Morphological Character and Percentage of Hotate Clams (Patinopecten Yessoensis) Meat Weight in the Growing Phase, in Funka Bay, Hokkaido, Japan.

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Abstract

This study focuses on the growth and meat weight percentage of Hotate clams (Patinopecten yessoensis) during the rearing phase in Funka Bay, Hokkaido, Japan. Japan, as a major producer of seafood, including Hotate clams, plays a significant role in global seafood consumption. The objective of this study was to analyze the length-weight relationship of Hotate scallops and assess their meat weight percentage during the rearing phase. The research method involved observations using a random sampling technique during the period from August to October 2022. Samples were taken in Funka Bay, with coordinates between 42°20’-42°40’ North and 140°00’-141°00’ East at a depth of 43 meters. Results showed that the length-weight relationship of Hotate clams during August to October exhibited a negative allometric growth pattern, with the highest constant reaching 2.640. This means that length growth is faster than body weight. The percentage of Hotate clam (P. yessoensis) meat weight during the rearing phase ranged from 31.03% to 35.70%. This study provides important insights into the growth and meat composition of Hotate clams during critical phases in their culture in Funka Bay, Hokkaido, Japan. It can serve as a valuable information foundation for the management and maintenance of sustainable and productive Hotate clam aquaculture in the future.

Introduction

Japan is one of the largest seafood producing island countries in the world with the majority of its population consuming seafood such as fish, shrimp and shellfish, one of which is Hotate clams (Patinopecten yessoensis) (Aya et al., 2014). According to Guo dan Luo (2016), Hotate clams are a successful cultivated shellfish species with production increasing from less than 50,000
tons to 500,000–600,000 tons every year and accounting for 90% of Hotate shellfish production in Japan (Sakurai and Seto, 2000). Hotate clams cultivation is carried out through several stages.

Hotate clams are bred in pearl nets or lantern nets from summer to spring during the hon-bunsan and kari-bunsan breeding stages. The most efficient method of obtaining good and fast growth is to place 20-30 clams per sheet in pearl and lantern nets and cultivate them for approximately one to two years (Dvoretsky, 2022). The growing phase begins after the clams are 1 year old in spring from the growth of juvenile clams measuring 5-7 cm to a marketable size of 10-13 cm using the "Mimi-zuri" (hanging) method by drilling the left valve ear (Kosaka, 2016). Hotate clams during the enlargement phase experience changes in length and weight.

The length-weight relationship is the process of increasing clams growth over a certain period of time. Negative allometric and positive allometric values from the relationship between length and weight describe morphological characters as growth patterns for the clams (Aisyah, 2021). Negative allometric values indicate that the increase in length of the clams is more dominant than the increase in weight, and vice versa, this value also describes the environmental, physiological and productivity conditions of the clams (Kovitvadhi et al., 2009). Previous research indicates that the relationship between length and weight of Knife Clams is negative allometric. According to Prasadi et al., (2016) the length-weight relationship of blood clams (Anadara granosa) in Karangantu and Labuan shows negative allometric values. Apart from the length-weight relationship, shellfish growth can also be seen from the percentage of meat weight.

The percentage of meat weight in various types of clams is a form of growth pattern. Changes in size and increase in body weight of each clams are a measure that the organism is experiencing growth (Zabarun et
Additionally, the meat weight percentage describes how much meat consumers can consume. Research on the weight percentage of clams meat was carried out by Zabarun et al. (2016) who informed that the weight percentage of clams meat was influenced by the time of sampling; Setiawan et al. (2016) reported the percentage of wet meat weight of male *A. antiquata* clams; Haryatik et al. (2013) reported the percentage of wet meat weight of *S. grandis* clams. There is still not much information regarding the growth of Hotate clams from the aspect of the relationship between length and weight and percentage of meat weight, so research needs to be done.

**Materials and Methods**

This research was carried out from August–October 2022 in Funka Bay, Hokkaido, Japan. Astronomically, the latitude and longitude points of Funka Bay are located at 41°50’–42°40’ North and 140°00’–141°00’ East. Funka Bay is a location for cultivating Hotate clams in the Kunnu area of Hokkaido, Japan. The research location was carried out on the border of the beach located at the Hotate shellfish cultivation location. Hotate clams were collected with a tool called a creane in Funka Bay, Hokkaido, Japan. The depth of collection for the research samples was 42 – 45 m. The location for collecting Hotate clams from the processing location is approximately 20km.

**Research Methods**

The method used in this research is observation. The observation method is a method used to obtain data directly by observing and examining objects. The research data collection technique uses random sampling technique. According to Harahap et al., (2018) random sampling is a technique for determining locations and samples randomly by determining the number of samples to be studied. The main variables in this study include measuring growth characteristics which include length, weight and weight of clams.

**Clam Weight Total Calculation**

The total weight of the clams was calculated using a Tanita Fit Scan digital scale with an accuracy of 1 g. Total weight is measured by weighing the total weight of the shellfish as a whole by first cleaning the shells of attached parasites and pests.

**Meat Weight Calculation**

The weight of the meat was calculated using a Tanita Fit Scan digital scale with an accuracy of 1 gram. Weighing wet meat is done by weighing the meat filling which includes meat, heart, liver, tautacles, stomach, gills, intestines and tentacles without using feces.

**Data Processing**

![Figure 2. Hotate Clams Length Measurement (a) Ventral; (b) dorsal](image)

![Figure 3. Total Weight Calculation](image)
Sample data processing was carried out using Microsoft Excel software. Then the data is tabulated to get the desired data. The total lengths and weight of the clams will be used to calculate the length-weight relationship to calculate the growth of shellfish. Then divided the wet meat weight by the total meat clams weight, then multiply by 100 to get the percentage of clams weight (Zabarun et al., 2016).

Results and Discussion

Relationship between Length and Weight of Hotate Clams

The length-weight relationship is a relationship that describes two forms of growth, namely allometric and isometric. A value of $b<3$ means growth in length is faster than growth in weight (negative allometric), while a value of $b>3$ means growth in fish weight is faster than fish length (positive allometric) (Monice et al., 2021). The length-weight relationship also shows the growth value using length-weight parameter calculations ($a$ and $b$) (Rahardjo dan Simanjuntak, 2008). Data on the total length and weight of Hotate clams (*Patinopecten yessoensis*) with an observation period of three months were used to calculate the relationship between length and weight. The results of calculating the relationship between length and total weight of Hotate clams in August, September and October can be seen in Figure 5.

![Figure 4. Meat Weight Calculation](image)

![Figure 5. Graph of the Relationship between Length and Weight of Hotate Clams for the Months (a) August, (b) September and (c) October](image)

The relationship between the length and weight of Hotate clams in August, September and October showed $b$ values of 2.640, 1.001 and 1.793 respectively so that the growth of Hotate clams was negative allometric ($b<3$). Accordingly, shell length growth dominates shell weight growth. The results of this study are the same with Maharani et al., (2019) which stated that shellfish (*Anodonta woodiana*) from July to September showed a constant value of $b<3$, which was negative allometric. Research by Haryatik et al., (2013) explains that the relationship between length and weight of knife clams (*Solen grandis*) shows a negative
allometric value with a constant b value of 2.152 in November, resulting in a flat shape due to the increase in shell length being faster than the increase in weight. According to Hasan et al., (2014) the b value for the length-weight relationship of G. erosa clams in the Belawan mangrove ecosystem is 2.302. Notonegoro and Pratiwi, (2022) also explained that shellfish (Anadara granosa) produced a b value of 2.132.

The calculation results in Figure 5 for August, September and October produce coefficient of determination (R2) values of 58.9%, 21.9% and 55.7%. According to Komala et al., (2011), the coefficient of determination (R2) for A. antiquata clams was 0.94, indicating that the length of the shells influenced the total weight of the shells by 94.5%. Each point has a constant b value and a different coefficient of determination (R2) value with a different correlation coefficient (r) value, namely in August and October it was 0.767 and 0.746, meaning the correlation is strong, while in September the r value is 0.468, which means weak correlation. The correlation coefficient (r) is used to determine the direction and strength of the relationship between two or more variables. According to Rochmady, (2012) if the correlation coefficient value is close to 1 then there is a strong relationship between total weight and shell length. This is in accordance with (Monice et al., 2021; Windarti, 2020) which states that if the r value is close to 1, it means there is a strong relationship between length and weight and if the r value is not close to 1, it means the relationship between length and weight is weak. This strong or close relationship is thought to be due to the availability of sufficient food and also environmental conditions that support growth. This is in accordance with (Jamabo et al., 2009) the value of the b constant in Tympanotonus fuscatus var clams from August to October decreased, thought to be caused by three factors that influence the growth rate of clams, namely water temperature, food and reproductive activity.

![Figure 6. Weight Percentage of Hotate Clams Meat in August, September and October](image)
Hotate Clams Meat Weight Percentage

Hotate clams (*Patinopecten yessoensis*) have internal organs such as mantle, tentacles, eyes (ocelli), flesh, anus and nervous system (adductor muscles). Calculation of wet meat weight per total weight aims to determine the percentage of wet meat weight contained in the shell (Zabarun *et al*., 2016). The calculation of the percentage of meat weight from August to October is shown in Figure 6.

Based on the research results, it shows that the weight percentage of Hotate clams meat in August was 35.70%, in September was 34.46% and in October was 31.03%. The results of the ANOVA analysis showed that the time (month) of sampling had a significant effect on the percentage of meat weight (P<0.05). Tukey’s further test results showed that the percentage of Hotate clam meat in August (35.70 ± 5.41%) b was significantly different from October (31.03 ± 4.70%) a, while the percentage of Hotate clams in August was (35.70 ± 5.41%)b is not significantly different from September (34.46 ± 5.28%)b (Figure 6). This is thought to be due to the high suspended food and organic matter values in August and September compared to other months. According to Bahtiar (2012), food availability is one of the factors that influences growth. Food provides energy for organisms that allows them to grow, survive, and develop. If food is available abundantly enough, it will allow for increased reproduction in clams.

The results of the percentage weight of Hotate clams meat ranged from 31.03 ± 4.70 to 35.70 ± 5.41. The results of this study are similar with Fuji and Hashizume, (1974) who stated that the percentage of meat from *P. yessoensis* clams kept for 3 years was 29%-50%. The results of this study differ from those of Parsons and Dadswell, (1991) who also stated that the percentage of cultured mussels (*P. magellanicus*) in Passamaquoddy Bay, New Brunswick was 17.08% and wild mussels was 12.23%. Hennen and Hart, (2012) said that clams (*P. magellanicus*) in Georges Bank had a meat weight percentage of 8.55% to 7.94%.

**Conclusion**

Based on the results and discussions it was concluded that Hotate Clams (*P. yessoensis*) in the enlargement phase produced negative allometrics, which means that growth in length was more dominant than weight. The weight percentage of Hotate clam meat (*P. yessoensis*) in the growing phase in August, September and October produced a percentage of (31.03 ± 4.70 %) to (35.70 ± 5.41 %).

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