be maintained in a narrow area and can live in an unfavorable environment. This is the reason Sangkuriang (Clarias sp.) Catfish are widely cultivated by the community, but the increased need for catfish is not accompanied by high productivity. Feed is the biggest contributor to production costs, namely 50-70% of operational costs (Handajani, Hastuti, & Wirawan, 2014).

Utilization of protein sources from local ingredients that have been studied include snail flour, chicken waste silage, and fish, blood meal, shrimp head flour, but the results are only able to replace the maximum 20% fish meal protein source, depending on fish species. However, it is constrained by its availability in large quantities and quality, among others it still contains certain compounds which if mixed in the feed can affect the quality of the feed including silage pH is always low, free amino acids are high and contain lots of fats that are easily oxidized, thereby increasing fat peroxide (Azwar, 2010). Overcoming this problem requires alternative raw materials to replace fish meal as a source of protein based on local raw materials.

Many fish farmers do not know about natural food that is easily obtained and economical with quality nutritional content, the culture of people that prioritizes practicality causes the dependence of factory-made feed. Sources of feed can come from natural food or artificial feed. Artificial feed is food produced by the factory, while one of the natural feeds sourced from nature as an alternative to artificial feed is high nutritious maggot.

Maggot or larvae from black soldier fly (Hermetia illucens L.) is one alternative feed that meets the requirements as a source of protein and can increase the growth of catfish seeds (Rahayu, 2013). Potential availability of maggot in the field is very good to be able to meet feed requirements because the amino acid content of maggot is higher at 99.80% compared to artificial fish feed around 90.90% (Muller, Wolf & Gutzeit, 2017). Maggot is a larva from black soldier fly (Hermetia illucens L.) which has potential as a bioconversion and alternative protein source for fish food (Newton, et al, 2005). Organic waste is available at cheap and abundant prices so that it has the potential as a medium for maggot development. The need for human animal protein from year to year is increasing by around 15.87 grams. Therefore it is necessary to consider in calculating the consumption needs and availability of animal protein, at least once every ten years as soon as there is data on population census results (Setiawan, 2008). Amino acid sample test results from the IPB Integrated Science Laboratory said that maggot has an amino acid content of 13.67%. Proximate sample test results from the Spice and Medicinal Crops Research Institute said that maggot has a protein content of 17.94%. While the protein requirement of catfish is 17.09% (Listiyani, Asriani & Santoso, 2019). This means that maggot qualifies as a source of protein.

The seed phase at the fish growth stage is a critical phase where death often occurs. High protein content in feed affects the speed of seed growth, this is due to the energy used for the transition process of food utilization from egg yolk (endogenous feeding) to the utilization of feed from outside (exogenous feeding). The seeds have not performed organogenesis perfectly, such as the formation of eye spots, mouth openings, etc. (Tjodi, Kalesar & Watung, 2016). Artificial feed for seed breeding to fish rearing must contain at least 30% protein (Nurhakim, 2015).

Maggot can be used as feed directly in the fresh form or mixed with other materials such as bran to be used as pellets. This will make it easy for catfish farmers to produce their own feed. Thus the farmers can save production costs and be more effective in the use of feed.

Some relevant research support that is based on the results of research Rachmawati & Samidjan (2013) shows that the test feed with fish flour substitution with maggot 25% provides the best growth for catfish seeds. Then there are the results of research Hariadi, Irsan & Wijayati (2014) showed that the highest growth rate and protein efficiency as well as the lowest feed conversion for jambal catfish is a combination of 75% pellets and 25% fresh maggot. This study uses catfish, this is in accordance with the results of research Meitiyani, et al. (2018) which showed that feeding maggot 30% and 70% pellets affected the growth of catfish (Clarias sp.). Research conducted using fish seed, this is supported by research Prihadi, et al. (2009) showed that substitution of maggot as a protein source substitute for fish meal is recommended not more than 16.47% for Balashark fish seeds. It is necessary to further investigate the limiting element (chitin) in maggot which causes very limited substitution despite the high maggot protein content.

Research conducted by Dudusola & Temenu (2013) shows that the best feed substitution results for African catfish seeds are on the use of 75% maggot flour. The results of the study of Xiao, et al (2018) showed that the composition of maggot flour not more than 48% is a good composition for and does not cause a negative effect on the growth of yellow catfish. Subsequent research also conducted by Hu, et al (2017) showed the results of the combination of maggot flour 20% and 30% had a significant effect on the growth of yellow catfish.

The renewal of this study is that the researchers used Sangkuriang (Clarias sp.) Catfish seeds aged 2 weeks. The maggot needed in this research is in the form of flour. The best combination of maggot flour is in the composition of 30% maggot flour, so as to reduce the use of fish meal in the manufacture of nutritious fish feed. This research is important to continue because of the potential of Hermetia illucens larvae as a source of cheap and sustainable alternative protein for animal feed (Nyakeri, et al, 2016) and the ability of maggot to convert organic waste into high-quality protein (Barragan & Fonseca, 2018). Hermetia illucens fly larvae can contribute to food security through the supply of protein for fish production (Nyakeri, et al, 2016).

MATERIALS AND METHODS

Research Scope

This research was conducted in February - July 2019 in the greenhouse of Prof. Muhammadiyah University Dr. Hamka The tools used are 40 x 22 x 35 cm aquarium with 24 units, pellet printing, digital scales, water quality measurement tools such as pH, TDS, and temperature thermometers. The materials used are Sangkuriang catfish seeds (Clarias sp.) 240 tails, ingredients for fish feed include: corn flour, soy flour, flour, starch, fish flour, top mix, corn oil and fish oil.

Research Design

The method used in this research is experimental method. This study uses a Completely Randomized Design (CRD) consisting of 6 treatments and 4 replications according to the Frederer formula (t-1) (n-1)> 15, with t many treatments. Then the number of replications (n) 4 replications there are 24 units of the experiment. Sampling was done by purposive sampling in accordance with the criteria of test animals. Samples were divided into 6 groups, where each group consisted of 10 catfish seeds. The distribution of samples for each group was carried out using completely randomized design techniques (Gomez, 2015).

RESEARCH PROCEDURE

Preparation

The containers used in the study were 24 aquarium units measuring 40 x 22 x 35 cm and a large drum as a reservoir. The aquarium and drum are cleaned and washed then the drum is filled with water to the full and allowed to stand for 7 days. The aquarium is placed on a cardboard box, then the entire outside is coated with a black trash bag. Each aquarium filled with water as much as 8.8 liters then put banana leaves which are cut according to size to place catfish seeds.

Implementation

The sample used in this study was Sangkuriang (Clarias sp.) Catfish seeds obtained from fish farmers in Cimanggis, and transportation of seeds was carried out in the afternoon. Initial average length of 1.32 - 1.79 cm / head and initial average weight of 0.04 - 0.09 gram / head of 240 tails. Fish stocked with a total of 10 fish per pond. After stocking, fish are not fed for three days. After the adaptation process, in the afternoon the fish body weight and length measurements are carried out using digital and ruler scales and measure water quality as preliminary data.

Observation

During the maintenance of the test feed provided in the form of artificial pellets with the basic ingredients of maggot flour obtained from the Maggot Biomagg cultivator in Cimanggis. The size of the feed provided is in the form of powder that is made into a paste. The age of catfish seeds in this study was 2 weeks. Feeds given with a frequency of 2 times a day ie morning at 09.00 West Indonesia Time and afternoon at 17.00 West Indonesia Time with a dose of 5% daily feed requirement of catfish seed weight.

Before the feed is given, the feed is weighed first by using a digital scale. Feeding each in each aquarium are P0 (0%

maggot), P1 (10:90), P2 (20:80), P3 (30:70), P4 (40:60), P5 (50:50) . Water quality management is done by replacing water as much as 25% of the volume of water which is done every 7 days. Catfish seeds are kept for 4 weeks or 28 days. As supporting data, during the study water quality monitoring included measurements of pH, temperature and TDS. Water quality measurements are carried out every day so that changes in water quality can be controlled. PH measurements are made with a pH meter, temperature with a temperature thermometer, and TDS with a TDS meter. Weighing the body weight and measuring fish length every 7 days.

Data Collection and Data Analysis

The parameters observed in this study are:

Absolute Weight

Catfish seed weight gain was measured using a digital scale with 0.01 gram accuracy and carried out every 7 days until the end of the study. To calculate the absolute weight growth done using the formula proposed by Gomez (2015), namely:

$$W_m = W_t - W_0$$

Information:

W_m = Absolute Weight growth (cm)

W_t = Average individual weight at the end of the study (gr)

W_0 = Average weight of individuals at study entry (gr)

Panjang Mutlak

Absolute Length

$$L_m = L_t - L_0$$

Information:

L_m = Absolute length growth (cm)

L_t = Average length of individuals at the end of the study (cm)

L_0 = The average individual score at the study entry (cm)

Relative Weight

$$W_r = \frac{W_t - W_0}{W_0} \; x \; 100\%$$

Information:

W_r = Growth in relative Weight (%)

W_t = Average individual weight at the end of the study (gr)

W_0 = Average weight of individuals at the study entry (gr)

Relative Length

$$L_r = \frac{L_t - L_0}{L_0} \; x \; 100\%$$

Information:

L_r = Growth in relative length (cm)

L_t = Average length of individuals at the end of the study (cm)

L_0 = Average length of individuals at study entry (cm)

Life sustainability

$$TKH\ (\%) = SR\ (\%) = \frac{\sum N_t}{\sum N_0} \; x \; 100\%$$

Information:

SR = Life sustainability (%)

ΣN_t = The total number of fish at the end of the observation (tail)

ΣN_0 = The total number of fish at the end of the observation (tail)

Feed Efficiency Ratio

$$FER = \frac{W_t - W_d - W_0}{F} \; x \; 100\%$$

Information:

FER = Feed efficiency (%)

W_t = Fish biomass final test (gr)

W_0 = Initial fish test biomass (gr)

W_d = Biomass of dead test fish (gr)

F = Amount of feed given during the study (gr)

Data analysis began with the normality test and continued with the homogeneity test as a prerequisite for the ANAVA test. After the ANAVA test the LSD test was performed to see the difference in effect between treatment pairs (Gomez, 2015).

Table 2: Growth Parameters of Sangkuriang Catfish (Clarias sp)

Treatment (%)	Absolute Weight (g)	Absolute Length (cm)	Relative Weight (%)	Relative Length (%)	Life sustainability (%)	Feed Efficiency (%)
P0 (100:0)	0,08	$12,65^{e}$	$72,25^{abcd}$	80,18	82,50	$39,97^{a}$
P1 (90:10)	0,09	$3,03^{ab}$	$71,52^{abc}$	20,11	55,00	$42,97^{a}$
P2 (80:20)	0,06	$5,5^{abc}$	$36,57^{ab}$	32,38	65,00	$28,60^{a}$
P3 (70:30)	0,13	$17,8^{f}$	$223,79^{f}$	112,01	90,00	$70,25^{a}$
P4 (60:40)	0,10	$1,38^{a}$	$23,99^{a}$	11,82	45,00	$31,02^{a}$
P5 (50:50)	0,08	$5,83^{abcd}$	$83,67^{abcde}$	12,53	67,50	$45,06^{a}$

RESULT AND DISCUSSION

The results of research on the effect of maggot flour (Hermetia illucens L.) on the growth of Sangkuriang catfish (Clarias sp.) After 28 days of treatment showed a difference in the treatment and water quality data, can be seen in the following table:

Table 1. Range of Water Quality Parameter Values in Maintenance Media.

Treatment	Water quality parameters		
	pH	Temperature (°C)	TDS (ppm)
P0	6,5 – 7,3	27-29	214 - 366
P1	6,5 – 7,3	27-29	207 - 288
P2	6,5 – 7,3	27-29	203 - 337
P3	6,5 – 7,2	27-29	227 - 295
P4	6,7 – 7,3	27-29	231 - 294
P5	6,8 – 7,4	27-29	216 - 288
Standard standard	6,5- 8,5 (Wibowo, 2012)	25-30 (Darseno, 2010)	100-300 (moderate to moderate categories) (Kuncoro, 2008)

According to Wibowo (2012: 82), the range of pH values for catfish native habitat is 6.5-8.5. According to Darseno (2010: 23), the range of temperature values that can be tolerated by catfish is 25-30 ° C and TDS has a standard of 100 - 300 ie the moderate to rather hard category. The results of measurements of pH, temperature, and TDS quality are in accordance with standard theoretical standards. This is very influential on the growth of Sangkuriang catfish (Clarias sp.)

The results obtained based on observations of the growth parameters of Sangkuriang catfish seedlings (Clarias sp.) Showed that the treatment of P3 (30% maggot and 70%) fish flour showed the highest results in all parameters, namely absolute weight growth 0.13 gr, absolute length 17.8 cm, relative weight 223.79%, relative length 112.01%, feed efficiency ratio 70.25%, and 90% survival rate. The lowest yield on absolute weight parameter is P2 treatment (20% maggot and 80% fish meal) which is 0.06 gr, the lowest yield on absolute length parameter is P1 treatment (10% maggot and 90% fish flour) which is 3.03ab, yield the lowest is on the relative weight parameter 23.99a, the relative length is 11.82, the survival is 45.00 and the efficiency ratio of 31.02a feed is the P4 treatment (40% maggot and 60% fish meal). ANAVA analysis results of one factor indicate that the administration of maggot flour in feed has a very significant effect on the absolute length growth parameters. The real difference test (BNT) showed that there were significant differences in the absolute length and relative weight parameters.

Table 3. Fish Feed Amino Acid Test Results

Parameter	Fish Flour	Maggot
Asam Amino Essensial		
Aspartic acid	1,69	1,63
Threonine	0,64	0,60
Valine	0,84	0,75
Methionine	0,22	0,18
Ileusine	0,74	0,71
Leusine	1,27	1,30
Histidine	0,46	0,49
Phenylalanine	0,78	0,80
Lysine	0,34	0,93
Arginine	0,46	0,54
Asam Amino Non Esensial		
Serine	0,73	0,72
Glutamate	2,59	2,73
Glisine	1,26	1.02
Alanine	0,95	0,93
Tyrosine	0,32	0,34
Amino acid total	**13,30**	**13,67**

Source: Lab Test Results Chemistry of IPB, 2019

Amino acid test analysis results at the Bogor Institute of Agriculture's Integrated Science Laboratory show that maggot has an amino acid content of 13.67% while fish meal is 13.30%.

The results obtained based on the study showed that the feeding of pellets based on fish meal and maggot flour generally had an effect (P <0.05) on the growth of relative weight, absolute length and efficiency ratio of feed, this showed that the feed provided was of the same quality in terms of fish response to feed. The results obtained based on the study that the treatment of P3 (70% fish meal 30% maggot flour) produced the highest average on all parameters. This is in accordance with the statement of Priyadi, et. al (2009) namely maggot has one of the advantages in terms of completeness of the nutritional value used to meet the needs of the growth process.

Research conducted using catfish seeds that are still 2 weeks old, therefore in this case the digestion of catfish seeds has not been stable and cannot digest the composition of maggot which is too high because chitin in maggot cannot be digested optimally by catfish seeds. Protein deficiency in feed can cause stunted growth, followed by loss of body weight due to the use of protein from body tissues to maintain vital functions. An increase in growth in the treatment of feed which has a composition of 70% fish flour and 30% maggot flour, this is thought to be due to the balance of nutrients, especially protein in the feed. According to Effendie (2002), that excess energy input is used by the body for metabolism, movement, reproduction, and replacing damaged cells. This is in line with the statement of Affandi and Tang (2002) which states that the energy needs for metabolism

must be met first, then if excessive, the excess will be used for growth.

Protein deficiency in feed can cause stunted growth, less than perfect reproductive processes, and can cause fish to become susceptible to disease (Kordi, 2010). Utilization of protein for fish growth is influenced by several factors including size, protein quality, feed energy content, water temperature, and feed level. Protein is a nutrient that is relatively expensive compared to other nutrients. Therefore, the balance between protein and non-protein energy sources such as fat and carbohydrates in feed can act as a sparing effect of protein.

Growth has decreased again in the treatment of P4 and P5, this suggests the recommendation of maggot in fish feed is recommended only up to 30%. There is a limiting factor in the maggot content that cannot be tolerated by fish. (Azwar & Melati, 2010) states that maggot has one of the advantages in terms of the complete nutritional value used to meet the needs during the growth process, but maggot also has a limiting factor (chitin) so that its use is only as a substitute for artificial feed substitutes only in quantities limited. Chitin is crystalline and insoluble in a strong acid solution, so it cannot be digested completely by the body (Ediwarman, et al. 2008). According to Kordi (2010) catfish (Clarias sp.) Require protein content in feed of 25 - 40%. The results of this study indicate that the administration of fish meal and maggot in the treatments P0, P1, P2, P4, and P5 yields a lower average on all parameters compared with the administration of fish meal and maggot in the treatment P3 (70% fish meal).

If protein intake from feed is too excessive, only a portion of it will be absorbed and used for growth and forming or repairing cells that have been damaged and the excess is excreted. The impact of a high excess protein causes an increase in energy requirements for protein catabolism, one of which is nitrogen which will be released in the form of ammonia through the kidneys. This is because fish have limitations in storing protein.

The results of this study are in line with the results of the study of Ediwarman, et al (2008) showing that the administration of a combination of maggot to substitute trash fish that provides a specific growth rate and good feed conversion is up to 50% and will further reduce feed growth and efficiency. Furthermore, Rachmawati et al (2013) research results showed that substitution of fish meal with maggot flour in artificial feed on catfish (Pangasius pangasius) that to get the best absolute weight growth and specific growth rate (SGR), maggot could replace fish meal in test feed up to 25%.

Amino acids in maggot higher than fish meal include essential amino acids Leusine, Histidine, Phenylalanine and Lysine. While non-essential amino acids include amino acids Glutamate and Tyrosine. Amino acids in BSF maggot that can meet the needs of amino acids in the body of aquatic pomfret, including Tyrosin, valine, threonine, isoleucine, histidine, arginine, leucin and lysin (Lochmann, 2004). Amino acids that directly influence fish growth are histidine which functions in the development of a baby's brain and growth. Non-essential amino acid Glutamate plays a role in the immune system, digestive system and DNA synthesis process, Turosine plays a role in reducing fat and controlling appetite.

Amino acid sample test results from the IPB Integrated Science Laboratory said that maggot has an amino acid content of 13.67%. Proximate sample test results from the Spice and Medicinal Plants Research Institute said that maggot has a protein content of 17.94%. While the protein requirement of catfish is 17.09% (Listiarini, Asriani & Santoso, 2019). Feed test results obtained based on the analysis of the proximate content test at the Laboratory of the Spice and Medicinal Plants Research Institute (Balittro) showed that the water content, ash content, protein content and carbohydrate content in artificial pellets made from 100% fish meal were higher than those of artificial pellets which is made from maggot flour, but the fat content in artificial pellets made from maggot flour is higher which is 13.76% compared to artificial pellets made from fish flour which is 9.69%. This is what causes a balanced and complementary nutrition. These results are reinforced by the results of research Subamia, et al, (2010) which states that the levels of amino acids in maggot are slightly lower compared to fish meal, but the levels of linoleic fatty acid (n-6) maggot flour are higher than fish meal.

The nutritional content of artificial pellets made from maggot flour is higher than the nutritional value of catfish per 500 grams, therefore an effective feed formulation to obtain optimal growth of catfish is to use a mixture of maggot flour on the basic ingredients of artificial feed. There was a difference in the percentage of survival in each treatment. The survival rate with the highest average is at P3 treatment by 90%. This shows that the feeding of sufficient quality and quantity as well as the condition of water quality in P3 treatment is quite good. While the lowest survival rate is at P4 treatment that is 45%, this is presumably because catfish seeds do not respond optimally to feeding, so it can cause the state of pond water to be filled with leftover feeding which can lead to dead catfish seeds. This is in line with the statement of Alfiyansyah (2016) which states that the better the environmental conditions, the amount of feed consumption will increase. This is also reinforced by the statement of Khairuman & Amri (2011) that the feeding is adjusted to the needs, meaning that the feed provided does not leave too much. If this happens, the leftover food will rot and can reduce water quality.

The following is a description of the environment condition of the culture container seen from several parameters measured. Water quality parameters measured include pH, temperature and TDS. According to Wibowo (2012), the range of pH values for catfish native habitat is 6.5-8.5. Based on the results of the study, the pH value in the maintenance container ranged from 7.13 to 7.98. The pH value is within the tolerance range of catfish. This is reinforced by the growth of catfish that rises and high survival.

According to Darseno (2010), the range of temperature values that can be tolerated by catfish is 25-30 ° C. Based on the research results, the temperature value ranges from 27-29 ° C so that the value is still within the tolerance range according to Darseno (2010). Therefore, fish can live and grow well. And the range of TDS values in the maintenance container is 116-295 ppm. This means that the TDS values in the study fall into the moderate to moderate category (Kuncoro, 2008).

This condition allows in the future giving the amount of feed composition affects the growth and survival of fish. The high survival is in line with the condition of water

quality that supports fish life. Thus, artificial feeding based on fish meal and maggot has a significant effect between each treatment, except for absolute weight and relative length.

CONCLUSION

The best combination of maggot flour in fish feed tends to affect the growth of Sangkuriang catfish (Clarias sp.). The combination of maggot flour (Hermetia illucens L.) in P3 treatment (30% maggot and 70% fish meal) produced absolute weight, absolute length, relative weight, relative length, and feed efficiency higher than other treatments.

REFERENCES

1. Affandi, Ridwan dan Usman Muhammad Tang. 2002.Fisiologi Hewan Air. Unri Press. Pekanbaru.
2. Alfiyansyah, M. 2016. Pertumbuhan dan Kelangsungan Hidup Benih Ikan Platidoras (Platydoras costatus) Pada Padat Penebaran 2, 4, 6 dan 8 Ekor Per-Liter. Jurnal Pertanian. Vol.1(1): 1 – 8.
3. Azwar, Z.I. dan Melati, I. 2010. Peningkatan Kualitas Tepung Magot Melalui Penggunaan Mikroba (Aspergillus niger) dan Pemanfaatannya dalam Pakan Ikan Lele Dumbo (Clarias gariepinus). Prosiding Forum Inovasi Teknologi Akuakultur. Vol 3(1): 703-713.
4. Barragan, KB. & Fonseca. 2018. Flies are what they eat Tailoring nutrition of Black Soldier Fly (Hermetia illucens L.) for larval biomass production and fitness. Wageningen University. Netherlands.
5. Darseno. 2010. Budidaya & Bisnis Lele. Argo Media Pustaka. Jakarta.
6. Dudusola, A., Temenu, AS. 2013. The use of maggot meal in African cat fish Feeding. Advances in Aquaculture and Fisheries Management. Vol 1(5): 48 -51.
7. Departemen Kelautan dan Perikanan. 2015. Pedoman Penulisan Laporan Penelitian. Jakarta: Depdikbud.
8. Ediwarman, H.R., Andrianto, W., & Yonn, M. 2008. Pengguaan Maggot Sebagai Substitusi Ikan Rucah Dalam Budidaya Ikan Toman (Channa micropelles). Jurnal Riset Akuakultur. Vol. 3(3): 395 – 400.
9. Effendie. 2002. Metode Biologi Perikanan, Bagian perikanan, Bagian I. Yayasan Dwi Sri, Institut Pertanian Bogor.
10. Gomez, K.A. & Arturo A.G. 2015. Statistical Procedures For Agricultural Research. International Rice Research Institute. USA.
11. Handajani, H., Hastuti, S.D. & Wirawan, G.H. 2014. IbM Pada Kelompok Tani Ikan "Mina Untung" dan " Mina Lestari Di Kecamatan Kepanjen Kabupaten Malang. Jurnal Pertanian Peternakan. Vol. 11(1): 56 – 65.
12. Hariadi, S., Irsan, C. & Wijayanti, M. 2014. Kombinasi Larva Lalat Bunga (Hermetia illucens L.) Dan Pelet Untuk Pakan Ikan Patin Jambal (Pangasius djambal). Jurnal Akuakultur Rawa Indonesia, Vol. 2(2): 150 – 161.
13. Hu, J., Wang, G., Huang, Y., Sun, Y., He, F., Zhao, H., & Li, N. 2017. Effects of Substitution of Fish Meal with Black Soldier Fly (Hermetia illucens) Larvae Meal, in Yellow Catfish (Pelteobagrus fulvidraco) Diets. The Israeli Journal of Aquaculture. Vol. 1(1): 1 - 9.
14. Khairuman dan Khairul Amri . 2011. Buku Pintar Budi Daya 15 Ikan Konsumsi. Agro Media Pustaka. Jakarta.
15. Kordi, M.G. 2010. Buku Pintar Pemeliharaan 14 Ikan Air Tawar Ekonomis di Keramba Jaring Apung. Lyly Publisher. Yogyakarta.
16. Kuncoro, Eko Budi. 2008. Aquascape Pesona Taman Akuarium Air Tawar. Kanisius. Yogyakarta.
17. Listiarini, S., Asriani., & Santoso, J. 2018. Nilai Gizi Konsentrat Protein Ikan Lele Dumbo (Clarias gariepenus) Ukuran Jumbo. Jurnal Perikanan Dan Kelautan IPB. Vol. 19(2): 106 – 113.
18. Lochmann, R. 2004. Broodstock Diets and Spawning of Colossoma macropomum and Piaractus Brachypomus. University of Arkanansas at Pine Bluff Aquqculture/ Fisheries Center Pine Bluff. Amerika Serikat.
19. Meitiyani., Erwin., Rahmawati, H., Rahayu, S. 2018. Perbedaan Pengaruh Pemberian Belatung Lalat Tentara Hitam (Hermetia illucens) Terhadap Pertumbuhan Ikan lele (Clarias sp.) dan Ikan Bawal (Colossoma macroponum). Seminar Nasional Biologi dan Biologi UKSW . 62 – 70.
20. Newton, L., Sheppard C., Watson, DW., Burtle G., Dove R. 2005. Using the black soldier fly, Hermetia illucens, as a value- added tool for the management of swine manure. Report for The Animal and Poultry waste Management Center. Vol. 1(1): 1-18.
21. Nurhakim, YI. 2015. Langsung Hasil Ternak Lele Sangkuriang. Infra Pustaka. Jakarta.
22. Nyakeri, EM., Ogola, HJ., Ayieko, MA., Amimo FA. 2017. An open system for farming black soldier fly larvae as a source of proteins for smallscale poultry and fish production. Journal of Insects as Food and Feed. Vol. 3(1): 51-56.
23. Muller, A., Wolf, D., Gutzeit, HO., 2017. The black soldier fly, Hermetia illucens – a promising source for sustainable production of proteins, lipids and bioactive substances. Technische Universität Dresden. Vol. 1(1): 1-13.
24. Priyadi, A., Zafril I. A., I Wayan S., dan Sauri H. 2009. Pemanfaatan Maggot sebagai Pengganti Tepung Ikan dalam Pakan Buatan untuk Benih ikan Balashark (Balanthiocheilus melanopterus Bleeker). Jurnal Riset Akuakultur 4(3): 367-375.
25. Rachmawati, Diana & Samidjan Istiyanto. 2013. Evektivitas Substitusi Tepung Ikan Dengan Tepung Maggot Dalam Pakan Buatan Terhadap Pertumbuhan dan Kelulushidupan Ikan Patin. Jurnal Saintek Perikanan Vol. 9(1): 62 – 67.
26. Rahayu, Sri. 2013. Budidaya Lele Di Lahan Sempit. Infra Pustaka. Jakarta.
27. Renita, Riana & Suriana, Neti. 2016. Panen Maksimal Budidaya Lele Unggulan. Anugrah. Jakarta.

28. Setiawan, N. 2008. Peningkatan Kebutuhan Protein Hewani di Jawa Barat: Dampak dari Perubahan Struktur Penduduk. Jurnal Ilmu Ternak. Vol. 3(1): 65 – 71.
29. Subamia, I.W., Bastiar, Nur., Musa, Ahmad., Kusumah, R.V. 2010. Pemanfaatan Maggot Yang Diperkaya Dengan Zat Pemicu Warna Sebagai Pakan Ikan Hias Rainbow (Melanotaenia boeseman) asli Papua. Prosiding Forum Inovasi Teknologi Akuakultur. Vol. 3(1): 755 – 760.
30. Tjodi, R., Kalesaran, OJ., Watung, JC. 2016. Kombinasi pakan terhadap pertumbuhan dan kelangsungan hidup larva ikan Lele Sangkuriang (Clarias gariepinus). Jurnal Budidaya Perairan. Vol. 4(2): 1-7.
31. Xiao, X., Jin, P., Zheng, L., Cai, M., Yu, Z., Yu, J., Zhang, J. 2018. Kombinasi pakan terhadap pertumbuhan Effects of black soldier fly (Hermetia illucens) larvae meal protein as a fishmeal replacement on the growth and immune index of yellow catfish (Pelteobagrus fulvidraco). Aquaculture Research. Vol. 4(2): 1-7.
32. Wibowo, Kesit Tisna. 2012. Mendongkrak Produksi Lele Dengan Sistem Padat . Tebar Tinggi. Agromedia. Jakarta.

Agus Pambudi Dharma - Combination of Hermetia Illucens L Maggot Flour With Fish Feed Against Growth of Sangkuriang Catfish (Clarias sp.)

ORIGINALITY REPORT

7%	2%	6%	4%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Academic Library Consortium Student Paper	2%
2	S Sinansari, M R Fahmi. "Black soldier fly larvae as nutrient-rich diets for ornamental fish", IOP Conference Series: Earth and Environmental Science, 2020 Publication	2%
3	Submitted to Universitas Diponegoro Student Paper	1%
4	Y G Budiman, M Lamid, B S Rahardja, M Amin. "Utilization of fermented Seligi leaf flour Phyllanthus buxifolius toward the specific growth rate, daily growth rate and survival rate of siam catfish (Pangasius pangasius)", IOP Conference Series: Earth and Environmental Science, 2021 Publication	1%
5	Submitted to Universitas Negeri Jakarta Student Paper	<1%

6	"30th Scientific-Experts Conference of Agriculture and Food Industry", Springer Science and Business Media LLC, 2020 Publication	<1%
7	jurnal.untidar.ac.id Internet Source	<1%

Exclude quotes	On	Exclude matches	< 17 words
Exclude bibliography	On		