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Drying Methods of Commercially Valued Sea Cucumbers: Holothuria Scabra and Holothuria Nobilis

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Abstract

The aim of this study is to investigate the effect of drying methods (sun-drying and microwave drying) on the shrinkage ratio of commercially valued sea cucumber - Holothuria scabra and Holothuria nobilis. The shrinkage ratio was derived from the utilization of thirty-six sea cucumber samples obtained from Brgy. Cahayagan, Laoang, Northern Samar with varying sizes to ensure representativeness. Sun-drying was carried out for 24 hours, while microwave drying was performed for 10 minutes at 40°C. Results revealed that as the weight of the samples increases, the shrinkage ratio decreases. Microwave drying also obtained the highest shrinkage ratio at 95%; however, the study also revealed no significant difference in the shrinkage ratio between the sun-dried and microwave-dried sea cucumbers, suggesting that these methods can be used alternately in drying sea cucumber species.

Keywords: sun-drying; microwave drying; sandfish; black teatfish; shrinkage.

1. Introduction

Holothuroids, or sea cucumber, is large and diverse marine invertebrates belonging to the Echinodermata class. They live on muddy and sandy grounds, especially on the ocean and seashores, and consume organic materials such as protozoa, diatom, and detritus as nutrients. Having more than 1400 described extant species constituting 160 genera occurring in benthic environments from the intertidal to the deepest oceanic trenches, sea cucumbers form 90% of the biomass[1].

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They are unique ocean creatures often mistaken for sea slugs or trepang and are morphologically characterized by having a cylindrical, elongated body that extends from diverging colors from pitch black to light yellow or white or white with a blend of colors[13]. Locally known as "balat," sea cucumbers are common inhabitants of tidal flats and are collected by hand from deep water dive-in or trawling activities. Despite having an enormous number of species, only a few are said to be edible and are acknowledged a delicacy. Nonetheless, increased demand has been observed worldwide, making these species one of the most sought marine invertebrate species. Sea cucumbers are a source of high value-added aggregates with health compensation effects, often employed as functional ingredients[10]. Examples of its functional component comprise bioactive peptides, vitamins, minerals, fatty acids, saponins, carotenoids, collagens, gelatins, chondroitin sulfates, amino acids, fatty acids, and other bioactive compounds. These derived functional ingredients can be added at different food and biomedicine production stages[9]. Aside from its chief components believed to be an excellent source of nutrients, local claims of its healing properties over a wound, gastric ulcers, arthritis, gout, asthma, eczema, rheumatism, kidney, and reproductive system disorders are acknowledged universally. According to traditional Chinese medicine, sea cucumbers nourish the blood and vital essence. It can also treat weakness, impotence, debility of the aged, constipation due to intestinal dryness, and frequent urination. There is also an emerging market for the use of sea cucumbers in cosmetics industries and pharmaceuticals[8]. In Laoang, Northern Samar, Philippines, Barangay Cahayagan had been the main bulb for sea cucumbers, where an estimated 80 % harvest of the anglers in the coastal area process sea cucumbers in their own home, fresh from the sea. Their most commercially valued species are *Holothuria scabra* (sandfish), locally known as Hanginan, and *Holothuria nobilis* (black tea fish), locally known as Abohan. Sandfish is the most commercially valued tropical species and commands high market value. In the Philippines, sandfish is harvested and transported for food and medicinal purposes, predominantly in China, Hong Kong, Singapore, the Republic of Korea, Taiwan Province of China, and Japan[7]. On the other hand, Black tea fish are also used commercially in the Philippines and is a substitute for various food products such as chips[4]. Generally, sea cucumbers quickly autolyze after being caught because of enzymes, microorganisms, and several environmental factors; they also exhibit a remarkable cytotoxic effect. A study showed that *H. scaba* was ineffective against bacterial species even at 19 ug/ml concentration for this reason; they must be stored using various processing techniques to prolong their shelf life and diminish transportation constraints[11]. Sun-drying and microwave drying are the most straightforward and repeatable methods used in drying various natural products and are effective through their application. In order to know the effects of various drying methods, the researcher conducted this study which deals with commercially valued sea cucumbers — *Holothuria scabra* and *Holothuria nobilis.*

2. Materials and Methods

2.1 Sample preparation

Fresh sea cucumbers (*H. scabra* and *H. nobilis*) were purchased from a fisherman from barangay Cahayagan where there is an abundant catch. They were quickly transported and processed. Thirty-six samples were utilized in the study — 18 *H. scabra* and 18 *H. nobilis*. Replication concerning sea cucumber sizes was done to ensure the representativeness of the result.

2.2 Cleaning

Freshly eviscerated cucumbers are cleaned by lightly brushing the surface with coconut husk to remove the sand and other material adhering to the surface. Cucumbers are then washed in clean seawater, and any other remaining in the belly cavity is gently squeezed out. Next is gutting of the cucumbers; for Abohan (*H. nobilis*), gutting is employed after boiling, while Hanginan (*H. scabra*) gutting is done before boiling. The internal organs are removed and ensure that no stubs are left at the ends.

2.3 Sun-Drying Method

For the sun-drying method, the cleaned sea cucumbers were placed in the sun and wind for 24 hours and were carried out on raised platforms and racks. The final product must be around 4-10% of the original weight and must be as hard as wood. Dried products were then inspected thoroughly to investigate if some surfaces were still soft and damp, indicating the need to subject the samples to drying further.

2.4 Microwave Drying Method

The following procedure was undertaken to perform the microwave drying method. The fresh and cleaned sea cucumbers were placed immediately into a microwave drying oven and allowed to dry for 10 minutes at 40°C. The samples were then checked to inspect if they were still watery, suggesting the necessity to subject the samples to drying further.

2.5 Shrinkage Ratio

The fresh and dried sea cucumber was weighed using a weighing scale. The initial weight and the weight after drying the samples were obtained for further calculation. The shrinkage ratio was calculated as:

$$Rs = \frac{Vo - Vt}{Vo}$$

Where *Rs* is the shrinkage ratio of the sea cucumber, *Vo* is the initial weight of sea cucumber before drying, and Vt is the weight of the sample after drying time.

2.6 Statistical Analysis

T-test was performed on the obtained data to determine if there is a significant difference between the shrinkage ratio of sun-dried sandfish and black teatfish and the shrinkage ratio of microwave dried sandfish and black teatfish.

3. Results

Table 3.1 shows the shrinkage ratio of sandfish and black teatfish after being subjected to 24-hour sun-drying.

As reflected on the table, small sea cucumbers weighing 100 grams obtained a shrinkage ratio of 91% for sandfish and 92% for black teatfish. For the sea cucumbers weighing 110 grams, the shrinkage ratio obtained for sandfish and black teafish was 90.91%. Lastly, for small sea cucumbers weighing 120 grams, the shrinkage ratio obtained for sandfish and black teatfish was both 90.83%.

For medium-sized sea cucumbers, the shrinkage ratio obtained for the three samples was generally similar to that obtained for small-sized. The 200 grams weighing sea cucumbers obtained a shrinkage ratio of 90.5% and 90.45% for sandfish and black teatfish, respectively. On the other hand, the sea cucumbers weighing 220 grams obtained a shrinkage ratio of 90.45% for sandfish and 90.80% for black teatfish. Lastly, 250 grams of sea cucumbers obtained a shrinkage ratio of 90.80% for sandfish and 89.60% for black teatfish.

The large-sized sea cucumbers also reflected a shrinkage ratio highly similar to that of the small and medium-sized with a minute disparity on the ratio for other samples. The 300 grams weighing sea cucumber obtained a shrinkage ratio of 90% for both species. On the other hand, the 350 grams weighing sea cucumbers obtained a shrinkage ratio of 90% for sandfish and 88.29% for the black teat fish. Lastly, the 400 grams obtained 90% for sandfish and 87.5 for black teatfish.

Table 3.1: Shrinkage ratio of sun-dried Sandfish and Black Teatfish.

Size	Weight (g)	Sandfish (%)	Black Teatfish (%)
Small	100	91	92
	110	90.91	90.91
	120	90.83	90.83
Medium	200	90.5	90.45
	220	90.45	90.80
	250	90.80	89.60
Large	300	90	90
	350	90	88.29
	400	90	87.5

Table 3.2 exhibits the shrinkage ratio of sandfish and black teatfish under microwave drying at 40°C for 10 minutes. For small-sized sea cucumbers weighing 100 grams, the shrinkage ratio obtained was both at 95%. The shrinkage ratio obtained for the sea cucumbers weighing 110 grams was 93.63% and 92.73% for sandfish and black teatfish, respectively. Lastly, the 120 grams weighing sea cucumbers obtained a shrinkage ratio of 94.17% for sandfish and 91.67% for the black teatfish.

The medium-sized sea cucumbers weighing 200 grams obtained a shrinkage ratio of 91.5% for sandfish and 92% for black teatfish. For the sea cucumbers weighing 220 grams, the shrinkage ratio obtained was 91.36% for both species. Lastly, the sea cucumbers weighing 250 grams obtained a shrinkage ratio of 92% for both species.

For the large-sized species, the 300 grams weighing sea cucumber obtained a shrinkage ratio of 91.67% and 93.33% for the sandfish and black teatfish, respectively. On the other hand, the 350 grams obtained a shrinkage ratio of 91.43% for the sandfish and 94% for the black teatfish. Lastly, the sea cucumbers weighing 400 grams obtained a 90.5% and 90% shrinkage ratio for sandfish and black teatfish, respectively.

Table 3.2: Shrinkage ratio of microwave dried Sand Fish and Black Teat Fish.

Size	Weight (g)	Sandfish (%)	Black Teatfish (%)
Small	100	95	95
	110	93.63	92.73
	120	94.17	91.67
Medium	200	91.5	92
	220	91.36	91.36
	250	92	92
Large	300	91.67	93.33
	350	91.43	94
	400	90.5	90

Figure 1 shows the effects of sun-drying on the shrinkage ratio of sandfish and black teatfish. The results from sandfish ($M = 90.5, SD = 0.42$) and black teatfish ($M = 90.04, SD = 1.4$) indicate the shrinkage ratio of sun drying, the null hypothesis is not rejected, $\mathrm{t}(16) = 0.25, \mathrm{p} < 0.05$. This means that there is no significant difference between the shrinkage ratio of sun-dried sandfish (hanginan) and black teatfish (abohan).

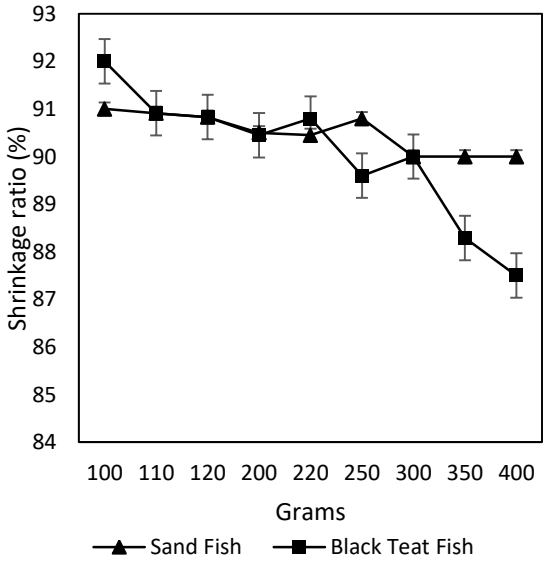

Figure 1: Effects of sun-drying (24 hours) on the shrinkage ratio of sea cucumbers.

Figure 2 shows the effects of microwave drying on the shrinkage ratio of sandfish and black teatfish. The results from sandfish ($M = 92.36, SD = 1.43$) and black teatfish($M = 92.45, SD = 1.41$) indicate the shrinkage ratio of microwave drying, the null hypothesis is not rejected, $t(16) = 0.89, p < 0.05$. This means that there is no significant difference between the shrinkage ratio of microwave dried sandfish (hanginan) and black teatfish (abohan).

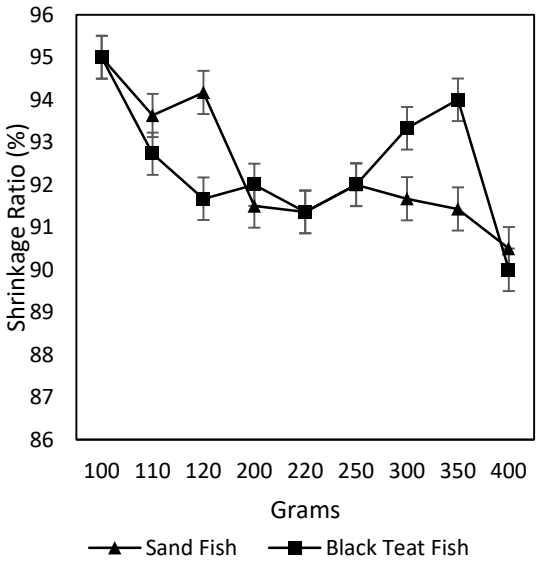

Figure 2: Effects of microwave drying (10 mins at 40°C) on the shrinkage ratio of sea cucumbers.

4. Discussion

Globally, the highest valued sea cucumbers emanated from *Holothuria scabra* (sandfish), and *Holothuria nobilis* (black teatfish) are well accepted by various small and large companies and manufacturers. These marine species are commercialized to serve a bioremedy for many types of health problems, traditional cuisines and are traded widely from country to country via import and export [2]. However, sea cucumbers quickly autolyze after they have been caught; for this reason, they must be stored using various processing methods. One of the widely used preservation methods worldwide is the drying method [5]. This study determined the shrinkage ratio of two commercially valued sea cucumbers — *Holothuria scabra* (sandfish) and *Holothuria nobilis* (black teatfish) using the traditional sun drying and modernized microwave drying.

Table 1 revealed that the shrinkage ratio for sun-dried black teatfish ranges from 90% to 91%, and for the sandfish, it ranges from 87.5% to 92%. From the data, it can be inferred that as the weight of the sample increases, the shrinkage ratio decreases. The disparity in the shrinkage ratio of the sea cucumbers is mainly due to the increased presence of collagen on heavier samples which can prevent water from vaporizing totally[14]. Additionally, as observed in Figure 1, the differences in the shrinkage ratio of black teatfish are more deviated than the sandfish.

For the microwave drying, Table 2 showed that the shrinkage ratio ranges from 90% to 95% for sandfish and 90.5% to 95% for black teatfish. As seen in Figure 2, the trend corroborates with the findings for sun-dried sea cucumbers; the shrinkage ratio decreases as the weight of the sample increase, mainly due to the increased presence of collagen on heavier samples preventing the water from vaporizing during the process[14]. It can also be inferred that the data obtained for both species showed lower discrepancy than the sun-dried data. It also obtained the highest shrinkage ratio for both methods and species. This result is mainly associated with the continuous exposure of the samples to a continuous stream of hot air that removes the water present resulting in

a more homogenized result[3]. However, it is said that this method results in significant product deterioration affecting the overall quality and composition of the sea cucumbers[6].

The study also revealed no significant difference between the sun-dried and microwave dried sandfish and black teatfish, suggesting that these two drying methods will yield similar results based on their drying efficacy. This corroborates with the study of[14], which revealed no significant difference in sun-drying and microwave drying in terms of its shrinkage ratio.

5. Conclusion

This study determined the shrinkage ratio of two commercially valued sea cucumbers —*Holothuria scabra* (sandfish) and *Holothuria nobilis* (black teatfish) employing sun drying and microwave drying. It was determined that as the weight of the sample increases, the shrinkage ratio decreases. It was also determined that the influence of continuous exposure of sea cucumbers to a continuous stream of hot air under microwave drying results in a higher shrinkage ratio and a more homogenized result. Lastly, it was revealed that there is no significant difference in terms of shrinkage ratio between the sun-dried and microwave-dried sea cucumbers, suggesting that these methods can be used alternately in drying sea cucumber species.

6. Recommendation

The researcher of the study strongly advice that for future studies, researchers shall explore the different areas of the research topic that should be enhanced and further examined, such as the effect of sun-drying and microwave drying on the quality and nutritional content of sea cucumbers, the marketability of sun-dried and microwave dried sea cucumbers, rehydration ratio of the two species, and the effect of the combinatory method on the quality of sea cucumbers.

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