Global Scientific JOURNALS
GSJ: Volume 10, Issue 3, March 2022, Online: ISSN 2320-9186
www.globalscientificjournal.com

PROVISION OF SOYBEAN OIL AS SOURCE OF OMEGA-3 FATTY ACIDS IN CATFISH (CLARIAS SP.) BIOFLOC

Rita Rostika*, Fittrie Meyllianawaty Pratiwy, Dzikri Ahmad Fauzy, Kiki Haetami, Aulia Andhikawati

Fisheries Study Program, Fisheries and Marine Science, Universitas Padjadjaran, Indonesia

**Co-Author email : rita.rostika@unpad.ac.id*

KeyWords
Catfish, Soybean Oil, Omega-3, EPA, DHA

ABSTRACT

Omega-3 is one type of essential fatty acid that has many benefits for human health, helping cognitive development, immune system, and metabolism. Provision of soybean oil to catfish feed can be an alternative to increase the content of Omega-3 fatty acids in catfish. This study aims to determine the optimal concentration in feeding with the addition of soybean oil to increase levels of omega-3 fatty acids EPA and DHA. This study used a completely randomized design (CRD) with 4 treatments and 4 replications, which tested were various additions of soybean oil in the feed, namely treatment A (0%); B (2%); C (4%); and D (6%). The study was conducted for 30 days in biofloc ponds and fed 3% of the weight of the biomass. The results showed that the use of soybean oil as much as 4% had a significant effect on the increase in Omega-3 fatty acids EPA and DHA in catfish by 25 (EPA) and 89.5 (DHA) with a growth rate value of 1.10 ± 0.008.

INTRODUCTION

Public awareness of the importance of consuming fish because it has many benefits for health, brain function, immunity, metabolism to cognitive development. The content that has this effect is found in omega-3 (Greatalya 2008). Omega-3s that are commonly found in fish are EPA (*eicosapentaenoic acid)* and DHA (*docosahexaenoic acid*) fatty acids. This type of fatty acid is an essential fatty acid that can be synthesized in the body.

Currently, the availability of EPA and DHA is quite limited and has a relatively expensive price, this has prompted the search for alternative sources of freshwater fish. Catfish is one of the freshwater fish that is in great demand by the Indonesian people and contains relatively higher omega-3 fatty acids compared to other freshwater fish [1]. In addition, catfish farming is also relatively easy and has strong endurance because it has an *arborecent* which functions as an oxygen absorber from the air so that catfish cultivation can be carried out by utilizing limited land on various media with high stocking density/intensive.

One of the problems in intensive cultivation is the increasing levels of organic matter contained in aquaculture water caused by feces and feed residues. According to [2] stated that fish only absorb about 25% of the feed given and the remaining 75% remains as waste at the bottom of the water. One solution to the accumulation of organic waste in the cultivation system is to use biofloc technology.

Increasing levels of omega-3 catfish with biofloc technology can be done by giving oil containing omega-3 fatty acids in the feed. Soybean oil is one type of vegetable oil that can be used because it contains high omega-3 fatty acids with a percentage of linolenic acid 9.1% and linoleic acid 49.4% [1]. In addition, soybean oil also has a more affordable price than oil from animal sources. Therefore, there is an opportunity for soybean oil that can be used to increase the content of omega-3 fatty acids EPA and DHA in catfish through feeding.

METHODS

This research was conducted in August – September 2021 at the Ciparanje Inland Fisheries Laboratory, Padjadjaran University using catfish with rearing age taken from catfish farmers in Cileunyi Kulon village, Cileunyi district, Bandung regency, West Java

province. Maintained for 30 days in a fiber tub pool with a size of 68x68 cm. Analytical aids include catfish feed, soybean oil, probiotics, molasses, and progol. The equipment used includes digital scales, pH meters, DO meters, measuring cups, millimeter blocks, heaters and thermometers.

The feed and soybean oil were stirred until homogeneous with the addition of progol as an adhesive, then the feed was dried by aerating. Feed was given to each rearing pond twice a day (at 07.00 and 16.00). The weighing of fish is done once a week.

The study was conducted experimentally with a Completely Randomized Design (CRD) consisting of four treatments and four replications. The treatment used was the addition of soybean oil into the feed with the following concentrations.

A: Control (without the addition of soybean oil)
B: Feed with the addition of 2% soybean oil
C: Feed with the addition of 4% soybean oil
D: Feed with the addition of 6% soybean oil

The data analyzed using the gas chromatography method were the content of EPA and DHA in catfish. And the fat content contained in catfish was analyzed using the proximate method. The supporting test parameters in this study include temperature, acidity (pH), ammonia (NH3), dissolved oxygen (DO), nitrate (NO2), and nitrite (NO3) which were examined in the laboratory where the research was carried out and calculated the specific growth rate of catfish.

The hepatosomatic index was calculated based on the formula [3] as follows.

$$HSI = \frac{Wh}{Wt\text{-}Wh} \times 100$$

Note:

HSI = Hepato Somatic Index
Wh = Liver weight (g)
Wt = Body weight (g)

Feed efficiency (EP) can be calculated based on the [4] formula as follows.

$$EP = \frac{(Wt + D) - Wo}{F} \times 100\%$$

Information:
EP = Feed Efficiency (%)
Wt = Average weight of fish at the end of the study (g)
Wo = Average weight of fish at the beginning of the study (g)
F = Total amount of fish feed given (g)
D = Weight of fish who died during the study (g)

To see fish growth specifically, the formula used to calculate *Specific Growth Rates* (SGR) is:

$$SGR = \frac{\ln Wt - \ln Wo}{t} \times 100\%$$

Description:
Wt = Average weight of fish at the end of rearing (g)
Wo = Average weight of fish at the beginning of rearing (g)
t = Length of time for rearing

RESULTS AND DISCUSSION

The results of the analysis in table 1 show that the fat content of catfish with the addition of soybean oil in the 4% treatment was able to increase the fat content in fish by 6.81% while the fat content in fish with the treatment without the addition of soybean oil was 4.94%. In line with the opinion of [5], the fat content in fish can vary in each part of the fish body, one of which depends on the source of the feed consumed. The source of feed given in this study was by using feed with the addition of soybean oil.

Table 1. Proximate Test Results of Catfish Samples

Control	Treatment	
	Content (0%)	(4%)
Water (%)	74.93	74.23
Ash (%)	18.23	14.12
Protein (%)	16.46	17, 62
Fiber (%)	0	0
Fat (%)	4.94	6.81
Carbohydrates (%)	60.38	63.44
Gross Energy (Kcal/kg)	3416	3721

Information: Proximate Test Results of Laboratory of Ruminant Animal Nutrition and Animal Feed Chemistry, Faculty of Animal Husbandry, University of Padjadjaran (2021)

Likewise, the energy produced in the best treatment (4%) with a fat content of 6.81% contains energy as much as 3721 Kcal/kg. This value is higher when compared to the control treatment, it is suspected that the addition of fat content given to the feed will cause an increase in the energy source produced for fish activities and energy sources derived from protein will be utilized by fish to optimize their growth [6].

According to [7], the protein contained in soybean oil is relatively higher than other types of nuts. Soybean oil is used more as a source of protein than as a source of fat. Therefore, the addition of soybean oil to catfish feed resulted in a higher percentage of treated catfish protein than the control.

Comparison of Omega-3 Catfish

The results showed that the content of omega-3 fatty acids in catfish increased after soybean oil was added to the feed consumed. This is reinforced by the statement according to [8] that the total fatty acid composition is generally influenced and determined by the fatty acids in the feed. Thus, the addition of soybean oil to catfish feed was able to increase the omega-3 fatty acid content of fish and was efficient at a concentration of 4%.

This is in accordance with the results of [9] which shows that the use of a 4% fat concentration can be used in tilapia feed formulations and is in accordance with the optimum fat requirements. In addition, at this concentration, it succeeded in producing the best performance in pellet physical quality and growth with higher protein efficiency.

Table 2. The fatty acid content of EPA and DHA Catfish

Treatment	Amount of Fatty Acids	
	EPA	DHA
Control	16.4	69.8
Treatment	25	89.5

Remarks: Test results of saturated and unsaturated fatty acids by GC (2021)

The increased fatty acid content of DHA treatment higher than the increase in EPA fatty acids during the maintenance period by a difference of 19.7. Although soybean oil was able to increase the fatty acid content of DHA more than EPA, in its absorption, catfish was able to absorb more fatty acid content of EPA with a percentage increase during maintenance of 28.2%.

According to [10], the increase in the function of essential fatty acids is closely related to its role as a phospholipid component and as a prostaglandin precursor. Essential fatty acids with high concentrations of phospholipids have an important role in maintaining the flexibility and permeability of biological membranes, lipid transport, and activation of certain enzymes. [10] stated that a deficiency or lack of fatty acids in fish can cause disruption of growth function, feed efficiency to the death of fish.

Hepatosomatic Index (HSI)

The following are the results of observations of the *Hepatosomatic Index* (HSI) which are presented in graphical form in Table 8. Based on Duncan's multiple test results show that P>0.05, H0 is rejected so there is a significant difference in the treatment of HSI values with the addition of soybean oil in feed. To further explore which groups were significant, Duncan's test was performed.

The results of Duncan's multiple tests showed that the treatment given the addition of soybean oil to catfish feed showed a difference (P>0.05) with a HIS value range of 1.52 ± 0.115 in treatment C (4%).

Table 3. Hepatosomatic Index (HSI)

Components of	HSI			
	A (0%)	B (2%)	C (4%)	D (6%)
HSI	1.15 ± 0.148^{a}	1.42 ± 0.214^{ab}	1.52 ± 0.115^{b}	1.41 ± 0.202^{ab}

the Duncan test level has a value of 5%

The hepatosomatic index is a method used to quantitatively determine changes that occur in the liver. There is a significant effect between treatment A (0%) and treatment C (4%). It is suspected that the dose of soybean oil added to the feed can be used to break down the nutritional components in the feed so that the accumulation of nutrients and fat content in catfish liver can be utilized properly for its growth at 4% treatment. According to [11], stated that an increase in the HSI value indicates an increase in the number of nutrients absorbed and causes the amount of nutrient accumulation in the liver to increase as well. According to [12], the liver is one of the fat storage sites before the gonadal maturation occurs in fish. The liver also has a major role in the metabolism and synthesis of fat. Fat stored in the liver will cause an increase in the size of the liver. The amount of fat content in the fish liver is thought to be directly proportional to the number of fatty acids contained in the fish.

Feed Efficiency

Based on the analysis of Duncan's multiple test variance, it showed that there was a significant effect (P>0.05) on treatment D on other treatments. The results of the observation of feeding efficiency during catfish rearing showed that treatment C(4%) had a higher feed efficiency value than other treatments. This is comparable to [9] which suggests that different types of 4% fat treatment resulted in better feed conversion ratios and feed efficiency.

Table 4. Feed Efficiency

EP	A			
	(0%)	B (2%)	C (4%)	D (6%)
EPP	42.20 ± 4.77^{a}	42.20 ± 3.19^{a}	44.35 ± 0.47^{a}	36.87 ± 0.66^{b}

It is suspected that the efficiency of feeding with the addition of soybean oil in supporting the growth of catfish will be good if used more than 4%. Because the use of excess oil content in feed can cause a decrease in the value of quality and nutritional content that is not balanced so that it cannot be utilized and digested by the body properly. Stated that the higher the efficiency value of feed utilization, it can be said that the quality of the feed given is getting better and has a balanced nutritional content so that the efficiency of utilization is also getting better in meeting the growing needs of fish [6].

The Growth Rate of Catfish

graph of the growth rate shows that the growth rate of catfish treated with the addition of soybean oil to feed of 0%, 2%,

4% and 6% was not significantly different (Figure 1).

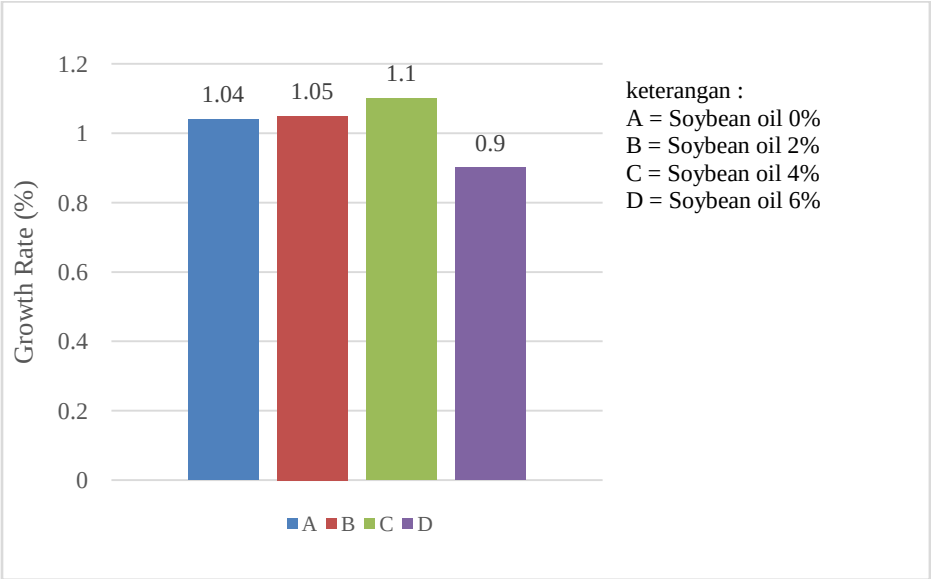

Figure 1. The Catfish Growth Rate

addition of 4% soybean oil to catfish feed shows the highest growth rate value of 1.1%, the addition of 2% soybean oil shows a growth rate value of 1.05%, without the addition of soybean oil or 0% shows a growth rate value of 1.04% and the addition of 6% soybean oil shows a growth rate value of 0.9%. The decrease in the value of the growth rate in treatment D (6%) was presumed because the added soybean oil caused a decrease in the value of feed quality and the nutritional content became unbalanced for catfish.

Table 5. Growth Rate of Catfish

Components	SGR			
	A (0%)	B (2%)	C (4%)	D (6%)
SGR	1.04 ± 0.115^{b}	1.05 ± 0.06^{b}	1.10 ± 0.008^{b}	0.90 ± 0.02^{a}

. Observations show that the value of the growth rate of catfish given the addition of soybean oil to the feed obtained the highest value compared to other treatments, namely treatment C (4%) with a value of 1, 10 ± 0.008%. This is presumably because the oil content used is the optimal level for fish and has a balanced nutritional content.

This study showed lower results than [9] study on tilapia fry, which was 2.09 ± 0.03%. The difference in the value of this growth rate occurs because of the difference in the size of the fish used. [6] stated that young fish will experience relatively fast growth, while adult fish will experience slow growth because generally the food they eat will be used more for body metabolism. According to [6] the use of oil as a source of fat in fish feed is very important to support fish growth. To produce optimal growth in fish, the use of oil in feed must be following the needs.

Water Quality The

survival of fish is closely related to environmental quality. Good water quality also has a good influence on fish growth [13]. The results show that the water quality parameters observed during the study have a range of values that can still be tolerated by catfish to be able to grow (Table 6) Parameter

Table 6. Water Quality Parameter Value

	Range	during the study	*

Temperature (^{0}C)	27.2-28.0	25-30
pH	6.6-6.9	6-9
DO (ppm)	50.7-54.0	>4
Ammonia (mg/L)	0.04-0.44	<1
NO^2 (mg/L)	1.4-6.0	
NO^3 (mg/L)	7,9-35.8	

Note: water quality is tested every 7 days
(*): Tolerance range. Source: Suprapto and Samtafsir (2013)

Temperature is one of the water quality parameters that have an important role in a cultivation system. The effect of temperature on fish is that if the temperature in the culture media is relatively low, it will affect the metabolic process that is inhibited and decrease appetite so that it can cause slow growth in fish so that fish weight gain will below. The results showed that the temperature value obtained was an average of 27.5 ^{0}C. The temperature was in the good range for catfish to grow with a good appetite as well.

The use of high aeration in biofloc cultivation systems is needed to maintain the availability of dissolved oxygen content in the culture media. The availability of dissolved oxygen is not only used by fish to maintain their survival but also by bacteria to break down unutilized feed residues by converting ammonia to nitrite and then to nitrate. So that with the high dissolved oxygen content in the maintenance media during the research the water quality is maintained. The range of dissolved oxygen during the study of all treatments ranged from 50.7 – 54.0 ml/L. This range is appropriate in meeting the needs of catfish with a biofloc system in the formation of biofloc-forming organisms. This is related to [14], which states that a good dissolved oxygen level for the growth of aquatic organisms is >3.5 mg/L. And according to Suprapto and Sumtafsir (2013), the recommended oxygen content for the growth of heterotroph bacteria in the maintenance media so that it can still absorb ammonia and protein formation is recommended to have a dissolved oxygen content of at least 4 mg/L.

The degree of acidity (pH) during the study was in the range of 6.7-6.9. Based on the range of pH tolerance in the rearing media during the study, it was still in a good range for the growth of catfish. States that a pH value that is below 5 or under certain limits can cause growth to be delayed. PH 6-9 is the ideal pH range for fish life [15].

The potential ingredients in the formation of ammonia compounds in the rearing media come from unutilized feed residues and the remains of catfish metabolism. Ammonia levels contained in the maintenance media during the study ranged from 0.04 to 0.44 mg/L. These levels indicate a low ammonia content and are not toxic to catfish during rearing. This is presumably due to the presence of several types of bacteria that make up bioflocs that can convert ammonia into non-toxic compounds. Floc-forming bacteria will break down organic matter (protein, carbohydrates, fat, etc.) from feed residues, fish waste, and dead bodies in the rearing media. With sufficient oxygen (aerobic) conditions, the organic matter will be broken down into inorganic minerals that are needed by phytoplankton. Ammonia will be synthesized into cell protein by several types of bacteria and some will be oxidized by nitrifying bacteria to nitrite by *Nitrosomonas* and then from nitrite to nitrate by *Nitrobacter bacteria.* Thus, the level of ammonia contained in the rearing media is low so that it does not harm catfish during rearing.

Conclusion

Based on the discussion of this study, it can be concluded that the best dose of soybean oil to increase the EPA and DHA content of catfish is the addition of soybean oil to the feed by 4%.

Suggestions

Based on the results of the study, suggestions that can be given are that further research is expected to increase the content of EPA and DHA in catfish and find out the content of other types of fatty acids that are useful and can be applied on a larger scale.

References

[1]. Salasah, R., & Nilawati, MJ (2016). Study of increasing omega-3 fatty acids EPA and DHA in catfish oil-fed soybean oil. *Journal of Science Partners*, *4*, 1–12.

[2]. Imron, A., Sudaryono, A., & Harwanto, D. (2014). Effect of Different C/N Ratio on Feed Conversion Ratio and Growth of Catfish Seed (Clarias sp.) In Biofloc Media. *Journal of Aquaculture Management and Technology*, *3*, 17–25.

[3]. Effendi. (2002a). *Fisheries Biology*. Archipelago Library Foundation.

[4]. Effendi, MI (2002b). *Fisheries Biology Yogyakarta*. Archipelago Library Foundation.

[5]. Nakamura, YN, Ando, M., Seoka, M., Kawasaki, K.ichi, & Tsukamasa, Y. (2007). Changes of proximate and fatty acid compositions of the dorsal and ventral ordinary muscles of the full-cycle cultured Pacific bluefin tuna Thunnus orientalis with the growth. *Food Chemistry*, *103*(1), 234–241. https://doi.org/10.1016/j.foodchem.2006.07.064

[6]. Munisa, Q., Subandiyono, & Pinandoyo. (2015). Effect of Different Fat and Energy Content in Feed on Feed Utilization and Growth of Catfish (Pangasius pangasius). *Journal of Aquaculture Management and Technology*, *4*(4), 95–100.

[7]. Pranowo, D., & Muchalal, M. (2004). Analysis Of Free Fatty Acid On Soybean Oil Using Gas Chromatography-Mass Spectroscopy. *Indonesian Journal of Chemistry*, *4*(1), 62–67.

[8]. Pranowo, D., & Muchalal, M. (2004). Analysis Of Free Fatty Acid On Soybean Oil Using Gas Chromatography-Mass Spectroscopy. *Indonesian Journal of Chemistry*, *4*(1), 62–67.

[9]. Haetami, K. (2018). The Effectiveness Of Fat In The Formulation Of Pellet Quality And The Growth Of Tilapia. *Journal of Community Service*, *2*(1), 6–11.

[10]. Sumiyati. (2003). *Pengaruh Pemberian Artemia Hasil Bioenkapsulasi Dengan Asam Lemak Omega- 3 HUFA dan Vitamin C Terhadap Kelangsungan Hidup Post Larva Udang Windu (Penaeus monodon Fab)*

[11]. Yanto, A. (2018). *Effect of Various Doses of Mixed Microorganisms in Feed Containing Sargassum Sp. Against Hepatosomatic Index and Body Chemical Composition of Milkfish (Chanos chanos Forsskal)*. Hasanuddin University.

[12]. Tresnati, J., Umar, MT, & Sulfirayana. (2018). Liver Changes Associated with Oocyte Growth of Side Fish (Psettodes erumei). *Journal of Water Management*, *1(1)*(x), 31–36. http://journal.unhas.ac.id/index.php/jpp/article/view/4033

[13]. Kusumah. (2016). *Effect of Different C/N Ratio in Biofloc Formation and Growth of Dumbo Catfish (Clarias Gariepinus)*.

[14]. Urbasa, PA, Undap, SL, & Rompas, RJ (2019). Impact of Water Quality on Fish Cultivation with Plug-in Nets in Toulimembet Village, Lake Tondano. *E-Journal of WATER CULTURE*, *3*(1), 59–67. https://doi.org/10.35800/bdp.3.1.2015.6932

[15]. Koniyo, Y. (2020). Analysis of Water Quality at Freshwater Fish Cultivation Locations in Central Suwawa District. *Journal of Technopreneur (JTech)*, *8*(1), 52–58. https://doi.org/10.30869/jtech.v8i1.527