Analysis of Chemical Quality of Dried Sendeish Sea Cucumber (*Holothuria scabra*) using Different Enzyment Methods

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Abstract Dried sandfish sea cucumber is one of the export commodities in the international market. Since ancient times, sea cucumbers have been used as medicines and foodstuffs. Certain nutritional content can be lost if there is an error in processing. The exact method used to remove calcium content is important because it can also affect the quality of sea cucumbers. Sea cucumbers can experience a decrease in quality so that it can have an impact on the price of sea cucumbers in the market. The purpose of this study was to determine the best method of processing dried sea cucumbers by using the enzyme papain from papaya fruit and leaves and its impact on the chemical quality of dried sea cucumbers. This study used a completely randomized design (CRD) with 2 treatments and continued with the Dunchan multiple range test at the level of α = 0.05 if the treatment had a significant effect (p < 0.01). This study used 2 treatments, namely treatment A which is the method of giving the enzyme, consisting of 3 levels, namely: A1 = initial immersion together with the papain enzyme (after washing sea cucumbers soaked in papain enzyme ± 30 minutes, before boiling 1). A2 = boiling the papain enzyme together (after washing, the sea cucumber is immediately cooked together with the papain enzyme). A3 = Stirring with the papain enzyme after boiling 1 (boiled sea cucumbers are stirred with the papain enzyme in a hot state). Treatment B, namely the part of papaya which is the source of the enzyme, consists of 2 levels, namely: B1 = sliced papaya leaves and B2 = sliced papaya fruit. Data were analyzed by ANOVA. From the analysis, the lowest water content in the boiling method together with the enzyme from papaya fruit was 12.48%, the highest ash content in the boiling method together with the enzyme from papaya leaves was 4.32%, the highest protein content in the initial soaking method along with the enzyme from papaya fruit was 74.03%, the highest fat content in the method of giving the enzyme from papaya leaves after boiling 1 was 2.14%, and the highest carbohydrate content in the boiling method together with the enzyme from papaya leaves was 9.02%. The results of statistical tests showed that there was no significant difference between the enzymes from the leaves and papaya fruit on the chemical quality of dried sea cucumbers and the boiling method together with the enzymes from papaya fruit was the best treatment because it had the best chemical quality characteristics.

1. Introduction

This animal is called sea cucumber because of their elliptical shape, similar to a cucumber. The body shape of sea cucumbers is elliptical (elongated cylindrical) along the oral-aboral axis, which is the axis connecting the anterior and posterior (Wilmoth, 1967).

The potential for sea cucumbers from capture fisheries in Indonesia is quite large, namely 3,517 tons in 2001 (DKP, 2003). According to Brown et al. (2010), Indonesia ranks first out of 38 exporting countries of sea cucumbers in the world with a percentage of 12% of total exports. Most of the processed
sea cucumber products from Indonesia are exported in the form of dried and smoked sea cucumbers. Sea cucumbers contain various kinds of compounds whose size varies depending on the species. Processing of sea cucumbers in dry form can have an impact on their nutritional content. Dried sea cucumber contains the following nutrients: 8.90% water content; protein 82.0%; 1.70% fat; ash 8.60%; 4.80% carbohydrates; Vitamin A 455 μg%; vitamin B (thiamine) 0.04 mg%; niacin 0.4mg%; riboflavin 0.07mg%; and calories 365 cal/100 g (Anonymous., 2007a) while according to Herliany et al (2016), the moisture content of dried sea cucumbers is 7.3%; ash content of 9.8% and protein content of 79.59%. Various technologies and methods are used to reduce the nutritional value of sea cucumbers to a minimum.

Sea cucumbers are one of the potential export commodities in Indonesia. The Southeast Maluku region is one of the areas that has the potential to produce sea cucumbers, this is supported by the condition of the waters including the substrate which can be a good habitat for sea cucumber growth.

According to Azis (1987), about 23 types of sea cucumbers are exploited in Indonesian waters. Holthuria scabra is a type of sea cucumber that is widely exploited. Sandfish Sea Cucumbers (Holothuria scabra) have the same body structure as sea cucumbers in general, which have a soft and slippery body. The body surface is not ciliated and covered by a thin layer of calcium depending on age. Along the mouth to the anus there are five rows of tube legs, consisting of three rows of tube feet with a sucker on the stomach (trivium) that plays a role in respiration (Lawrence 1987). The surface of the body covered with a layer of calcium is a characteristic of sandfish sea cucumbers. This calcium is often a problem in dry sea cucumber processing because it can affect the quality of dried sea cucumbers. Processing requires special treatment to soften the calcium layer. One way to soften the layer is by using an enzyme derived from papaya sap.

Until now, the use of sea cucumber has not been optimal and is still limited due to the lack of information on proper and correct post-harvest handling and processing. So far, the handling carried out is still traditional, namely drying sea cucumbers. The drying process is still conventional, so it tends to produce dried sea cucumbers that do not meet export standards. Lack of information about the nutritional content of dried sea cucumbers causes people who process sea cucumbers to sell them at low prices. One of the efforts that can be made to increase the added value of sea cucumbers is through increasing knowledge about good production stages and correctly including the method used. The step that needs to be considered is the removal of calcium on the surface of sea cucumbers. The more calcium that comes out can affect the appearance of dry sea cucumbers. In this process, the enzyme papain is usually used. This enzyme contains a lot of papaya sap. The part of the papaya plant that is the source of this enzyme that is commonly used is fruit and leaves. It is necessary to know the effectiveness of these two parts with the technique of using them in an effort to release calcium during processing. Through this research, it is hoped that it can provide information about which parts of papaya (fruit and leaves) are more effectively used as well as the best method of giving enzymes so that good quality sea cucumbers can be obtained. The purpose of this study is to determine the best treatment between the parts used as the source of papain enzyme from papaya (leaves and fruit) and the method of using the enzyme so that information is obtained about the best method using the enzyme papain in processing dried sea cucumbers.

2. Research Methods

Materials and Tools: The main ingredients used are sea cucumber (Holothuria scabra) obtained from the Regional Leading Product Development Program of Southeast Maluku harvest, papaya fruit, papaya leaves, water and several chemicals for testing, namely H2 SO4, Cu SO4 crystals, K2SO4 crystals, acid solution borate 5%, concentrated NaOH solution, HCI standard solution 0.1 N, Tashiro indicator, 1% Phenolphthalein indicator, concentrated nitric acid, hexane.

The tools used are cool box, boiling pan, thermometer, small basket for samples, trays, and equipment for analysis: Analytical scales, Memmert brand ovens, ovens, and Kjeldahl ashing furnaces. Glassware for testing purposes.
Processing of dried sea cucumbers is carried out at Mitra Regional Leading Product Development Program processing facilities in Langgur village, Southeast Maluku. The analysis was carried out at the Environmental Biotechnology Laboratory of PT. Biodiversity Biotechnology Indonesia.

Work procedure: The processing process uses three (3) methods. Method A1: A freshly harvested sea cucumber was eviscerated by cutting it 1 cm wide in the anus, then pressing it firmly on the stomach so that all the contents of the stomach come out. The sea cucumbers were then washed using clean water. Furthermore, sea cucumber treatment A1 was immersed in papain enzyme which consists of papaya leaf slices (B1) and papaya fruit slices (B2). Initial soaking with the enzyme papain for 30 minutes, stirring occasionally. The sea cucumbers that have been soaked are then carried out by boiling 1 with water at a temperature of $60^\circ \pm 5^\circ \text{C}$ for 30 minutes. Washed sea cucumbers to remove the calcium layer while brushing with a soft brush and then do boiling 2 to ripen the sea cucumbers. After that, washed and dried it again using a conventional dryer by maintaining a temperature of $60^\circ \text{C}$ for ± 24 hours until the sea cucumbers were dry. Dried sea cucumbers were ready to be analyzed for moisture, ash, protein and fat content. The A2 method refers to the modified Sasongko (2015) method: The process from harvesting to the washing stage after evisceration is the same as the A1 method. The washed sea cucumbers were then proceeded to boiling 1. The boiling process was carried out together with the papain enzyme from the papaya leaf slices (B1) and the papaya fruit slices (B2) while stirring. The boiling process was carried out at a temperature of $60^\circ \pm 5^\circ \text{C}$ for 30 minutes. The next process is the same as the A1 method, only boiling 2 is still boiling together with the papain enzyme. A3 method: this method used the traditional method which is usually done by Mitra. The process from harvesting to washing after evisceration was the same as the A1 method. The washed sea cucumbers would then carry out the boiling 1 process until the sea cucumbers were wrinkled and chewy. The boiled sea cucumbers were then put into a container that already contains the enzyme papain from the papaya leaf slices (B1) and another container containing the papaya fruit slices (B2) while stirring until the calcium layer came off. The rest of the process is the same as the A1 method. For more details, see the flow chart of the processing process in Figure 1. The resulting dried sea cucumbers were analyzed proximate, including water content (SNI 01-2356-1991), ash (SNI 01-2354-1991), protein (SNI 01-2365-1991), and fat (SNI) 01-2354.3-2006. This study used a completely randomized design (CRD), and continued with the Dunchan multiple range test at the 0.05 level if it had a significant effect. There are 2 treatments, namely treatment A: the method of giving the enzyme which consists of 3 levels, namely: A1: the initial immersion method in the papain enzyme before boiling, A2: The method of boiling together with the papain enzyme, A3: The method of stirring with the enzyme papain after boiling 1. Treatment B: The part of papaya as a source of enzymes consists of 2 levels, namely B1: Papaya leaves and B2: Papaya fruit. Performed 3 repetitions. Data were analyzed by ANOVA using SPSS version 23.
Figure 1. Dried Sea Cucumber Processing Flow Chart

3. Result And Discussion
The results of the analysis of the quality of dried sandfish sea cucumbers can be seen in Table.

| No. | Parameter     | Unit | A1 B1   | A1B2   | Average Analysis Results |
|-----|---------------|------|---------|--------|-------------------------|
| 1   | Water Content | %    | 12.54   | 15.93  | 12.76 12.48 14.58 14.52 |
| 2   | Ash Content   | %    | 4.11    | 3.40   | 4.32  3.94  3.82  3.36  |
| 3   | Protein       | %    | 73.06   | 74.03  | 72.77 73.82 73.37 71.14 |
| 4   | Fat           | %    | 1.99    | 1.08   | 1.13  1.45  2.27  1.23  |
| 5   | Carbohydrate  | %    | 8.30    | 5.56   | 9.02  8.31  5.96  8.31  |

Description:
A1B1: Initial immersion method before boiling 1 with enzymes from papaya leaves
A1B2: Initial immersion method before boiling 1 with enzymes from papaya fruit
A2B1: The method of boiling together uses enzymes from papaya leaves
A2B2: The method of boiling together uses enzymes from papaya fruit
A3B1: Stirring method with the enzyme from papaya leaves after boiling 1
A3B2: Stirring method with the enzyme from the papaya fruit after boiling 1

3.1 Water Content
The results of the analysis of diversity showed that the treatment of the enzyme application method, the source of the enzyme, and the interaction between the two treatments had a significant effect (p < 0.01) on the moisture content of dried sea cucumbers. Based on the results of the analysis of the water content of dried sea cucumbers, the highest water content was in the initial immersion treatment with the enzyme derived from papaya fruit before boiling 1 (A1B2) which was 15.93%, while the lowest water content was in the boiling treatment together with the enzyme from papaya fruit (A2B2), which was 12.48% (Figure 2).

![Figure 2. Water Content of Dried Sea Cucumber](image)

The results of Duncan's continued test showed that the second method of treatment (A2), namely boiling with the papain enzyme at a level of α = 0.05, was significantly different from the other two methods. This shows that the method of giving the enzyme with the joint boiling method produces dry sea cucumbers with a lower water content, while the initial immersion method with enzymes has a higher water content. This is thought to be due to the initial soaking with a more specific enzyme that comes from fruit, there is absorption of water from papaya. The water content of the papaya fruit is quite high. According to Mahmud et al. (2009), papaya fruit moisture content was 86.70%. This water may be trapped with the enzymes so that the water content is not completely evaporated causing a high-water content during drying.

Low water content will have an impact on the long endurance of sea cucumbers during storage. The drier a product is, the longer its durability will be (Herliany, 2011). This study produced dried sea cucumbers with a lower water content than Hutomo's research (1997), which produced dry sea cucumbers with a water content of 17.9%, but was somewhat higher than the research of Inayah et al. (2012) which produced dried sea cucumbers with a moisture content of 7.773%. 
3.2 Ash Content
The results of the diversity analysis showed that the treatment method, enzyme source, and the interaction between the two treatments had a significant effect (p <0.01) on the ash content of dry sea cucumbers. The mean of the analysis results showed that the highest ash content in the boiling treatment together with the enzyme from papaya leaves (A2B1) was 4.32, while the lowest ash content in the stirring treatment with enzymes from papaya fruit after boiling 1 (A3B2) was 3.36% (Figure 3).

![Figure 3. Ash Content of Dried Sea Cucumber](image)

The DMRT follow-up test showed that the treatment of method 2 boiling together with the papain enzyme (A2) was significantly different at the level of α = 0.05 with the other two methods, while the treatment of sources originating from papaya leaves was different (B1) from those from fruit (B2). From the graph, it could be seen that the use of papaya leaves with the boiling method together with the enzyme produced dry sea cucumbers with the best ash content. However, this result is still lower than the SNI standard, which is at least 7%. It is assumed that the ash content in the second method has less mineral damage because during boiling the temperature is controlled at 60°C compared to the other methods. Low ash content is also caused by other factors such as species and habitat. The higher the ash content contained in a food ingredient, the more mineral content is produced (Herniawan, 2010). The dominant minerals in sea cucumbers are sodium, calcium, potassium, phosphorus, and iron (Astawan, 2008).

3.3 Protein
The results of the analysis of diversity showed that factor A, namely the method of administering the enzyme and the interaction between the two, had a significant effect (p <0.01) on protein content, while factor B, the source of the enzyme, had no significant effect (p> 0.01) on protein content. The average result of the analysis of the highest protein content in the immersion treatment with enzymes from papaya fruit before boiling 1 (A1B2) was 74.03, while the lowest protein content was in the enzyme treatment of papaya fruit after boiling 1 (A3B1), namely 71.14 (Figure 4).
Figure 4. Protein Content of Dried Sea Cucumber

The results of Duncan's continued test showed that the initial immersion treatment of the papain enzyme (A1) was not significantly different at the level of $\alpha = 0.05$ with the boiling method together with the papain enzyme (A2) but significantly different from the stirring method together with the papain enzyme (A3). It can be seen here that the method has an effect on protein content. The average method of initial soaking with enzymes and boiling with enzymes produces dry sea cucumbers with higher protein content compared to dry sea cucumbers resulting from stirring after boiling 1. This is presumably due to the effect of temperature on boiling 1, where the A1 and A2 methods use a temperature of 60°C. Because using the traditional method, the temperature increase of the A3 treatment is not controlled, causing protein damage known as protein denaturation. Denatured protein is caused by several factors, one of which is due to heating. According to the results of research conducted by Nurjanah (2008), there was a decrease in protein levels after boiling the ronggeng shrimp, from 87.09% to 86.33% which was followed by a decrease in carbohydrate and fat levels.

The highest dried sea cucumber protein content of this study (74.03%) was higher than the dried sea cucumber protein content produced by Hutomo (1997), namely 56.62%, but still low from the results of the research by Herliany et al. (2016), which was 79.59.

3.4 Fat

The results of the analysis of diversity showed that the method had no significant effect ($p>0.01$) on fat content, while the source of the enzyme and the interaction between the two had a significant effect ($p<0.01$). The fat content of dried sea cucumbers from the research results obtained the highest levels in the stirring treatment with the enzyme from papaya leaves after boiling 1 (A3B1), namely 2.27%, while the lowest was in the soaking treatment with enzymes from papaya fruit before boiling1 (A1B2), namely 1.08% (Figure 5).
Method 1: Initial immersion with the enzyme papain
Method 2: Boiling with the papain enzyme
Method 3: Stirring with enzymes after boiling

Figure 5. Fat Content of Dried Sea Cucumber

The results of the DMRT follow-up test showed that although the interaction of the stirring method with the enzyme source after boiling 1 had a high fat content, it was not different from other treatments at the level of α = 0.05. The fat content of this study was not different from the research of Kustiariyah (2006) where dried sandfish sea cucumber contained 2.17% fat, while lower than the research of Karnila et al. (2011) where it was found that the fat content of sandfish sea cucumber meat was 3.68%. Sea cucumber fat content is influenced by several factors. According to Martoyo, et al (2006), differences in nutritional content in sea cucumbers are due to differences in species and biological conditions of sea cucumbers. This difference can also be caused by the availability of food in the waters and the types of sea cucumbers themselves.

Fat is one component of nutritional value that is important for the body because it has an important function for the body but can be a problem for health if it is too much in the body. Excess fat can cause obesity and hardening of the arteries. Compared to other fish, the fat content of sea cucumbers is relatively low, namely 1.7 g / 100 g dried sea cucumber, but it is quite rich in omega-3 fatty acids. Thus, sea cucumber meat is safe for consumption by those who have high serum cholesterol levels (Astawan, 2008).

3.5 Carbohydrate

The results of the analysis of diversity showed that the method of giving the enzyme (A) and the interaction between the two treatments and the enzyme source had a significant effect (p <0.01) on carbohydrates, while the enzyme source had no significant effect (p> 0.01). The treatment of boiling together with the enzyme from papaya leaves (A2B1) was 9.02%, while the lowest carbohydrate was in the boiling treatment together with the enzyme from papaya fruit (A2B2), which was 5.56% (Figure 6).
Metode 1: Initial immersion with the enzyme papain
Method 2: Boiling with the papain enzyme
Method 3: Stirring with enzymes after boiling

![Carbohydrate Content of Dried Sea Cucumber](image)

**Figure 6.** Carbohydrate Content of Dried Sea Cucumber

Duncan's further test showed that the treatment of boiling together with the enzyme papain (A2) was significantly different at the α 5% level with the other two methods, while the enzyme source from papaya leaves (B1) was significantly different from the enzyme source from papaya (B2). It appears that the papaya leaves provide the highest carbohydrate value. The use of papaya leaves as a source of the papain enzyme actually causes little damage to sea cucumber carbohydrates. The use of temperature needs to be considered because the use of high temperatures in boiling 1 causes damage to the nutritional value of sea cucumbers including carbohydrate content.

According to Ibrahim (2003) the carbohydrate content of sea cucumbers ranges from 3-5% while according to Martoyo et al (2000) the carbohydrate content of dried sea cucumbers is 4.8%. The carbohydrate content of this study was higher than previous studies. Sea cucumber carbohydrates contain functional compounds that have medicinal potential. Sea cucumber meat is a source of mucopolysaccharides, especially chondroitin, which functions to reduce pain. The mucopolysaccharide content in sea cucumbers is 10-16% (Sendih and Gunawan, 2006). Sea cucumbers are also rich in saponins, especially triterpene glycosides. According to Dharmananda (2003), saponins show activity as anti-inflammatory and anticancer.

### 4. Conclusions And Suggestions

Based on the results of chemical quality analysis, This can be concluded that the best method of giving papain enzymes is the second method. Either with enzyme from leave or papaya fruit, both of them are no matter. Because there is no significant difference between the enzymes derived from leaves and fruit.

Suggestion: It is recommended that during the first boiling, the temperature is maintained at the optimum temperature of the enzyme, which is 60\(^0\) C, because if the temperature is too high it can damage the effectiveness of the enzyme.

### References

[1] Anonim. 2007a. Segudang manfaat dari Teripang. Warta Perikanan. Edisi Juli No 47.
[2] Astawan, M. (2008). Sehat dengan Hidangan Hewani. Jakarta: Penebar Swadaya.
[3] Brown, EO., ML Perez, LR Garces, RJ Ragaza, RA Bassig and EC Zagaroza. 2010. Value Chain Analysis for Sea Cucumber in Philippines. Studies and Reviews 2120. The WorldFish Center, Penang, Malaysia. 44pp
[4] Dharmananda S. 2003. Sea cucumber: food and medicine. Institute for Traditional Medicine. Oregon: Portland

[5] DKP. 2003. Statistik Perikanan Tangkap Indonesia, 2001. Jakarta: DKP

[6] Herniawan. 2010. Pengaruh metode pengeringan terhadap mutu dan sifat fisika-kimia tepung kasava terfermentasi. Skripsi. Fakultas Teknologi Pertanian. Institut Pertanian Bogor. Bogor

[7] Ibrahim J. 2003. Gamat emas sasar perolehan RM 10 juta. http://sas782.org/Documents/AlumniPress/SyidAyob-UtusanMalaysia 131003.pdf

[8] Karnila, R., Astawan, M. Sukarno dan Wresdiyati, T. (2011). “Analisis Kandungan Nutrisi Daging dan Teripang Pasir (Holothuria scabra J.) Segar”. Jurnal Terubuk. 39, (2), 51-52

[9] Kustiariyah. (2006). Isolasi, Karakterisasi dan Uji Aktivitas Biologis Senyawa Steroid dari Teripang Sebagai Aprodisiaka Alami. Tesis Magister pada Sekolah Pascasarjana Institut Pertanian Bogor: Tidak diterbitkan

[10] Kustiariyah,2007. TERIPANG SEBAGAI SUMBER PANGAN DAN BIOAKTIF. Buletin Teknologi Hasil Perikanan. Vol X Nomor 1

[11] Mahmud M.K., Hermana, N.A. Zulfianto, R.R. Apriyantono, I. Ngadiarti, B. Hartati, Bernadus, dan Tinexcelly. 2009. Tabel Komposisi Pangan Indonesia. PT. Elex Media Komputindo. Jakarta

[12] Martoyo, J., Aji, N. dan Winanto, T. (2006). Budidaya Teripang (Ed. Revisi). Jakarta: Penebar Swadaya

[13] Nurjanah. 2008.Perubahan Komposisi Kimia dan Vitamin Daging Udang Ronggeng (Harpioquilla Raphidea) Akibat Perebusan. Buletin Teknologi Hasil Perikanan; XI (2): 76-88

[14] Nurlaila Ervina Herliany, Eko Nofridiansyah, Bayu Sasongko. Studi pengolahan teripang kering. Jurnal Enggano Vol. 1, No. 2, September 2016: 11-19

[15] Sasongko, B 2015 Kajian pengolahan dan mutu teripang asap. Skripsi. Program Studi Ilmu Kelautan, Fakultas Pertanian, Universitas Bengkulu. Bengkulu.

[16] Sendih S, Gunawan. 2006. Keajaiban Teripang: Penyembuh Mujarab dari Laut. Agromedia Pustaka. Jakarta

[17] (SNI) Standar Nasional Indonesia 01-2356-1991. Penentuan Kadar Air. Jakarta : Dewan Standarisasi Nasional.

[18] (SNI) Standar Nasional Indonesia 01-2354-1991. Penentuan Kadar Abu. Jakarta : Dewan Standarisasi Nasional.

[19] (SNI) Standar Nasional Indonesia 01-2365-1991. Penentuan Kadar Protein. Jakarta :Dewan Standarisasi Nasional.

[20] (SNI) Standar Nasional Indonesia 01-2354.3-2006. Penentuan Kadar Lemak Total pada Produk Perikanan, Jakarta. Badan Standarisasi Nasional.