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COMPARISON AMINO ACID PROFILE OF PEARL LOBSTER (*Panulirus ornatus*) FED WITH COMBINATION OF FISH MEAL AND MOLLUSC MEAL

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Abstract

Panulirus ornatus is a vital fishery commodity that has high economic value. The research aims to examine the growth, amino acid profile, and intestinal histology of Panulirus ornatus fed a combination of fish meal and mollusk meal using a randomized block design (RBD) method with four treatments and three replications fed with four formulations for 50 days of maintenance. Four formulated feeds contained 20% sardine fish meal + 20% jackmackerel fish meal (treatment A), 10% mangrove snail meal + 15% golden snail meal + 15% mussel clam meal (Treatment B), 15% mangrove snail meal + 10% golden snail meal + 15% mussel clam meal (Treatment C), and 15% mangrove snail meal + 15% golden snail meal + 10% mussel clam meal (Treatment D) were given to pearl lobsters once a day at a dosage of 3% of their weight body. Mussel clam meal has more essential and nonessential amino acids than mangrove and golden snail meal. Mangrove snail meal has higher histidine levels than golden snail meal and mussel clam meal. The results of the amino acid analysis of the test feed showed that the total essential amino acids and total nonessential amino acids in all test feeds showed the same amount, namely 13,0 -14,0%.The findings concluded that feed containing The combination of mollusks meal is more suitable than the combination of fish meal for the growth and amino acid needs of pearl lobsters.

Keywords: *Amino Acids, Intestinal Histology, Pearl Lobster, Mollusc Meal*

INTRODUCTION

Pearl lobster (*Panulirus ornatus*) is a vital fishery commodity with high economic value and is one of Indonesia's mainstays of cultivation efforts. Pearl lobster (*Panulirus ornatus*) is an essential economic organism cultivated when it entered the puerulus phase (Haikal et al., 2017). Pearl lobster (*Panulirus ornatus*) is one type of seafood from the crustacean group that has high economic value among other crustaceans, such as shrimp and crab. Lobster is also a mainstay of fishery export commodities to foreign countries, and demand increases yearly. Some export destination countries are Japan, Korea and China (Mahmudin et al., 2016).

The success of cultivation is greatly influenced by feeding, which is one of the critical factors. The type of feed and the cost of feed are the benchmarks in selecting feed for the organisms being cultivated. Several things are unknown about the feed requirements of coral/marine lobsters. The suitability of the food evaluated from the experiment is based on two main criteria: optimal performance in terms of growth rate and survival and the best feed conversion ratio. Good growth with meat feed in coral lobsters (Suriadi et al., 2017).

The feed requirements used in the cultivation process must be adjusted to the body needs desired by the lobster so that the feed requirements can be practical and do not become waste or dirt in the cultivation container. Good nutritional content for seawater lobsters is 53% protein, 10% fat (Smith et al., 2003). The dietary needs in artificial feed are usually necessary to maintain cultivated organisms' growth. Protein is the most significant component of feed, around 40-60% of feed ingredients. So far, the source of protein feed ingredients generally comes from fish meal (Smith et al., 2005; Barclay et al., 2006; Khosravi & Lee, 2017).

So far, cultivating sea lobsters has used a lot of natural feed, one of which is trash fish, but its nutrition is not complete, so it is done by using mollusc meal in artificial feed. Mollusc meal, which has the potential to replace the essential ingredients of fish meal, is mangrove snail meat meal, golden snail meal, and kepah shell meal. These three ingredients have a high protein content and are abundant in nature. In addition, their use is rarely used (Lawao et al., 2018).

The quality of a protein ingredient is closely related to the type and amount of amino acids it contains (Machado et al., 2020). Likewise, the growth of shrimp and fish will be optimal if there is a match between the amino acids in the body of the fish/shrimp and the amino acids contained in the feed provided (Nuryadin et al., 2023), according to amino acids. Analysis of the amino acid profile can provide important information about the composition of essential and nonessential amino acids and show the overall amino acid composition. Therefore, it is required to conduct research combining three mollusc meals as feed to determine the amino acid content of pearl lobsters (*Panulirus ornatus*) fed a combination of mollusc meals.

RESEARCH METHODS

This research was completed in August - December 2023. The test lobster were reared at the Faculty of Fisheries and Marine Sciences, Halu Oleo University. Kendari. Proximate and amino acid analysis was performed at PT Saraswanti Indo Genetec Bogor.

Tools and materials

The tools and materials used in this study were analytical scales, thermometers, litmus paper, refractometers, shelters, plastic container boxes, aerators, aeration stones, surgical instruments, shell fragments/sand, seawater, pearl lobsters (*Panulirus ornatus*), and formalin.

Test Feed

The four types of feed tested on pearl lobsters differ in the content of fish meal, mangrove snail meal, golden snail meal and mussel clam meal in the feed. The test feed was made with a feed formulation according to the nutritional needs of the test lobsters. The ingredients and composition of the feed formulation used in the test lobsters (Table 1).

Table 1. Pearl Lobster (*Panulirus ornatus*) Test Feed for Each Treatment

Feed Raw Materials	Amount of Raw Materials in Each Treatment (%)			
	A	B	C	D
Sardine fish Meal (SFF)	20	0	0	0
Mackerel Meal (MF)	20	0	0	0
Mangrove Snail Meal (MSF)	0	10	15	15
Golden Snail Meal (GSF)	0	15	10	15
Shellfish Meal (SF)	0	15	15	10
Shrimp Head Meal (SHF)	15	15	15	15
Soybean Meal	25	25	25	25
Cornstarch	9	9	9	9
Fine Bran Meal	5	5	5	5
Sago meal	4	4	4	4
Corn Oil	0,5	0,5	0,5	0,5
Fish oil	0,5	0,5	0,5	0,5
Squid Oil	0,5	0,5	0,5	0,5
Top Mix	0,5	0,5	0,5	0,5
Total	**100**	**100**	**100**	**100**

Maintenance and Feeding

A total of 36 pearl lobsters weighing small 90-120 g, medium 120-150 g, and large 150-180 g were placed in 12 plastic container boxes measuring 61×43×38 cm designed using a seawater recirculation system and equipped with aerators, hoses and aeration stones and labelled according to treatment. The container was filled with water and aerated for 24 hours with a water volume of 70 L. Maintenance was carried out for 50 days. The lobsters used were acclimatized first. The acclimatization process was carried out for one week so that the lobsters could adjust to the environmental conditions of the study, both in terms of feed and water quality. During the acclimatization period, the lobsters were fed with trash fish. Feeding was carried out once a day, namely in the afternoon at 16.00 WITA, with a feed dose of 3% of the body weight of the pearl lobster. Daily observations of temperature, pH, salinity and dissolved oxygen (DO) at the study's beginning, middle and end.

Observed Parameters

Proximate Analysis

The proximate analysis conducted includes water content, protein, fat content, ash content, and crude fibre of the test feed. Proximate feed analysis is conducted by analyzing water content using the heating method in an oven at a temperature of 110℃ (method SNI 01-2891-1992 point 5.1). Protein content is tested by the Titrimetry method (method 18-8-31/MU/SMM-SIG). Total fat content is measured by the extraction method with a soxhlet apparatus (method 18-8-5/MU/SMM/SIG point 3.2.1). Ash content is done by drying the material in a heating oven at 600℃ (method SNI 01-2891-1992 point 6.1). Crude fibre dissolves samples with solid acids and bases (method 18-11-111/MU/SMM-SIG gravimetry).

Amino Acids and the Pearl Lobster Body

Amino acid analysis of test feed, molluscs and pearl lobster bodies were analyzed at PT. Saraswanti Indo Genetec. The amino acid analysis is used to determine the content of essential and nonessential amino acids using a method according to standard number 18-5-17/MU/SMM-SIG ultra-performance liquid chromatograph (UPLC).

Data Analysis

The amino acid profile of the pearl lobster body, and water quality were analyzed using descriptive method.

RESULTS

Proximate Analysis

The proximate analysis results of the test feed and mollusc meal (Tables 2 and 3).

Table 2. Results of Proximate Analysis of Test Feed

Parameter (%)	Test Feed			
	A	B	C	D
Water Content	9,93	9,36	9,15	9,71
Protein Content	38,52	33,76	35,52	35,56
Fat Content	2,96	1,74	1,99	1,11
Ash Content	13,17	11,34	10,39	10,9
Crude Fiber	9,66	10,39	11,36	11,12

Table 3. Results of proximate analysis of molluscs

Parameter (%)	Mangrove Snail meal	Golden Snail meal	Mussel Clam meal
Water Content	9,64	10,76	5,92
Protein Content	67,6	35,2	54,66
Fat Content	6,35	3,58	4,26
Ash Content	7,72	35,94	25,57
Crude Fiber	2,54	2,59	2,1

The results of the proximate analysis of the test feed showed that the protein content of the test feed ranged from 33,76%-38,53%, the water content was around 9%, the fat content ranged from 1,11= 2,96%, the ash content of the test feed ranged from 10-13%, and the crude fibre of the feed ranged from 9,0–11,0%. The mollusc feed ingredients showed that the highest protein and fat content were obtained in mangrove snail meal, which was 67,6% and 6,35%, respectively. At the same time, the ash content of mangrove snail meal was only around 7,72, while the ash content of kepah shell meal and golden snail meal were 35,94 and 25,57 mg/L, respectively.

Amino Acid Analysis

The amino acid analysis results of molluscs and test feed (Tables 4 and 5).

Table 4. Results of Mollusc Amino Acid Analysis (mg/kg)

Types of Amino Acids	Mangrove Snail meal	Golden Snail meal	Mussel Clam meal
Essential Amino Acids (EAA)			
Histidine	13500	5435	11780
Threonine	8200	15837	28461
Arginine	15300	20537	48370
Leucine	17300	24421	43806
Lysine	21200	15199	35837
Valine	7200	16771	27011
Isoleucine	14200	14098	25393
Phenylalanine	8400	15580	24111
Total	**105300**	**127878**	**244769**
Nonessential Amino Acids (NAA)			
Serine	9000	14528	28283
Glutamic Acid	39700	32207	67277
Alanine	7900	18035	31192
Glycine	20100	16027	30265
Aspartic Acid	26900	22926	43753
Tyrosine	11000	10158	18873
Proline	28500	10989	21716
Total	**143100**	**124870**	**241359**

Table 5. Results of Amino Acid Analysis of Test Feed (%)

Types of Amino Acids	Test Feed			
	A	B	C	D
Essential Amino Acids (EAA)				
Histidine	1,16	1,05	1,07	1,12
Threonine	1,8	1,75	1,81	1,8
Arginine	2,05	2,66	2,84	2,77
Leucine	2,51	2,28	2,44	2,4
Lysine	1,91	1,33	1,44	1,3
Valine	1,71	1,45	1,55	1,52
Isoleucine	1,43	1,2	1,27	1,25
Phenylalanine	1,83	1,77	1,86	1,89
Total	**14,4**	**13,49**	**14,28**	**14,05**
Nonessential Amino Acids (NeAA)				
Serine	1,68	1,79	1,88	1,83
Glutamic Acid	3,79	3,45	3,71	3,67
Alanine	1,81	1,55	1,68	1,65
Glycine	2,01	1,96	2,1	2,07
Aspartic Acid	2,38	2,09	2,25	2,19
Tyrosine	1,16	1,23	1,29	1,31
Proline	1,51	1,37	1,49	1,47
Total	**14,34**	**13,44**	**14,4**	**14,19**

Mussel clammeal has more essential and nonessential amino acids than mangrove and golden snail meal. Mangrove snail meal has higher histidine levels than golden and mussel clam meal. The results of the amino acid analysis of the test feed showed that the total essential amino acids and total nonessential amino acids in all test feeds showed the same amount, namely 13,0 -14,0%.

Total Amino Acids of The Test Lobster Body

The results of the calculation of total essential amino acids (ΣEAA) and nonessential amino acids (ΣNeAA) during the study are presented in Figures 1 and 2. Treatment A (20% TFF + 20% MF), B (10% MSF + 15% GSF + 15% CF), C (15% MSF + 10% GSF + 15% TKK), D (15% MSF + 15% GSF + 10% CF).

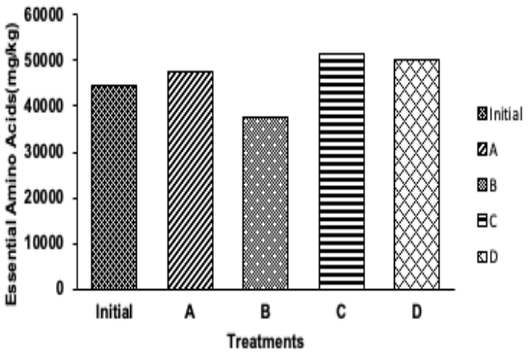

Figure 1. Total essential amino acids in the body of pearl lobster (*Panulirus ornatus*)

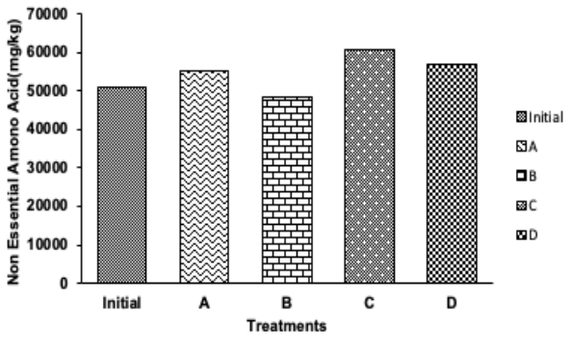

Figure 2. Total nonessential amino acids in the body of pearl lobster (*Panulirus ornatus*)

Composition of Essential Amino Acids

The results of measuring the composition of essential amino acids (*Panulirus ornatus*) during the study are presented in Figures 3 and 4.

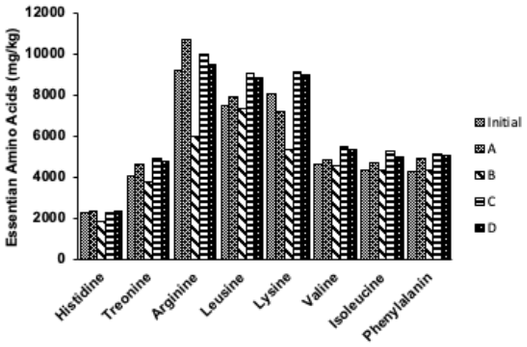

Figure 3. Essential amino acid composition of pearl lobster (*Panulirus ornatus*)

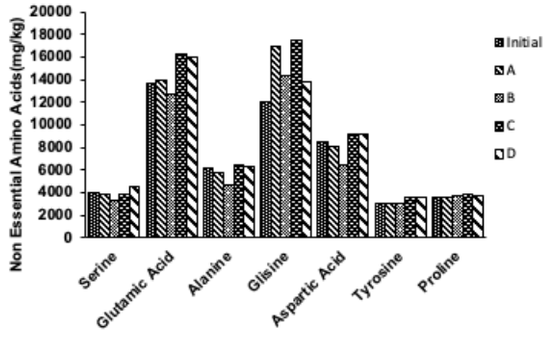

Figure 4. Nonessential amino acid composition of pearl lobster body (*Panulirus ornatus*)

DISCUSSION

Amino acids are the most crucial part of the formation of proteins. Complex and simplified proteins are broken down into two groups, namely essential amino acids and nonessential amino acids. Essential amino acids are amino acids that cannot be produced in the body, so they must be added or taken from outside the body in the form of food and drink. In contrast, nonessential amino acids are amino acids that can be produced in the body, so they do not need to be taken from outside the body (Sitompul, 2004).

The results of the study of total essential amino acids and nonessential amino acids showed an increase. The highest crucial amino acids and nonessential amino acids were found in treatment C (Figure 5 and Figure 6). This is thought to be because the amino acid content in treatment C (15% MSF + 10% GSF + 15% SF) has the highest amino acid content, both essential and nonessential amino acids (Table 6), so that absorption goes well. Ramadhan et al., (2021) state that the body can absorb amino acids, which help carry out protein functions in the body, so the higher the protein, the higher the levels of amino acids produced. Wu et al., (2011) also stated that the higher the levels of essential amino acids in a food ingredient, the better the protein quality in the food ingredient.

The lowest total essential and nonessential amino acids (Figure 5 and Figure 6) were found in treatment B (10% MSF + 15% GSF + 15% SF). It is suspected that in treatment B, there was inflammation of the intestinal tissue, so more amino acids were used to repair the inflammation of the intestinal tissue. This is to the statement of Kamiya et al., (2002) that amino acids function to repair damaged tissue after injury, protect the liver from various toxic substances, lower blood pressure, regulate cholesterol metabolism, encourage growth hormone secretion, and reduce ammonia levels in the blood. Paisey (2009) also expressed that amino acids are part of the protein that repairs body organ tissue. As a source of energy in the metabolic process, there is an imperfection if there is a lack of amino acids, so the growth system is disrupted and does not run optimally.

The amino acid profile conducted aims to determine the amino acid composition of the body of pearl lobsters fed with a combination of mollusc meal test feed. The results of the amino acid content test of the body of pearl lobsters after being fed a combination of mollusc meal contained eight types of essential amino acids, namely histidine, threonine, arginine, leucine, lysine, valine, isoleucine, and phenylalanine. At the same time, nonessential amino acids contain seven types of nonessential amino acids, namely serine, glutamic acid, alanine, glycine, aspartic acid, tyrosine and proline. The analysis showed that essential and nonessential amino acids were composed in each treatment (Figure 7 and Figure 8).

The analysis results of essential amino acids have content values that are not much different, as there are as many as three types: arginine, leucine, and lysine. However, the highest crucial amino acid value is arginine, while the lowest amino acid is Histidine (Figure 7). The essential amino acid, arginine, is an amino acid that is included in the group of glucogenic amino acids, which are amino acids that can be converted into glucose and glycogen (Mandila, 2013). The amino acid arginine also functions in immune system activity and wound healing, helps regenerate damaged livers, and helps heal through collagen synthesis (Roberts et al., 2018; Arribas-López et al., 2021). The amino acid arginine is an essential amino acid necessary for marine animals. Therefore, it is a high-protein food (Wang et al., 2021). Leucine functions to increase the production of growth hormones and helps burn visceral fat located in the deepest layers of the body. Lysine is an essential ingredient for blood antibodies, strengthens the circulatory system, and maintains average cell growth with proline and vitamin C to form collagen. Histidine is an amino acid that promotes growth and repair damaged body tissue (Abdullah et al., 2013).

The analysis results of nonessential amino acids have content values that are not much different, as there are as many as two types, namely glycine and glutamic acid. However, the highest value is glycine, and the lowest is Tyrosine (Figure 8). Glycine is an amino acid inhibiting brain processes that cause movement stiffness, such as in multiple sclerosis (Özogul & Özogul, 2007). Glycine is essential in stimulating the release of growth hormones, helping muscle development and growth and wound healing. Glycine is an amino acid that is a primary metabolite for tissue formation (Razak et al., 2017). Besides providing an umami taste, Glutamic acid can accelerate wound healing in the intestines,

improve mental health, and reduce depression (Mandila, 2013). Tyrosine has several benefits, such as reducing stress, anti-depression and detoxifying drugs and cocaine (Marriott, 1994; Young, 2007).

Water quality parameters are one of the critical factors in the cultivation process. The results of temperature measurements during the study were 24-26°C, still within the optimal range. This aligns with (2010), who states that the optimal temperature for maintaining seawater lobsters ranges from 23 to 32°C. The pH value during the study was 7,0-7,2. The pH value is still within the optimal range for maintaining lobsters. This is based on (2018), who states that this pH range is still suitable for maintaining pearl lobsters in the range of 7,0-8,5. The dissolved oxygen content during maintenance was 4.9-5.9 mg/L. This result is still within the optimum range for pearl lobster maintenance media. This is in line with Kittaka & Booth's (2000) statement that the minimum dissolved oxygen concentration that can be used for lobster cultivation is equivalent to 2,7-5,4 mg/L. The salinity value at the time of the study was 30-33 ppt, which is still stable for maintaining pearl lobsters. According to Tong et al., (2000), sea lobsters are generally found in waters with a 25-40 ppt salinity. The results of research conducted by Akmal & Ahmadi (2021), namely the maintenance of sand lobster seeds (*Panulirus ornatus*), obtained an average salinity of 30 ppt, suitable for lobster cultivation.

CONCLUSION AND SUGGESTIONS

Conclusion

Based on the results of the study of amino acid profiles and histology of the intestines of pearl lobsters (*Panulirus ornatus*) fed a combination of mollusc meal, the following conclusions can be drawn:

1. The highest total essential and nonessential amino acids were obtained in treatment C (15% MSF + 10% GSF + 15% MCF) and the lowest in treatment B (10% MSF + 15% GSF + 15% MCF)
2. The highest essential amino acid composition content is arginine, and the lowest is histidine. The highest nonessential amino acid is glycine, and the lowest is tyrosine.

Suggestion

The use of mollusc meal combination feed in artificial feed for seawater lobster cultivation is given at a higher dose of 15% mangrove snail meal+ 15% golden snail meal + 10% mussel clam meal.

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