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International Journal of Zoology and Animal Biology
ISSN: 2639-216X

The Effect of Different Moon Phases to the Dynamics of Total Cholesterol and Glycogen Content of Mangrove Crab (Scylla Olivacea) Cultured with Silvofishery System

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Research Article
Volume 4 Issue 1
Received Date: December 21, 2020
Published Date: January 12, 2021
DOI: 10.23880/izab-16000265

Abstract

Scylla olivacea is one of mangrove crab species commonly found in South Sulawesi and has the potential to be cultivated using the silvofishery system. This research was conducted in the mangrove area of Mandalle Village, Pangkep Regency and South Sulawesi, Indonesia. The objective of this research was to compare the total cholesterol and glycogen contents of mangrove crabs (*S. olivacea*) maintained by the silvofishery system that was stocked with the beginning of different moon phases. The research container used a fixed cage made of bamboo in a circular shape with a diameter of 2.25 m. The tested animals used were mangrove crabs weighing 150-160g from collectors in Pallime Village, Cenrana District, Bone Regency, South Sulawesi and reared for 30 days. The study consisted of four treatments with three replications each. The four types of treatment were the differences in the beginning of the different phases of the moon, namely: new moon, quarter, full moon, and three-quarters. The research data were analyzed using the Kruskal-Wallis analysis and the Mann Withney U test. The results of the Kruskal-wallis analysis showed that the difference in the moon phase had no significant effect ($p > 0.05$) on cholesterol content, but had a very significant effect ($p < 0.01$) on the glycogen content of mangrove crabs. The best glycogen content of crabs is produced during the new moon phase.

Keywords: Moon Phase; Mangrove Crab; Body Chemical Composition; Growth; Survival

Introduction

One of many species of mangrove (mud) crabs found in South Sulawesi is *Scylla olivacea*. This species is preferred by the public because it contains high enough nutrients. Based on the results of proximate analysis, it was known that male *S. olivacea* contains 42.89-46.67% protein, 10.96-13.12% fat, and 3.660-3.883 kcal/g energy [1]. On the other hand, mangrove crabs contain high cholesterol levels, i.e. 76 mg /100 g [2]; 58.33-66.67 mg /100 g [3], while the mole crab ranges from 3.89 g/100 g [4]. This is one of the reasons for older people to avoid consuming it. Cholesterol is a component of fatty acids in the blood that the body actually needs to form hormones and treat nerve cells. However, if the cholesterol is in excess amounts, it may become a serious threat to the human body, even causing death [5,6]. Therefore, knowledge about crab cholesterol content is very important, to consider consumers in consuming crab.

Crab cholesterol content is thought to come from eating activity and the type of feed consumed. One of the factors that influence the activity and behavior of eating crabs in nature is the moon phase [1,7]. The moon's phase is the shape of the moon which always changes when viewed from the earth, depending on the position of the moon to the sun when viewed from the earth. The moon phase periodically

during one month changes which recur throughout the year, which can affect foraging, migration or reproduction patterns [8-11]. This phenomenon is something that affects the tidal, osmotic, and feeding activity of crab [12,13].

The lunar phase is also thought to have an effect on the glycogen content of mangrove crabs because it is related to the eating activity of crab. Glycogen is a form of polysaccharide that comes from excess glucose in the body and is a form of storage for glucose, especially stored in the liver and [14,15]. Glycogen is a form of polysaccharide that comes from excess glucose which is occurs in the body and is a storage form of glucose, mainly stored in the liver and in the muscles.) When mangrove crabs require an energy source from blood glucose but insufficient, the glycogen in the liver cells will be broken down to further become an energy source.

Information regarding the cholesterol and glycogen content of mangrove crabs that are maintained by the silvofishery system which is spread with different early moon phases does not yet exist, so research on this needs to be conducted. This study was aimed to compare the total cholesterol and glycogen content of mangrove crabs (S. olivacea) maintained by the silvofishery system that was stocked with the beginning of different moon phases.

Research Methods

The research was conducted in the mangrove area of Mandalle Village, Mandalle District, Pangkajene and Archipelago Regency, South Sulawesi Province, Indonesia. Crab cholesterol and glycogen analysis was carried out at the Animal Feed Chemistry Laboratory, Faculty of Animal Husbandry, Hasanuddin University, Makassar.

The research container used a fixed cage made of bamboo in a circular shape with a diameter of 2.25 m and embedded in the mangrove area of *Rhizophora.* To keep the water circulating in the cage running smoothly, the bamboo halves were spaced about 1 cm apart from each other. The outer part of the cage was covered with a *waring* (rope net) to protect the cage from garbage and dirt carried by the waves.

The tested animals used were mangrove crabs (*S. olivacea*) with a weight of 150-160 g each. The crabs were obtained from crab catchers in Pallime Village, Cenrana District, Bone Regency, South Sulawesi and kept for 30 days. Before the crabs were spread into the research container, their weight was first selected by weighing it using a digital sitting scale with an accuracy of 1.0 g and adapting them to the environmental conditions for two days. During the adaptation period, crabs were given food in the form of chopped *Tilapia* once a day.

The feed used was trash fish in the form of minced *Tilapia* fish. Feeding was done once a day, i.e., in the afternoon at 5 pm with a dose of 10% of the crab biomass.

The study consisted of four treatments with three replicates each, so this research consisted of 12 experimental units. The four treatments were differences in the time of spreading based on the phases of the moon, namely: new moon, quarter moon, full moon, and three-quarter month.

The parameters observed in this study were total cholesterol and glycogen content of mangrove crabs. Crab total cholesterol levels were analyzed using the Liebermann Burchard method. The glycogen content of mangrove crabs can be determined through the determination of glycogen following AOAC guidelines [16].

As supporting data, during the research, several parameters of water chemistry and physics were measured, including: temperature, salinity, pH, dissolved oxygen, ammonia, and nitrite. Temperature, salinity, pH, and dissolved oxygen were measured twice a day, namely in the morning (6 am) and evening (5 pm). Ammonia and nitrite were measured three times during the study, namely at the beginning, middle, and end of the study.

The data obtained were analyzed using non-parametric statistics (Kruskal Wallis and Mann Withney U test). As a tool to carry out these statistical tests, the SPSS version 23.0 program package was used. The water quality parameters were analyzed descriptively based on the feasibility of mangrove crab life.

Results and Discussion

Results

Crab Cholesterol Levels

The average total cholesterol content of mangrove crabs spreaded with different moon phases is presented in Table 1.

Moon Phase	Cholesterol Content (mg/100g)
New	95.33 ± 2.52
A Quarter	100.33 ± 10.21
Full Moon	90.33 ± 20.03
Three-Quarter	92.67 ± 4.16

Note: It is no significantly different between treatments at the 5% level ($p > 0.05$)

Table 1: The average total cholesterol level of mangrove crabs that is maintained by the silvofishery system with different moon phases

Kruskal Wallis Analysis results showed that the moon phase had no significant effect ($p > 0.05$) on the total cholesterol content of mangrove crabs.

Crab Glycogen

The average glycogen content of mangrove crabs stocked with different moon phases is presented in Table 2.

Moon Phase	Glycogen Content (%)
New	33.67 ± 0.68a
A Quarter	30.53 ± 1.21b
Full Moon	26.52 ± 0.65c
Three-Quarter	29.93 ± 1.13b

Note: Different letters in the same column show a significant difference between treatments at the 5% level ($p < 0.05$)

Table 2: The average glycogen content of mangrove crabs maintained by the silvofishery system which is stocked with different moon phases

Kruskal Wallis Analysis results showed that the moon phase had a very significant effect ($p < 0.01$) on the glycogen content of mangrove crabs. Furthermore, the results of the Mann Withney U test showed that the glycogen content of the mangrove crabs spreaded in the new and full moon phases was significantly different ($p < 0.05$) from other moon phases. However, the glycogen content of crabs between one-quarter and three-quarter moon phases did not show a significant difference ($p > 0.05$).

Water Quality

During the research, measurements were taken of the physical and chemical environment of mangrove crab maintenance. The range of physical and chemical environmental values for mangrove crab maintenance during the study is presented in Table 3.

Parameter	Value Ranges
Temperature (oC)	25-30
Salinity (ppt)	23-30
pH	7.25-8.12
Dissolved Oxygen (ppt)	3.80-5.78
Ammoniac (ppm)	0.005 – 0.054
Nitrite (ppm)	0.27 – 0.48

Table 3: The range of environmental water quality values for crab rearing during the study.

Discussion

The cholesterol content produced in this study is relatively similar in different phases of the moon, meaning that the maintenance month phase does not affect the cholesterol level of crabs. This is because the crab rearing system is good enough for controlled environmental conditions, thus limiting the crab's movement and foraging. Thus, the energy used for activities is stored as food reserves in the form of fat which contains cholesterol [3]. In addition, the feed given was trash fish with the same dosage and frequency. According to Hadiwiyoto, et al. [17] trash fish contains quite high nutrition, namely 60.78% protein, 10.23% fat, 19.12% carbohydrates, and 70 mg/g.

Cholesterol is a structural lipid (forming cell structures) that serves as a required component in most body cells. Cholesterol is produced in the liver about 80% and the rest is obtained from foods rich in cholesterol. Cholesterol is an important animal sterol which occurs almost exclusively in animal tissue. It is considered an essential dietary nutrient for crustaceans (crab and shrimp). Crustaceans are incapable of de novo sterol synthesis and require a dietary source of exogenous cholesterol for growth, development and survival. It was also reported that cholesterol is the highest precursor for ecdysone synthesis, which is closely involved in the process of moulting in crustaceans [14,18]. A dietary cholesterol level of 0.51% was found to be optimum requirement for the best growth of mud crab [14]. Another study suggested that mud crab (*Scylla serrata*) larvae required at least 0.61% cholesterol for maintaining good survival and development [19].

Knowledge of crab cholesterol content is very important, to be considered by the consumers in consuming crabs for their health. Cholesterol in crabs can increase cholesterol levels in the blood. The body will remain healthy, if the intake of cholesterol is still balanced with the needs, but the intake of excess cholesterol will increase cholesterol levels in the blood. Cholesterol levels obtained in this study ranged from 92.67 to 100.33 mg/100g. Different crab cholesterol levels were obtained by Syafiq, et al. [2] and Pramudya, et al. [3] and The U.S. Department of Agriculture was 76 mg/100g and 78 mg/100g, respectively. However, the resulting crab cholesterol levels are still within the threshold of normal human cholesterol consumption of around 300 mg/day [20,21].

Crab glycogen levels at a quarter month and three quarters month did not show any significant difference. The highest glycogen content of crabs was produced in the new moon phase and the lowest was at the full moon. The high glycogen content of crabs in the new month indicates that the maintenance of crabs in the new month can produce good glycogen deposits. In the new month the activity of eating crab increases and the excess feed consumed will be stored as reserve energy in the form of glycogen. When mangrove crabs require an energy source from blood glucose

but insufficient, the glycogen in the liver cells will be broken down to furtherly become a source of reserve energy which is essential for survival and maintaining normal function of body cells, for example when moving and swimming.

Conclusion

Based on this study, it may be concluded that the cholesterol content of the mangrove crab meat maintained by the silvofishery system is the same in all month phases, while the highest glycogen content is produced in the new moon and the lowest is at the full moon.

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