Bycatch sea cucumber *Holothuria scabra* processing and the quality characteristics

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**Abstract.** Sea cucumbers are marine invertebrate animals that have high economic value. Indonesia is the main exporter of trepang over the world; however, this trepang export has not yet contributed to the improvement of community welfare. The low quality of trepang produced by Indonesia makes the economic value of trepang was still low. The low quality was caused by changes in processing stages due to decreasing the wild catch. Since the ban of the mini trawl use (cantrang), fishermen only process the bycatch sea cucumbers *Holothuria scabra* or sandfish. Trepang produce from sandfish is the most expensive one; the price can reach 3-5 million per kg. The study aims to analyze the quality and analyze the potential of developing the quality of trepang produce using sandfish. The decrease in sandfish catch volume after the Danish seine ban prohibits the stage changes in sandfish processing. Elimination of fumigation stage, the addition of storage in the refrigerator, addition of boiling, overcooking, and using excessive papaya leaves, were the main causes of less than the minimum value specified in SNI for appearance and odor characteristic. Although water, ash, protein, total plate count, Salmonella content, Lead, and Cadmium are in the decent range, the exporters still buy trepang at lower prices because exporters have to do reprocessing to improve the quality.

**1. Introduction**

Dry sea cucumber or trepang has many benefits, such as a source of protein, wound medicine, and anti-inflammatory [1,2]. Trepang has protein content of 82.0\%, fat 1.7\%, ash 8.0\%, carbohydrate 4.8\%, calcium, phosphorus, substances, sodium, potassium, vitamin A, vitamin B, thiamine, and riboflavin, peptide, collagen, gelatin, polysaccharides, and saponins, which function as anti-cancer, anti-coagulation, anti-oxidant, and anti-osteoclastogenesis [2–4]. These diverse benefits make trepang as products of high economic value and are one of the favorite export products [5]. Sea cucumber production every year in Indonesia by 47% [6].

The potential of Indonesian sea cucumber resources has not significantly contributed to the improvement of community welfare, this is due to the low quality that causes the low economic value of trepang [7]. According to Ram et al. [8] processing greatly affects the quality of trepang. Generally, trepang processing in Indonesia was still done in the traditional way and has low technology input
Quality was greatly influenced the selling price of trepang, both in local and international markets [10]. The trepang quality can be known through visual examination such as appearance, texture, smell, and fungus; or through proximate examinations such as protein, water and ash content [11]. According to the Indonesian National Standard (SNI) the trepang quality can be known through sensory, chemical parameters, microbial contamination, metal contamination, and chemical residues.

One of the regions famous for trepang production in Indonesia is Sulawesi [12–14] where the two regions that have the highest production are South Sulawesi and Southeast Sulawesi [13,14]. Pangkep Regency is trepang producing region in South Sulawesi [15,16], where this region has long been the processing location that produce trepang by using sandfish as raw material [17].

Before the ban on the use of the Danish Seine (Dogol), Saugi Island (one of the islands in the Spermonde Islands region) within the Liukang Tupabbiring Sub-district, Pangkep Regency, was a sandfish processing region with a production of 100-200 kg trepang per month per business unit. After the ban on the use of Danish Seine, the volume of sandfish as a raw material has decreased dramatically. Currently, sandfish comes from crab nets bycatch, with a very small catch volume. Small catch volume causes sandfish processing businesses to switch from commercial scale to household scale with a production volume of only about 20 kg dry weight per month per business unit. This change in the catch volume causes a change in the processing stages. Since the ban on the use of Danish Seine, sandfish processing on Saugi Island has been stalled. At present, there is only one household scale business unit in the Labbakkang Sub-District. Labbakkang is a neighboring Sub-District of Liukang Tupabbiring.

The process and quality of trepang in Labbakkang Sub-district has never been analyzed based on the Indonesian National Standard, so it is necessary to analyze the process and the quality characteristics of trepang after the ban on the use of the Danish Seine. The purpose of this study was to analyze the processing and the quality characteristics trepang produced by using sandfish comes from crab nets bycatch.

2. Research methods
The research was conducted from December 2018 to April 2019 in Labbakkang Sub-district, Pangkep Regency, South Sulawesi, Indonesia (Figure 1).
Labbakkang is located on the mainland of the Sulawesi Island that facing the Makassar Strait. Makassar Strait which is one of the main fishing ground in South Sulawesi [18] (Figure 1). The object of the research was trepang processing using *H. scabra*.

Proximate analysis, chemistry, microbial contamination, and metal contamination were carried out at Central Health Laboratory of Makassar, South Sulawesi. While the sensory analysis was conducted at the Fisheries Product Laboratory, Department of Fisheries, Hasanuddin University, Makassar, South Sulawesi.

The quality characteristics of trepang that measured were: (1) organoleptic parameters, which consist of appearance, texture, odor, and fungus; (2) chemical parameters such as water content, protein, ash, total plate number (ALT), Salmonella, and metal contamination.

### 3. Results

#### 3.1. Trepang processing

The results of interviews and observations on how to treat trepang, it was obtained two processing patterns of trepang, namely before and after the ban on the use of Danish Seine (Figure 2).

![Trepang Processing Pattern](image)

**Figure 2.** Trepang processed using sandfish *Holothuria scabra* before (A) and after (B) the ban of the Danish Seine.

Trepang processed using sandfish before the ban of the Danish Seine was done through ten stages, namely first weeding, first boiling, soft outer shell with papaya, scrape the outer skin, second weeding, second boiling, salting, third boiling, fumigation, and sun drying (Figure 2A). After the ban of the Danish Seine, the trepang process was done through eleven stages, namely first weeding, first boiling,
storage in the refrigerator, second boiling, soft outer shell with papaya, scrape the outer skin, second weeding, third boiling, salting, fourth boiling, and sun drying (Figure 2B).

3.2. Trepang quality
Direct observation and sampling of quality parameters were done when trepang processing ongoing (Figure 3). Parameters organoleptic of trepang processed using sandfish were 6 for appearance, 6 for odor, 7 for texture, and 9 for mushroom (Table 1). The average of water, ash and protein content of trepang processed using sandfish were 19.95% water, 24.33% ash, and 44.31% proteins (Table 2). The average of Total Plate Count (TPC) and the average of salmonella content of trepang processed using sandfish were <12x10^1 total plate, and negative Salmonella Content (Table 3). The average of Total Plate Count and Salmonella Content of trepang processed using sandfish were 0.06 µg/g of lead and 0.01 µg/g of Cadmium (Table 4).

![Figure 3. Trepang processed using sandfish Holothuria scabra. 1: After first weeding; 2: Boiling; 3: Soften the outer skin with papaya leaf; 4-5: Scrape the outer skin; 6: After Scrape the outer skin; 7: Second weeding; 8-10: After second weeding; 11-12: Salting; 13-16: Sun drying.](image)

| Table 1. Parameter organoleptic of trepang processed using sandfish Holothuria scabra. |
|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Parameter          | Average | Coefficient | s/√n       | 1.96.s/√n   | P<     | ≤P    | Result   | SNI |
| appearance         | 6.2    | 1.96        | 0.193798   | 0.379845   | 5.8    | 6.6   | 6       | Minimum 7 |
| Odour              | 6.7    | 1.96        | 0.224806   | 0.440620   | 6.3    | 7.1   | 6       | Minimum 7 |
| Texture            | 7.5    | 1.96        | 0.251309   | 0.492565   | 7.0    | 8.0   | 7       | Minimum 7 |
| Fungus             | 9.0    | 1.96        | 0.0          | 0.0        | 9.0    | 9.0   | 9       | Minimum 7 |
Table 2. Water, ash, and protein contents of trepang processed using sandfish *Holothuria scabra*

| Repetition | Water Content | Ash Content | Protein Content |
|------------|---------------|-------------|-----------------|
| 1          | 18.18         | 24.11       | 44.46           |
| 2          | 20.79         | 23.78       | 43.88           |
| 3          | 20.88         | 25.11       | 44.59           |
| Average    | 19.95         | 24.33       | 44.31           |
| SNI        | Maximum 20    | Minimum 7   | -               |

Table 3. Total plate count and *salmonella* content of trepang processed using sandfish *Holothuria scabra*.

| Repetition | Total Plate Count | Salmonella Content |
|------------|-------------------|--------------------|
| 1          | <2.5x10^4         | Negative           |
| 2          | 3.1x10^2          | Negative           |
| 3          | <2.5x10^4         | Negative           |
| Average    | <12x10^4          | Negative           |
| SNI        | Maximum 12x10^5   | Negative           |

Table 4. Lead (Pb) and Cadmium (Cd) content of trepang processed using sandfish *Holothuria scabra*.

| Repetition | Lead (Pb) Content (µg/g) | Cadmium (Cd) Content (µg/g) |
|------------|--------------------------|-----------------------------|
| 1          | 0.07                     | 0.01                        |
| 2          | 0.06                     | 0.01                        |
| 3          | 0.05                     | 0.01                        |
| Average    | 0.06                     | 0.01                        |
| SNI        | Maximum 1.0              | Maximum 1.0                 |

4. Discussion

The main difference between the processing patterns before and after the banning of Danish Seine was no stage fumigation anymore; this was due to the small volume of processed sandfish so that trepang processors simplify processing and reduce production costs by eliminating fumigation. Fumigation requires time, labor, and firewood.

The small volume of catch causes the sandfish not more to be processed immediately. Sea cucumbers are stored in the refrigerator until the volume was sufficient for one processing. This causes the addition of two stages, namely storage in the refrigerator and the addition of one boiling stage.

The quality parameters of trepang indicate that some parameters were not in accordance with SNI, namely appearance, and odor. The sensory parameters of trepang for appearance and odour were less than (only 6) the minimum value specified in SNI (minimum 7). This lower value was thought to be caused by boiling which overcooking and using excessive papaya leaves. In addition, an incision that was too wide will reduce the quality because the incision will open and make the appearance looks bad [9].

The first boiling of *trepang* was carried out at a temperature that was too high, damaging the skin surface due to overcooking. According to [11] first boiling should not be too high around (60 ± 50°C), while according to [19] first boiling was between 45-80°C for 10 to 15 minutes. Boiling too long will damage the structure of the skin or tegument of sea cucumber. According to [9], high temperature surges can cause damage to sea cucumber skin, which in turn affects the appearance of the final product.

According to [20], the use of papaya leaves to release lime on sea cucumber skin has a negative impact because it can damage the skin layer if using excessive doses. From the results of research...
conducted by [20], the technique of removing lime layers using the enzyme papain showed that the use of the papain enzyme was good at a dose of 4%, where the black color on the back of the sea cucumber was not lost.

Another cause of poor appearance and odor is fumigation. Fumigation can give a distinctive brownish color to the trepang. Likewise with odor, fogging can give a characteristic odor to trepang. Poor appearance and odor cause low sea cucumber prices. This low price was due to the additional production costs that must be borne by exporters because they have to do reprocessing to improve appearance and odor. The parameters of microbial contamination (TPC and Salmonella) and metal contamination (Pb and Cd) do not pass the minimum value of SNI standard.

The measurement of ash levels was done to see the mineral content contained in trepang produces by using sandfish. The higher the ash content in food, the more minerals are contained. The results of the measurement of ash content of trepang were 24.33% on average. If this value is compared with the results of the study of [11], then the ash content of the trepang studied was higher. According to SPIKAN / 02/29/1987 dry sea cucumber mineral content of at least 7%.

The protein content for trepang studied was 30.78% on average. It was lower than the results of tests conducted by Herliany, Nofridiansyah, and Sasongko [11] which is 79.59%. This low value can be caused by the differences stage in processing, where Herliany, Nofridiansyah, and Sasongko [11] do the drying process using an oven so that the water content can be reduced to the optimum point.

5. Conclusion
The decrease in sandfish catch volume after the Danish seine ban prohibits the stage changes in sandfish processing. Elimination of fumigation stage, the addition of storage in the refrigerator, addition of boiling, overcooking, and using excessive papaya leaves, were the main causes of less than the minimum value specified in SNI for appearance and odor characteristic. Although water, ash, protein, total plate count, Salmonella content, Lead, and Cadmium are in the decent range, the exporters still buy trepang at lower prices because exporters have to do reprocessing to improve the quality.

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