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The Morphological-Anatomical Index Profile Of Tilapia (*Oreochromis niloticus*) Cultivated In The Mina Padi Pond System

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Abstract

The morphological-anatomical index profile is a value of changes in morphology (outer shape) and anatomy (internal organs) as a basis for calculating fish growth. Fish growth in terms of morphology includes length and weight, while in terms of anatomy, it can be seen from changes in gonad, liver, and visceral weight. The purpose of this study was to determine the value of the morpho-anatomical index of Nile Tilapia GIFT (*Oreochromis niloticus*) cultured in the POKDAKAN Mina Mandiri pond. This research was conducted in the Mina Mandiri Fish Cultivation Group (POKDAKAN) pond, Panembangan Village, Banyumas, from September 23, 2021, to November 28, 2021. The method used in this study was a survey method where the data was processed and analyzed descriptively and compared with the literature related. The results of the morpho-anatomical index of Nile Tilapia GIFT included a hepatosomatic index (HI) of 0.31%, a visceral somatic index (VI) of 14.09%, and a gonad somatic index (GI) of 2.61%. The fish condition factor value was 1.05557 and the length-weight relationship was 2.6, which is negative allometric.

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Introduction

The morphological-anatomical index profile is a value of changes in morphology (outer shape) and anatomy (internal organs) as a basis for calculating fish growth. Growth in terms of morphology includes length and weight, while in terms of anatomy can be seen from changes in gonad, liver, and visceral weight. The morpho-anatomical indices include the hepatosomatic index (HI), viscerasomatic index (VI), and gonadosomatic index (GI). The hepatosomatic index (HI) was defined as the ratio of liver weight to body weight. The hepatosomatic index is used to describe the distribution of energy in fish. This indicates that there is an energy reserve in the liver that is used to maintain the body's immune metabolism (Soedibya *et al.*, 2018). The viscerasomatic index (VI) is the ratio of the total visceral weight in the fish's body to the fish's body weight. Gonadosomatic Index (GI) is defined as the ratio between gonad weight and somatic weight expressed in percent (%) (Ibrahim *et al.*, 2020). Many factors affect this growth,

both internal factors and external factors, namely the aquatic environment where the fish live. The correlation of length and weight can describe the condition factor of the fish. The condition factor is a parameter of growth forms, whether it is allometric or isometric (Pamungkas & Burnawi, 2016).

Nile Tilapia (*Oreochromis niloticus*) is one of the fish that has important economic value in Indonesia. Efforts to increase the growth rate are one way to increase production (Karimah *et al.*, 2018). Nile Tilapia GIFT is a type of fish that has a fast growth rate and can reach a much larger body weight with a fairly high level of productivity (Aliyas *et al.*, 2016). Currently, Nile Tilapia is a freshwater fish that is very popular with the community, so it can be used as an opportunity for fish farmers to increase the productivity of their ponds (Soedibya, 2013).

The Mina Mandiri Fish Cultivation Group (POKDAKAN) is one of the POKDAKAN located in Panembangan village which has been established in 2018. The fish cultivation system in Mina Mandiri POKDAKAN still uses the traditional pond system. The source of water is obtained from irrigation rivers which are also used on agricultural land. Nile Tilapia production in one rearing cycle at POKDAKAN Mina Mandiri can produce 2 tons of fish.

Materials and methods

Research Implementation

This research was conducted from September – November 2021, at the Mina Mandiri Fish Cultivator Group (POKDAKAN) Pond, Panembangan Village, Banyumas. This study used a survey method with sampling using a random sampling method, where 15 fish were taken from a total population of 300 fish and were taken randomly using a fishing net. The test fish used were Nile Tilapia GIFT with an initial body length of 12-15 cm and a body weight of 20-50 grams which were reared for 2 months.

Media Preparation Maintenance

The media used in the study was a 12 x 3.5 m earthen pond. Preparation of the soil pond that will be used for cultivation was drained first. Then given dolomite lime and dried for 2 days. And filled with water to the ¾ height of the pool. The pool used was a traditional pool with water flowing from the inlet and out through the outlet.

Nile Tilapia GIFT Maintenance

Nile Tilapia GIFT were reared for 8 weeks by feeding 2 times a day in the morning (9 am) and afternoon (4.00 pm). The ratio to determine the amount of feed

given was 3% of the total biomass. During the maintenance period, fish were sampled 5 times, namely in the first week to determine the size of the fish before being reared and or once every 2 weeks to determine changes in fish. A sampling of Nile Tilapia by weighing and measuring the length during the rearing period.

Feed is one of the most influential factors in fish growth because feed serves as a supplier of energy to increase growth and maintain survival (Assan et al., 2021). The feed was given with the brand Rubi Hg 3 protein 28% and identified natural feeds that were potential sources of fish feed.

The water quality parameters that were measured every day during this research were pH, temperature, and dissolved oxygen (DO). pH measurement using pH paper, temperature using a thermometer. pH and temperature measurements were carried out every day in the morning and evening. while dissolved oxygen (DO) measurements use a DO meter which is carried out once a week.

Research Parameters

The Morpho-Anatomical Index

The data were collected at the beginning and end of maintenance. Liver, visceral, and gonad organ harvesting was conducted by dissecting the fish from the hole close to the rear fin in the upper vertical direction until it reached and followed the linea lateralis to the abdomen near the pectoral fin in a downward vertical direction. Measurement of data using digital scales with an accuracy of 0.01gram. The data obtained from this study are liver weight, visceral weight, and gonadal weight which can then be calculated using the formula.

The measured morpho-anatomical parameters include:

a. Viscerasomatic Index (VI) (Affandi *et al.*, 2011)

$$\text{VI (\%)} = \frac{\textit{visceral weight (g)}}{\textit{body weight (g)}} \boldsymbol{x\ 100}$$

b. Hepatosomatic Index (HI) (Kindom and Alisson, 2010)

$$\text{HI (\%)} = \frac{\textit{liver weight (g)}}{\textit{body weight (g)}} \boldsymbol{x\ 100}$$

c. Gonadosomatic Index (GI) (Ibrahim *et al.*, 2020)

$$\text{GI (\%)} = \frac{\textit{gonad weight (g)}}{\textit{body weight (g)}} \boldsymbol{x\ 100}$$

Absolute Growth

Growth is the process of increasing the length and weight of an organism that can be seen from changes in length and weight in units of time. Absolute growth is the difference between the length and weight of fish at the end of the study and body length at the beginning of the study.

Absolute length growth is calculated using the formula (Effendie, 1997):

$$Pm = Lt - Lo$$

Where:

Pm = Absolute increase in length (cm)

Lt = Final average length (cm)

Lo = Initial average length (cm)

The absolute weight growth is calculated by the formula (Effendie, 1997):

$$Wm = Wt - Wo$$

Where:

Wm = Growth absolute weight (gr)

Wt = Weight of biomass at the end of the study (gr)

Wo = Weight of biomass at the beginning of the study (gr).

Weight Relationship

Fish growth is closely related to the relationship between length and weight, based on physical observations and measurements this parameter can describe the condition of small, medium, or large fish (Ibrahim *et al.*, 2018). The relationship between length and weight uses the formula (Effendie, 1997):

$$W = aL^b$$

Where:

W = weight of fish (g)

L = total length of fish (mm)

a and b are regression coefficients

Condition Factor

The condition factor is the condition or bulkiness of the fish which is expressed in numbers based on the length and weight data. The condition factor value (K) can be calculated by the following formula (Effendie, 2002):

$$K = \frac{W}{aL^b}$$

Where:

K = condition factor

W = weight of fish (grams)

L = fish length (cm)

a and b are regression constants

Specific Growth Rate (SGR)

The specific growth rate explains thatfish can utilize feed nutrients to be stored in the body and convert them into energy (Abadi et al., 2022). Calculation of the specific growth rate (SGR) using the formula (Effendie, 1997):

$$SGR = \frac{wt - w0}{t} \times 100\%$$

Where:

Wt = weight of fish at the end of cultivation

Wo = weight of fish at the beginning of cultivation

T = length of cultivation time

Survival Rate

Survival Rateis the ratio of the number of fish that live from the beginning

to the end of the study. Survival rate can be calculated by the formula (Muchlisin *et al.*, 2016):

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

Where:

SR = Survival rate (%)

Nt = Number of fish at the end of the study (tails)

No = Number of fish at the beginning of the study (tails).

Results and Discussion

The research conducted showed that the final yield of cultivation and the value of the hepatosomatic index decreased, while the viscerasomatic index and gonadosomatic index increased.

The Morpho-Anatomical Index of Nile Tilapia GIFT

The data used in this study was the chroma value which is an indicator of increasing color in fish. The results obtained can be seen in Figure 1.

Based on Figure 1. the results of the morpho-anatomical index profile of Nile Tilapia at the beginning of cultivation include HI was 0.53%, VI was 12.42%, GI was 2.15%. Meanwhile, at the end of cultivation, the HI was 0.31%, the VI was 14.09%, and the GI was 2.61%. This explains that the final yield of cultivation and the value of the HI has decreased, while the VI and GI have increased. The decrease in the value of the GI is inversely proportional to the increase in the value of

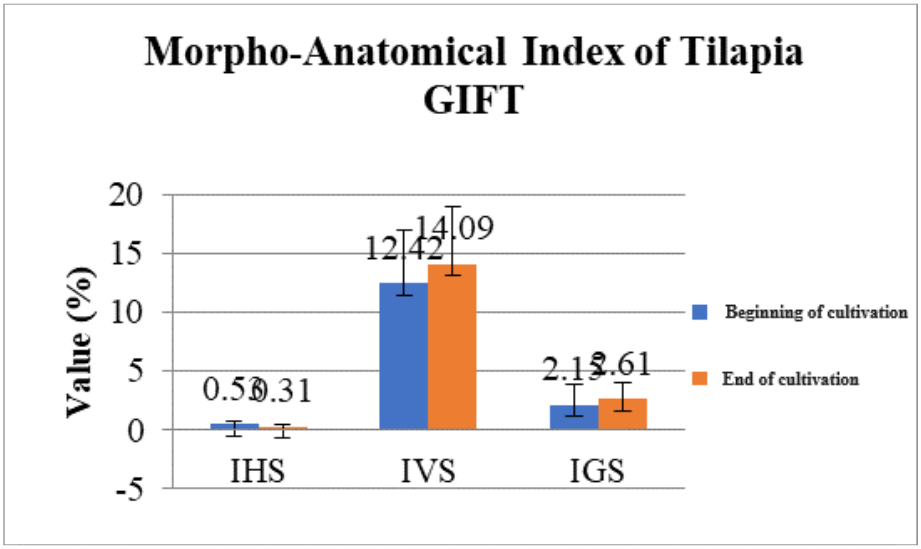

Figure 1. Average Graph of Morpho-Anatomical Index Profile of Nile Tilapia GIFT
Note: HI = Hepatosomatic Index, VI = Viscerasomatic Index, GI = Gonadosomatic Index

the HI. This explains that there is a decrease in fat in the liver during the gonadal maturation process so low liver weight affects the HI value. This causes an increase in gonadal weight so that the GI value increases.

the results achieved is also compared to the findings by Sulistyo *et al.*, (2000)the HI value of fish is in the range of 1.02% - 1.61% in their natural habitat, the results of Heltonika (2009)observations have the highest average HI value of 1.28% and the lowest 1% with an average body weight of 15-50 grams. Meanwhile, according to Gunawan (2013)the HI value of Nile Tilapia is 1.01% with a body weight range of 5-10 grams. This indicates that a decrease in the value of HI in fish occurs due to increased body weight (Hammock *et al*., 2020). Rahmati et al. (2019) reported that if the body length of the fish increases, the body weight of the fish also increases, but at the same time the value of the hepatosomatic index will decrease.

Gonadosomatic index was compared to Gunawan (2013) whichthe gonadosomatic index value of Nile Tilapia obtained was 4-31%-6.60% with a body weight range of 7-10 grams. This shows that the difference in fish weight also affects the value of the gonadosomatic index itself because the ratio of gonad weight to the body weight of fish is different. Wouters et al. (2001)stated that the change in GI value was caused by the increase in gonadal weight during the growth and maturation of the gonads, while Arfah et al. (2013) stated that the increase in GI value was due to the allocation of energy derived from the feed so that it could increase the GI value.

The VI value is in line with the growth of the fish. As the fish's body weight increases, the visceral weight also increases which causes the VI value to also increase. In comparation with the results of Gunawan (2013)the VI value of Nile Tilapia obtained was 7.61%-8.71% with a body weight range of 7-10 grams. In natural habitat conditions as reported (Sulistyo et al., 2000)the VI value was achieved at 7.32%. Research (Lubis et al., 2018)explains that the increase in VI value is in line with fish growth. The size of the VI value indicates viscerasomatic growth caused by the nutritional content consumed by the fish, both protein, carbohydrate, and fat. (Lefevre et al., 2017)stated that the high-fat tissue, especially in the visceral part, was thought to be influenced by the level of feed consumption.

Table 1. Results of Average Growth of Nile Tilapia GIFT

Parameters	Unit	Yield
Absolute Length	cm	4.84
Absolute Weight	gram	89.78
Length Weight Relationship	-	2.6
Condition Factor	-	1.05
Specific Growth Rate (SGR)	%	1.5
Survival Rate (SR)	%	79

Growth

Growth of Nile Tilapia GIFT observed were absolute length, absolute weight, length-weight relationship, condition factors, specific growth rate, and fish survival. The results obtained can be seen in Table 1.

Absolute Growth

The growth data of Nile Tilapia GIFT cultivated in the Mina Mandiri POKDAKAN pond has an absolute length of 4.84 cm and an absolute weight of 89.78 grams. The growth in length and weight of this fish is influenced by the provision of appropriate food and stocking density that is not too high. Elrifadah (2013)stated that that the growth of fish kept is caused by the protein content used, where the protein content is good for the growth of Nile Tilapia GIFT is 20%-25%.

Stocking density also has an influence on growth where there will be competition for the use of feed and space for living. Length growth is influenced by internal and external factors. Internal factors partly depend on the condition of the fish, for example, the ability of the fish to utilize the remaining energy and protein after metabolism for growth. While external factors such as environmental factors which include water quality, temperature, pH, dissolved oxygen, and feed factors are very influential in the growth of Nile Tilapia length. Feeding with good quality and the right quantity will support the long growth of the organism. These two factors will balance the state of the fish's body while in the maintenance media and support the growth of Nile Tilapia (Zulkhasyni *et al.*, 2017).

Long Weight Relationship

The calculation results between the length and weight relationship of Nile Tilapia GIFT can be seen in Table 1. These results indicate that the value of b is less than 3 (b=2.6) which explains the growth pattern of Nile Tilapia GIFT which is negative allometric, where the growth of

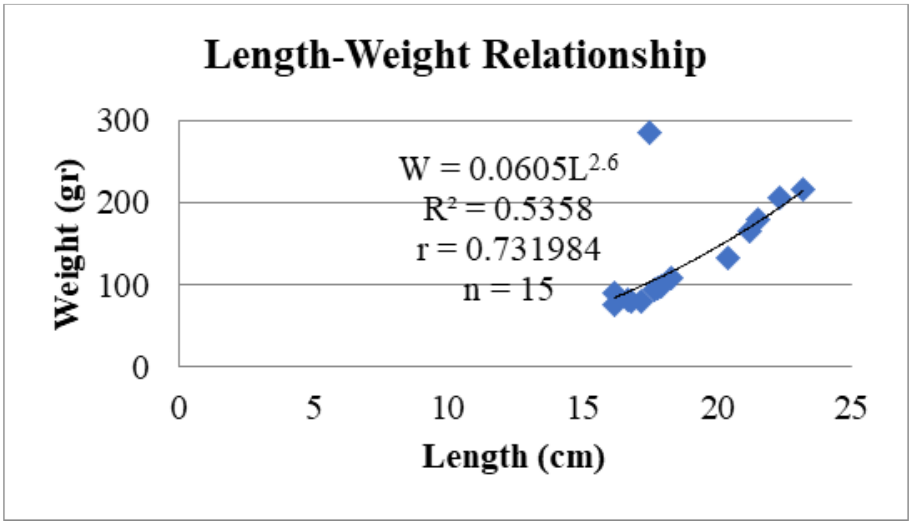

Figure 2. Graph of Nile Tilapia GIFT Relationship Length Weight

fish length is negative faster than body weight gain.

The results of the regression analysis and the graph of the relationship between length and weight at the end of cultivation had a regression equation of W= 0.0605 L2.6 with a coefficient of determination R2=0.5358. This means that a 53.58% increase in the body weight of fish occurs due to an increase in the body length of fish, while a 46.42% increase in fish weight is caused by other factors such as environmental factors. If the value of R2 is close to 1, the total length of the fish will increase as the body weight of the fish increases. The value of b in the relationship between length and weight of fish is a benchmark to determine the growth pattern of fish. The value of b = 3 indicates that the fish experienced an isometric growth (weight and length gain were equal). The value of b<3 indicates that the fish experienced negative allometric growth (length gain was faster than weight gain). A value of b>3 indicates that the fish experienced positive allometric growth (Supeni & Almohdar, 2017).

Condition Factor

Based on the data obtained, the condition factor was 1.05557. The condition factor can show the good or bad condition of the fish expressed in numbers. A condition factor value of more than 1 indicates that the environmental conditions of the fish are in good condition (Agustina *et al.*, 2018). Based on the results obtained, the condition factor of Nile Tilapia GIFT has good environmental conditions for fish growth. Condition factors provide an overview of the environmental conditions

of fish both in terms of water and feed quality. This is supported by good water quality and the discovery of various types of plankton which are suspected to be natural fish food. In addition, the appropriate density of fish is also one of the factors for fish to grow optimally.

Specific Growth Rate and Survival Rate

The results of the calculation of the specific growth rate (SGR) was 1.5% andfish survival was 79%, with the final number of fish as many as 237 fish and the final number of production of 36 kg. Based on the results obtained, the survival of Nile Tilapia GIFT is good which accordance to with the opinion of Mulyani& Fitrani (2014) that the survival rate of 50% is good, 30-50% survival is moderate and survival is less than 30% is not good. Nile Tilapia is easy to develop and has a high tolerance for changes in environmental conditions and can be reared with a relatively high density and fast growth and larger size than ordinary Nile Tilapia GIFT. These are result of cultivation for 2 months (60 days) of weight the initial average of 42.85 grams and the initial average length of 13.89 cm, being the final average weight of 132.63 grams and the final average length of 18.73 cm.

Feed

The content of pellet feed for Nile Tilapia GIFT cultivation has a protein content of 26-28%, a minimum of 5% fat, a maximum of 8% fiber, a maximum ash content of 13%, and a water content of 12%. This is in accordance with the nutritional quality standard in fish feed (SNI Nile Tilapia Feed (SNI 01-7242-2006).

Feed nutrition is one of the external factors that affect the growth of Nile Tilapia. Less and more nutrient content in fish feed will affect the consumption of fish, such as lack of protein will reduce fish weight, excess fat in feed has side effects on fish such as a decreased appetite for fish and decreased fish growth, fiber content affects fish digestibility so that feed good crude fiber is not more than 8% if more than 8% the digestibility of fish begins to decline (Nurfitasari et al., 2020). The high and low water content in the feed, the drier the feed, and the better the quality of the feed because the feed will not get moldy easily if the water content is high then the feed will get moldy (Zaenuri et al., 2014). Feeding with good quality and the right quantity will support the growth of the length of the organism, these two factors will balance the state of the fish's body

Table 2. Water Quality Data

Parameter	Yield	Quality Standart
Temperature	26-27^{0}C	25-32^{0}C (SNI 7550:2009)
pH	6-7	6-9 (PP No. 82 of 2001 Quality Standard Class II)
DO (mg/L)	5.2-5.4	>5 mg/l (SNI 01-6141-1999)

while in the maintenance medium and support the growth of Nile Tilapia.

Based on observations of natural food found in the POKDAKAN Mina Mandiri cultivation pond, plankton was identified in the laboratory of the Faculty of Fisheries and Marine Sciences, namely phytoplankton and zooplankton types. The types of phytoplankton found included P*ediastrum* s*p, Scenedesmus* sp, *Eudorina, Closterium* sp, *Actinotaeniumcucurbita, Ulothrix* sp, and *Coelastrum* sp. Meanwhile, from the zooplankton species, *Trichocerca Longiseta, Nicsmirnovius Eximius,* and *Trichocerca Pusilla* were found. Judging from their eating habits, Nile Tilapia is an omnivorous fish, so it is suspected that the plankton found is one of the natural food sources for Nile Tilapia (Iskandar& Elrifadah, 2015).

Water Quality

The water quality parameters measured were pH, temperature, and DO. Water quality during the Nile Tilapia GIFT rearing period is presented in Table 2 below.

The results of water quality measurements in aquaculture ponds include temperatures in the range of 26-27ºC, pH in the range of 6-7, and dissolved oxygen (DO) in the range of 5.2-5.4 mg/l. Referring to the quality standards, the measurement results are still in the good category for aquaculture.

Conclusion

Based on data processing, it can be concluded that the morpho-anatomical index profile value of Nile Tilapia GIFT cultivated in POKDAKAN Mina Mandiri has a hepatosomatic index (HI) of 0.31%, viscerasomatic index (VI) of 14.09% and a gonadosomatic index of 2.61%. The condition factor value of Nile Tilapia is 1.05557, and the relationship between length and weight is 2.6, which is negative allometric.

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