Fisheries Journal, 15 (1), 226-232 (2025)
http://doi.org/10.29303/jp.v15i1.1329

STUDY OF GONAD MORPHOANATOMY AND FECUNDITY OF NILEM FISH (Osteochilus vittatus) WITH SPIRULINA SUPPLEMENTED FEED

Studi Morfoanatomi Gonad Dan Fekunditas Ikan Nilem (*Osteochilus Vittatus*) Dengan Pakan Suplementasi Tepung Spirulina

Muhammad Azharul Rijal, Ikhsan Pratama[1*], Susanto[2], Rendi Marta Agung[3]

[1]Aquaculture Study Program, Muhammadiyah University of Purwokerto, [2]Biology Education Study Program Muhammadiyah University of Purwokerto, [3]History Education Study Program Muhammadiyah University of Purwokerto

KH. Ahmad Dahlan Street PO BOX 202 Purwokerto 53182

*Corresponding Author : MAzharulRijal@ump.ac.id

(Received December 17th 2024; Accepted January 20th 2025)

ABSTRACT

Nilem fish (*Osteochilus vittatus*) is a fish native to eastern Indonesia. People in general like nilem fish due to many factors. The demand for nilem fish increases every year. This increase in demand must be accompanied by an increase in reproductive performance so that the stock of nilem fish is always maintained. Reproduction is the ability of an individual to produce offspring. There are several factors that greatly influence reproductive success, including environmental factors and food. Food content that is high in protein can improve fish reproductive performance. Spirulina platensis is a type of blue green algae that can live in fresh and brackish waters. The content of macromolecules and micromolecules in spirulina is very high. The protein contained in spirulina ranges from 55-65%, 5-7% fat, while the micromolecules contain 6-13% amino acids, 5% minerals. This research was conducted using a completely randomized design method with four treatments and four replications. The results of this research are that the addition of spirulina flour has a good effect on the morphoanatomical response of nilem fish. Giving spirulina flour had a real effect on GSI, HSI and fish weight, while fish length, fecundity and VSI had no real effect. The optimum dose in this study was P2 30g spirulina flour in 1 kg fish feed. Based on this research, feeding spirulina supplementation can increase the reproductive response of nilem fish

Keywords: Fecundity, HSI, GSI, Nilem Fish, Spirulina, VSI

ABSTRAK

Ikan Nilem (*Osteochilus vittatus*) merupakan ikan asli Indonesia wilayah timur. Masyarakat secara umum menggemari ikan nilem karena banyak faktor. Peningkatan permintaan ikan nilem setiap tahun mengalami peningkatan. Peningkatan permintaan ini harus dibarengi dengan peningkatan performa reproduksi agar stok ikan nilem selalu terjaga Reproduksi adalah kemampuan individu untuk menghasilkan keturunan. Terdapat beberapa faktor yang sangat mempengaruhi keberhasilan reproduksi diantarnya faktor lingkungan dan

makanan. Kandungan makanan yang tinggi protein dapat meningkatkan kinerja reproduksi ikan. *Spirulina platensis* merupakan jenis alga biru hijau yang dapat hidup di perairan tawar dan payau. Kandungan makromolekul dan mikromolekul pada spirulina sangat tinggi. Protein yang terkandung pada spirulina berkisar 55-65%, 5-7% lemak sedangkan untuk mikromolekul terkandung 6-13% asam amino, 5% mineral. Penelitian ini dilakukan dengan metode rancangan acak lengkap dengan empat perlakuan dan empat ulangan. Hasil dari penelitian ini adalah penambahan tepung spirulina memberikan pengaruh baik pada respon morfoanatomi ikan nilem. Pemberian tepung spirulina memberikan pengaruh nyata pada GSI, HSI dan bobot ikan, sedang pada panjang ikan, fekunditas dan VSI tidak berpengaruh nyata. Dosis optimum pada penelitian ini adalah P2 30gr tepung spirulina pada 1 kg pakan ikan. Berdasarkan penelitian ini pemberian pakan spulementasi spirulina dapat meningkatkan respon reproduksi ikan nilem.

Kata kunci: Fekunditas, HSI, Ikan Nilem, GSI, Spirulina VSI

INTRODUCTION

Nilem fish (*Osteochilus vittatus*) is a fish native to eastern Indonesia. The community generally likes nilem fish for many reasons. The demand for nilem fish is high because this fish is utilized on a large scale. Starting from eggs to broodstock, this fish is utilized by the community. Nilem fish eggs are popular with the community and are even exported to Singapore, Taiwan and Malaysia (Rochmatin *et al*., 2014). Nilem fish measuring 5-7 cm are used as baby fish, while adult sizes are used as jerky, or pepes for the wider community (Tarigan *et al*., 2017). The increase in demand for nilem fish increases every year. This increase in demand must be accompanied by an increase in reproductive performance so that the stock of nilem fish is always maintained (Rijal *et al*., 2023).

Reproduction is the ability of individuals to produce offspring. There are several factors that greatly influence the success of reproduction, including environmental factors and food. High protein food content can improve fish reproductive performance (Rijal *et al*., 2023) (Rijal *et al*., 2024). Providing the right nutrition in the cultivation process can provide a response to the gonad maturation process of fish (Tarigan *et al*., 2017). One effort to improve the reproductive response of fish through good feeding is with spirulina supplementation.

Spirulina platensis is a type of blue-green algae that can live in fresh and brackish waters. The content of macromolecules and micromolecules in spirulina is very high. The protein contained in spirulina ranges from 55-65%, 5-7% fat while for micromolecules it contains 6-13% amino acids, 5% minerals. In the study (Rijal *et al*., 2024) the spirulina content in the green water system was able to increase the morphoanatomical value of tilapia fish. The effect of spirulina flour supplementation on fish can increase fish growth, immune response, and reproductive performance (Zhang *et al*., 2019).

Based on the introduction regarding Nilem fish and reproductive responses, the aim of this study was to determine the morphoanatomical response of Nilem fish gonads given spirulina flour supplementation feed and to determine the best dose of spirulina flour supplementation..

RESEARCH METHODS

This study was conducted experimentally with a completely randomized design (CRD) method, four treatments and six replications. The four levels of treatment in this study were the differences in the amount of spirulina flour supplementation doses. Namely P0 feed without supplementation, P1 feed with spirulina flour supplementation of 2% / kg, P2 feed with spirulina flour supplementation of 3% / kg and P3 feed with spirulina flour supplementation of 4% / kg (Rijal *et al.,* 2023).

1. **Ways of working**
   a. **Preparation of maintenance tank**
   Fish maintenance is carried out in 16 aquariums. Before using the fiber tub, first disinfect it and wash it clean.
   b. **Fish preparation**
   Nilem fish (*Osteochilus vittatus*) used in this study were fish with a weight range of 20-30 gr/tail with a length of 15-20 cm/tail as many as 160 fish. The fish came from fish farmers in Beji Village, Kedung Banteng District, Banyumas Regency.
   c. **Supplementation of *S. platensis***
   The preparation of spirulina flour supplementation in feed is done by dissolving 20 grams of spirulina flour in 100 ml of aquades. Then this mixture is mixed into 1 kg of fish feed. Then the feed is dried in the sun until dry and the supplemented feed is ready to be given to the fish. The same procedure is carried out at doses of 30 gr / kg and 40 gr/kg.

2. **Data collection and measurement**
   Reproductive response data collection will be conducted at the beginning and end of the study. Meanwhile, water quality parameters will be taken every 2 weeks during the study.
   a. **Hepato somatic index**
   Hepatosomatic index is obtained by weighing the total weight of fish samples at the end of the study. Then surgery is performed and the liver is taken. The liver is weighed carefully on a scale with high accuracy (Rijal, et al. 2023). Then calculated using the following formula:
   $\text{HIS} = \frac{WH}{H}$ x 100%
   Information :
   HSI : Hepato Somatik Inkeks
   WH : Heart Weight
   H : Fish body weight
   b. **Visceral somatic index**
   Visceral Somatic Index was obtained by weighing the total weight of the fish sample at the end of the study. Then surgery was performed and all body organs were taken. The internal body parts were carefully weighed on a scale with high accuracy (Rijal *et al*., 2023). Then calculated using the following formula:
   $\text{VSI} = \frac{WH}{H}$ x 100%
   Information :
   VSI : Viseral Somatik Inkeks
   WH : Internal organ weight
   H : Fish body weight
   c. **Gonadal somatic index**
   Gonadal Somatic index is obtained by weighing the total weight of fish samples at the end of the study. Then surgery is performed and the gonads are taken. The gonads are weighed carefully on a scale with high accuracy (Rijal *et al*., 2023). Then calculated using the following formula:
   $\text{GSI} = \frac{WH}{H}$ x 100%
   Information :
   GSI : Gonadal Somatik Inkeks
   WH : Gonad weight
   H : Fish body weight

d. Fekundity

Fish fecundity can be calculated by taking the entire gonad and weighing all and some of the fish eggs. Weigh the entire gonad and sub gonad, calculate the number of eggs in the sub gonad. Then with the comparison formula we can calculate the total number of eggs (Akhdiana *et al,*.2021). The gonad calculation formula is as follows:

$F = \frac{G}{Gn}$ x N

Information:
F : Fecundity (Grains)
G : Gonad weight (gram)
Gn : Sub gonad weight (gram)
N : number of eggs in the sub gonad (grains)

RESULT

Table 1. Results of calculating Visceral Somatic Index (VSI), Gonad Somatic Index (GSI), Hepato Somatic Index (HSI) Fecundity

Treatment	HSI(%)	GSI(%)	VSI(%)	Fekundity(10^3)
P0	0,57 ± 0,06[a]	9,89 ± 1,00[a]	23,29 ± 5,55[a]	8,6 ± 3,1 [a]
P1	1,01 ± 0,11[b]	13,04 ± 1,03[ab]	25,46 ± 1,21[a]	7,8 ± 2,5 [a]
P2	0,88 ± 0,08[b]	23,17 ± 3,39[c]	27,95 ± 2,68[a]	8,8 ± 0,45 [a]
P3	1,04 ± 0,11[b]	13,67 ± 0,72[b]	24,62 ± 2,01[a]	6,7 ± 1,98 [a]

Description: Values with the same superscript in the table indicate significant differences in HSI and GSI but not significant differences in VSI at (X±SD, n = 5 > 0.05); P0: spirulina supplementation 0%/kg, P1: spirulina supplementation dose 2%/kg, P2: spirulina supplementation dose 3%/kg, P3: spirulina supplementation dose 4%kg.

Based on the results of the ana test with a 95% confidence level and Duncan's further test, it showed that the Hepato sematic index and Gonadal Somatic Index parameters had significant differences, while the Visceral somatic index and Fecundity parameters did not have significant differences. The Hepato somatic index in this study had a range of 0.57 ± 0.06 - 1.04 ± 0.11%. Treatment P3 was the best treatment in this study with a value of 1.04 ± 0.11%. In this study, the Gonadal somatic index value had a range of 9.89 ± 1.00 - 23.17 ± 3.39%. The best treatment was P2 with a value of 23.17 ± 3.39% and this value was the largest GSI value. The Visceral somatic index value in the study had a range of 23.29 ± 5.55 - 27.95 ± 2.68%. In this parameter, there is no significant difference between treatments. The P2 treatment has the best VSI value when compared to other treatments. Fecundity in this study has a range of 6.7 ± 1.98 – 8.8 0.45 x 103. Fecundity in this study did not differ significantly between treatments. The P2 treatment has a higher number of eggs when compared to other treatments.

Table 2. Measuring the Length and Weight of Nilem Fish (*Osteochilus vittatus*)

Treatment	Fish Length (cm)	Fish Weight (gr)
P0	13,30 ± 0,59 [a]	26,70 ± 0,35 [a]
P1	14,00 ± 0,50 [b]	31,30 ± 1,24 [b]
P2	14,48 ± 0,35 [b]	36,58 ± 0,82 [c]
P3	13,75 ± 0,15 [ab]	32,78 ± 2,24 [b]

Description: Values with the same superscript in the table indicate significant differences in HSI and GSI but not significant differences in VSI at (X±SD, n = 5 > 0.05); P0: spirulina supplementation 0%/kg, P1: spirulina

supplementation dose 2%/kg, P2: spirulina supplementation dose 3%/kg, P3: spirulina supplementation dose 4%kg.

Based on the results of the ANOVA test with a 95% confidence level and further testing with the Duncan test, it showed that there were significant differences in the parameters of fish length and weight. Treatment P2 was the best treatment for the parameters of fish length and weight. The range of fish weight in this study was 26.70 ± 0.35 to 36.58 ± 0.82 gr, while the length of the fish was 13.30 ± 0.59 to 14.48 cm.

DISCUSSION

Fish liver is related to the development of fish gonads, especially in fish eggs. Fish egg yolk is composed of the main precursor, namely vitellogenin. Vitellogenin provides protein and lipid nutrients used in the fish larval stage. Vitellogenin activity occurs in the fish liver, thus increasing vitellogenin activity indicates an increased HSI value. The increase in the HSI value is due to the addition of liver volume weight (Elrifadah *et al*., 2024) The development of fish gonads is related to liver development. Vitellogenin synthesis carried out by the liver will be distributed throughout the body through the blood to the gonads. During this process, liver weight will increase (Tanbiyaskur *et al*., 2022). This study showed that treatments P1, P2, and P3 were significantly different from the control treatment. This indicates that the addition of spirulina flour can increase liver weight values. Vitellogenin that occurs in the liver of fish given spirulina supplementation is better when compared to the control. According to research conducted by (Akhdiana *et al*., 2021), providing spirulina supplementation of 30g/kg feed can increase the HSI value of Bada Fish (*Rasbora argyrotaenia*) which is maintained for 5 weeks.

Gonadal somatic index (GSI) is a comparison of fish weight with gonad weight. GSI development can be influenced by HSI. The increase in HSI value is proportional to the increase in GSI value (Akhdiana *et al*., 2021). GSI is needed as a measure of activity that occurs in the gonads. The GSI value will increase and reach a maximum limit when spawning occurs (Uswanas *et al*., 2024). The level of gonad maturity is greatly influenced by the provision of feed and nutrient content in fish feed. This study indicates a significant difference between treatments, with P2 being the best treatment and providing the highest GSI value. Fish feed containing high protein can accelerate the gonad maturation process so that GSI will increase. In general, the protein content in spirulina is around 55-70% (Rijal *et al*., 2020). This high protein content makes the fish gonad maturation process run smoothly.

Visceral somatic index (VSI) is a comparison of visceral weight with the overall weight of the fish. The results of the ANOVA variance analysis showed that there was no significant difference between treatments. The P2 treatment had the best VSI value. This is in line with the GSI value. The high VSI value in P2 indicates that the visceral part of the fish is almost full of fish gonads. The development of fish gonads involves the accumulation of nutrient reserves found in eggs (Pratiwi *et al*., 2020). Research conducted by (Purbomartono *et al*., 2023) stated that the addition of fish feed with spirulina flour can increase the VSI value in Tilapia and Catfish.

Fecundity is the number of eggs found in the ovaries of fish. The number of eggs is important for evaluating stock potential, life cycle, reproductive response (Andy, 2010). Variations in the number of eggs produced by one female fish parent depend on several factors including age, condition, feed. The high nutritional content of spirulina flour makes the P2 fecundity value higher when compared to other treatments (Setyaningrum & Wibowo, 2016).

Individual growth is the increase in tissue or volume due to cell division by mitosis. This process occurs when the process of food input and absorption of amino acids that can come from feed (Rizky *et al*., 2023). The high nutritional content of spirulina flour makes fish growth better when compared to control treatments. Research conducted by (Simanjuntak *et al*., 2019) the addition of fish feed with spirulina flour at a dose of 6 gr / kg of feed can increase

the growth and body composition of Gourami fish. The GLA (Gamma linoleic acid), vitamins, minerals and protein content in spirulina flour can increase fish growth (Rijal *et al.,*2023).

CONCLUSION

The conclusion of this study is that the provision of spirulina flour supplementation in Nilem fish has a positive impact (significant difference) on the GSI, HIS, and fish weight treatments, while in the VSI treatment, Fecundity and fish length did not provide a significant response in Nilem fish. The best dose that can be applied for spirulina flour supplementation is P2 with a dose of 3% or 30gr/fish feed.

ACKNOWLEDGEMENT

Gratitude is given to the Institute for Research and Community Service (LPPM) of Muhammadiyah University of Purwokerto (UMP) for research funding in the 2024 budget year.

REFERENCES

Akhdiana, I., Junior, M. Z., Haryani, G. S., & Suprayudi, M. A. (2021). Kinerja Reproduksi Induk Ikan Bada (*Rasbora argyrotaenia*) Melalui Pemberian Kombinasi Estradiol dan Spirulina dalam Pakan. *LIMNOTEK Perairan Darat Tropis di Indonesia, 28*(2), 59-69.

Andy, O. S. (2010). Aspek Reproduksi Ikan Nilem, *Osteochilus vittatus* di Danau Sidenreng, Sulawesi Selatan. *Jurnal Ikhtiologi indonesia, 10*(2), 111-122.

Elrifadah, Marlida, R., & Susastra, P. R. (2024). Studi Pendahuluan Rekayasa Rematurasi Ikan Nila (*Oreochromis niloticus*) dengan Penambahan Telur Bebek (*Anas domesticus*) dan Tauge (*Flammulina velutipes*) dalam Pakan Komersil. *Jurnal Cholophyl, 17*(1), 154-160.

Pratiwi, L., Windarti, & Syafriadiman. (2020). Pengaruh Fotoperiod dan Pakan yang Berbeda terhadap Indeks Morfoanatomi Ikan Selais (*Ompok hypopthalamus*). *Jurnal Ruaya, 8*(2), 86-98.

Purbomartono, C., Wikaneswari, A., Mulia, D. S., & Budi, G. P. (2023). Dietary of Spirulina Platensis Through Feed Againts Weight and Length Final, Hepatomatic Index and Visceral Organ Profile of Tilapia dan Pangasius. *International Conference on Sicial Science* (hal. 464-469). Purwokerto: UMP Press.

Rijal, M. A., Pratama, I., & Susanto. (2024). Morfoanatomi Ikan Nilem (*Osteochilus vittatus*) yang Diperlihara pada Sistem Green Water Technology. *Jurnal Ruaya, 12*(1), 45-51.

Rijal, M. A., Susanto, & Izzah, I. M. (2023). Respon Reproduksi dan Pertumbuhan Ikan Nilem (*Osteochilus vittatus*) yang Diberikan Pakan Suplementasi Tepung Spirulina. *Sainteks, 20*(1), 39-47.

Rijal, M. A., Susanto, Simanjuntak, S. B., & Hernayanti. (2020). Blood Hematological dan Biochemical Parameters of *Osteochilus vittatus* with *Spirulina platensis* Supplementation in Biofloc System. . *Biosainstifika*, 431-437.

Rizky, P. N., Halim, A. M., Nasuki, & Rohman, M. A. (2023). Peningkatan Pigmen Warna dan Pertumbuhan Ikan Koi (*Cyprinus carpio*) Melalui Pengkayaan Sumber Kartonoid Tepung Spirulina. *Jurnal Perikanan Pantura (JPP), 6*(1), 261-268.

Rochmatin, S. Y., Solichin, A., & Saputra, S. W. (2014). Aspek Pertumbuhan dan Reproduksi Ikan Nilem (*Osteochilus hasselti*) di Perairan Rawa Pening Kecamatan Tuntang Kabupaten Semarang. *Diponegoro Journal of Maquares Management of Aquatic Resources, 3*(3), 153-159.

Setyaningrum, N., & Wibowo, E. S. (2016). Potensi Reproduksi Ikan Air Tawar sebagai Baby Fish. *Biosfera, 33*(2), 85-91.

Simanjuntak, S. B., Indramawan, & Wobowo, E. S. (2019). Pengaruh Pakan Suplementasi *Spirulina platensi* dan *Chlorella vulgaris* terhadap Pertumbuhan dan Komposisi Tubuh Ikan Gurami (*Osphronemus gouramy*). *Majalah Ilmiah Biologi Biosfera: A Scientific Journal, 36*(2), 51-59.

Tanbiyaskur, Fitrani, M., Fahrudin, M., Lutfi, & Muslim. (2022). Perkembangan Gonad Ikan Betok (*Anabas testudineus*) Betina yang Diinduksi Ekstrak Hipofisa Sapi. *Jurnal Sumberdaya Akuatik Indopasifik, 6*(1), 37-46.

Tarigan, N., Supriatna, I., Setiadi, M. A., & Affandi, R. (2017). Pengaruh Vitamin E dalam Pakan terhadap Pematangan Gonad Ikan Nilem (*Osteochilus hasselti*). *Jurnal Perikanan Universitas Gadjah Mada, 19*(1), 1-9.

Uswanas, W., Ima, T. L., & munira, M. (2024). Pertumbuhan dan Tingkat Kematangan Gonad Ikan Wakongmerah (*Caesio chrysozona*) yang Didaratkan di Pantai Desa Kampung Baru Kecamatan Banda Maluku Tengah. *Munggai: Jurnal Ilmu Perikanan dan Masyarakat Pesisir, 10*(1), 40-50.

Zhang, F., Man, Y. B., Mo, W. Y., & Wong, M. H. (2019). Application of Spirulina in Aquaculture A Riview on Wastewater Treatmen and Fish Growth. Review in Aquaculture. *A Review on Wastewater Treatmen and Fish Growth* , 34-41.