Chemical and microbiology assessment of salted fish (anchovy and catfish) product in Banda Aceh District as a parameter of food safety

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Abstract. The process of salted fish which tends to neglect the elements of sanitation and hygiene and the use of formaldehyde provides a potential hazard if consumed by the community. This study aims to determine the chemical quality parameters of catfish and anchovy salted fish products circulating in Banda Aceh District Market. The analysis carried out are the analysis of moisture content, salt content, acid insoluble ash content, total plate count and formalin qualitative test. The results showed that 3 out of 5 local markets meet the SNI (Indonesian National Standard) requirements (8273: 2016) for moisture content. Salt content for both of salted fish in 5 local market meet the SNI. On the other hand, acid insoluble ash content and total plate count find higher than SNI requirement. The test results showed that catfish and anchovies in all the selected market are positive containing formaldehyde.

1. Introduction
Salted fish is one of the processed fish products with a partly process, simply by adding or soaking salt or salt solution, then drying it in the sun until the salt absorbs and dries [1]. Salted fish itself is one of the processed fish products favored by many people because of its unique taste and texture. The local people choose salted fish which has good quality by looking physically at the dried salted fish, fresh fish meat, and the salt is evenly spread and has a characteristic light yellowish brown color. However, it does not guarantee that the salted fish has good quality and safe for consumption. In the production process of salted fish tends to disregard the aspect of sanitation and hygiene also formaldehyde application is potentially hazardous for human consumption. Moreover, people feel uneasiness regarding salted fish with formaldehyde issue. It has a significant impact on the declining in sales of salted fish, which directly impacts the economy of the fish processing community.

The quality and food safety problems of fishery products occur in various types of products, stages of activity and areas with several types of hazardous materials and their sources with different characteristics. In Aceh, the production of salted fish mostly using high salt concentration to increase the weight of the dried salted fish and increase the storage capacity even though the water content is still relatively high [2]. This method causes the salt content in salted fish higher than SNI (8273: 2016). According to [3], the duration of salting process can also affect the chemical composition and texture of salted fish products. According to National Standardization Agency of Indonesia [4], Salted fish that have good quality and are safe for consumption are those that meet the requirements of the...
Indonesian National Standard for Dried Salted Fish (SNI 01-8273-2016) which includes a maximum water content of 40%, a maximum salt content of 12-20%, ash content insoluble acid 0.3%, sensory properties and a maximum total plate number of $1 \times 10^5$ colonies / g.

Studies on the quality of salted fish products were also carried out in several areas on the use of formaldehyde chemicals which could affect the level of public consumption. [5] reported that 14 samples of salted fish obtained from 3 local markets in Banda Aceh (Rukoh, Peunayong and Ulee Kareng) found 9 out of 14 samples was exposure with formalin. It is supposed that in the manufacture of salted fish, in supply chain system there are possibilities to add formaldehyde to extend the shelf life compare to salted fish that only preserved with salt [1]. This study aims to determine the quality and food safety of salted fish products (catfish and anchovy) circulating in Banda Aceh District Market in terms of moisture content, salt content, acid insoluble ash content, total plate count and formaldehyde qualitative test on salted fish were also carried out to find out that the product confirms meet SNI requirement and free from harmful microbiological contamination.

Salted fish circulating in the market have various quality standards. This is due to the production of salted fish is still done traditionally and from unorganized local manufacturing, compliance to this regulatory standard is unknown. Therefore, in this study a special market survey was conducted in the local market of Banda Aceh District by sampling techniques on a representative seller of salted fish products for the types of salted fish quite desirable by local community. This method will also determine the number of markets and sellers and samples quantity as research targets. The determination of food safety for salted fish products will be determined based on SNI 8273: 2016. The parameters contained in the SNI will be tested on the samples above. Furthermore, data analysis was carried out in order to obtain a conclusion on the safety of local food products (salted fish).

2. Materials and methods
This study was divided into 3 stages, the first point is to determine the market location of the salted fish seller, then collecting samples and finally examining the quality and safety of salted fish samples which included salt content, water content, acid insoluble ash content, total plate count, and formaldehyde qualitative test. There were two type of salted fish investigated in this study: anchovy and catfish.

2.1. Determining Market location and quantity of salted fish seller
The market location is determined based on the number of existed local markets in Banda Aceh District. The market was chosen based on scope size of the market in Banda Aceh. The salted fish sampled is determined based on the type of salted fish which is in great demand by consumers. There were two type of salted fish investigated in this study: anchovy and catfish. There were 5 local market selected in Banda Aceh: Rukoh, Peunayong, Seutui, Ulee Kareng, and Peuniti. Salted fish sampling is based on a purposive sampling method, which is based on a fairly well-known market in District of Banda Aceh and a large number of communities who can access it.

| Market Location | Number of seller | Adresses |
|-----------------|------------------|----------|
| Anchovy         | Catfish          |
| Rukoh           | 5                | Jl. Utama Rukoh, Syiah Kuala, Banda Aceh |
| Peunayong       | 10               | Jl. Kartini, Penayong, Kuta Alam, Banda Aceh Jl. Hasan Kreung Kalee, Penayong, Kuta Alam, Banda Aceh |
| Seutui          | 3                | Jl. Teuku Umar, Seutui, |

Table 1. Overview of the Banda Aceh District Local Market.
2.2. Sample collecting
Sampling of salted fish was carried out in 5 markets in Banda Aceh District, by counting the number of salted fish seller in each market. Selected sample obtained from seller to be used as samples are inserted into plastic to prevent contamination and brought to the laboratory for further analysis. The number of samples collected was 52 samples which included 26 samples of salted catfish and 26 samples of salted anchovies.

2.3. Analysis of the quality and safety of salted fish,
Salted fish that have been selected from certain local market were analyzed for salt content (SNI 01-2359-1991) [6], moisture content (SNI 2354.2.2015) [7], acid insoluble ash content (SNI 2354.1:2010) [8], total plate count (SNI 2332.3:2015) [9], and formaldehyde used in salted fish product using qualitative method (Formaldehyde kit).

2.4. Data analysis
The data obtained in this study were analysed, using analysis of variance, descriptively and presented in the form of tables or figures.

3. Results and discussion

3.1. Salt Content
The salt content in the salted fish varied from minimum of 11.34% in catfish and 2.31% in anchovy to maximum of 19.50% in catfish and 7.39% in anchovy. In several local markets for both of salted fish product, the average salt content meets the Indonesian national standard, 20% of maximum of salt content (Figure 1). In salted catfish, high salt content was observed because it is larger than anchovy. The amount of salt applied to salted fish may be influenced by fish size. Moreover, split open fish consume more salt than whole fish due to large surface area exposure, resulting in rapid salt penetration [10].
Figure 1 showed that salt content from 5 local market highly varied one to another with big range of data for each selected market. The salted fish sold in Banda Aceh local market came from different production areas, such as Lhoong (Aceh Besar), Lampulo (Banda Aceh), West Aceh, North Aceh and Lhokseumawe, based on interviews with several salted fish sellers in Banda Aceh. It is assumed that the varying amount of salt content is caused by differences in the salting process or using salt during the manufacturers' treating of salted fish [1]. Rini et al [11] recorded that the amount of salt was between 5.46-23.52% in traditional market, Yogyakarta. This shows that the amount of salt in salted fish varies widely.

Salt or salt solution used in the production of salted fish can affect the amount of salt in the product as well as shelf life. A Dharshini et al [12] reported common salt may not show antimicrobial action, but its ability to minimize the levels of water activity (aw) in food, slows down or even interrupts critical microbial processes

3.2. Moisture Content
Moisture content of salted catfish and anchovy procured from 5 local markets range 24.05 – 47.05% and 11.77 – 29.42% respectively. Salted fish taken from Ulee Kareng and Seutui market have moisture contain higher than Indonesian national standard (SNI) which is above 40%, while moisture content salted fish product in Rukoh, Peuniti, and Peunayong market meets the quality standard for dried salted fish. Figure 2 show that anchovy have low moisture content, Therefore, anchovy is classified as a safe product according to predetermined standards.
The parameter of moisture content in salted fish is affected by NaCl added to the salted fish during processing. Although the moisture content of the fish is still high, the fish can be stored for a while because of the relatively high salt added. According to Witono et al. [13], this is because salt has a high osmotic pressure so that it can cause plasmolysis (break down microbial cells). Though the NaCl concentration may influence the moisture content in dry fish the level of drying also plays a significant role [12].

### 3.3 Acid insoluble ash content

This study was noted that acid insoluble ash to be 0.2-1.2% in salted catfish and 0.1-1.5% in anchovy. The result of acid insoluble ash content from 5 local markets is present in Figure 3. High acid insoluble ash observed in all of market area, except for Peuniti local market noticed to be below 0.3% which is meet SNI.
It is obviously in Aceh fishes are dried on open beaches or along roadways and are severely polluted with sand and dirt. High content of acid insoluble ash indicates the high contamination of inorganic materials originating from the environment for the period of drying process [10] [14]. Thus, during the drying process, sanitation and hygiene, the area in which salted fish are dried and the drying media in order not to contaminate the dried fish. Previous study reported dried fish by hanging them on poles or ropes so that it does not come in contact with soil during drying [10].

3.4 Total Plate Count [15]
The research shows that the total plate count (TPC) in the present work ranged from $1 \times 10^5$ - $1 \times 10^6$ cfu/g in salted catfish and $1 \times 10^5 - 25 \times 10^6$ cfu/g in anchovy. Table 2 shows that the highest TPC in salted catfish of $1 \times 10^6$ cfu/g is found in Peuniti Market and the lowest at $1 \times 10^5$ cfu/g is found in Rukoh, Ulee Kareng and Peunayong market. The highest TPC in anchovy of $25 \times 10^6$ cfu/g is found at Ulee Kareng Market and the lowest is $1 \times 10^5$ cfu/g at Rukoh, Ulee Kareng, Seutui and Peunayong markets. The percentage of TPC in salted fish is 46.2% and 65.4% in anchovy meet the quality requirements of Indonesian national standard (SNI 8273: 2016) which is $1 \times 10^5$ cfu/g.

| No | Market       | Salted catfish | Anchovy |
|----|--------------|----------------|---------|
|    |              | Code | TPC     | Code | TPC     |
| 1  | Rukoh        | R1J  | $1 \times 10^5$ | R1T  | $1 \times 10^5$ |
|    |              | R2J  | $2 \times 10^5$ | R2T  | $1 \times 10^5$ |
|    |              | R3J  | $1 \times 10^5$ | R3T  | $3 \times 10^5$ |
|    |              | R4J  | $1 \times 10^5$ | R4T  | $1 \times 10^5$ |
|    |              | R5J  | $8 \times 10^5$ | R5T  | $2 \times 10^7$ |
| 2  | Ulee Kareng  | U1J  | $4 \times 10^5$ | U1T  | $3 \times 10^7$ |
|    |              | U2J  | $2 \times 10^5$ | U2T  | $1 \times 10^5$ |
|    |              | U3J  | $2 \times 10^5$ | U3T  | $1 \times 10^5$ |
|    |              | U4J  | $1 \times 10^5$ | U4T  | $25 \times 10^6$ |
|    |              | U5J  | $1 \times 10^5$ | U5T  | $2 \times 10^7$ |
|    |              | U6J  | $2 \times 10^5$ | U6T  | $4 \times 10^7$ |
| 3  | Seutui       | S1J  | $2 \times 10^5$ | S1T  | $2 \times 10^7$ |
|    |              | S2J  | $2 \times 10^5$ | S2T  | $1 \times 10^5$ |
|    |              | S3J  | $5 \times 10^5$ | S3T  | $1 \times 10^5$ |
| 4  | Peuniti      | G1J  | $1 \times 10^6$ | G1T  | $1,3 \times 10^6$ |
|    |              | G2J  | $3 \times 10^5$ | G2T  | $9,9 \times 10^6$ |
| 5  | Peunayong    | P1J  | $1 \times 10^5$ | P1T  | $1 \times 10^7$ |
|    |              | P2J  | $2 \times 10^5$ | P2T  | $1 \times 10^5$ |
|    |              | P3J  | $1 \times 10^5$ | P3T  | $1 \times 10^5$ |
|    |              | P4J  | $1 \times 10^5$ | P4T  | $1 \times 10^5$ |
|    |              | P5J  | $2 \times 10^5$ | P5T  | $1 \times 10^5$ |
|    |              | P6J  | $1 \times 10^5$ | P6T  | $4 \times 10^5$ |
|    |              | P7J  | $6 \times 10^5$ | P7T  | $1 \times 10^5$ |
|    |              | P8J  | $1 \times 10^5$ | P8T  | $1 \times 10^5$ |
|    |              | P9J  | $1 \times 10^5$ | P9T  | $1 \times 10^5$ |
|    |              | P10J | $1 \times 10^5$ | P10T | $1 \times 10^5$ |

The growth of bacteria in salted fish can be caused by many factors, including the inappropriate production process, such as the washing stage of fish, which is only carried out without the use of clean running water and is only carried out once. The washing process which is carried out does not necessarily guarantee that it is possible to remove microbiological contamination, especially...
pathogenic bacteria. The drying stage that is not covered with clear plastic, packaging that only uses used plastic and the process of storage that is not mounted on storage racks are another aspect. Other factors, apart from production factors, are the growth of bacteria due to inadequate production equipment that can cause salted fish pollution. Bacteria can rapidly develop from these variables, so initial control needs to be done. One of the controls for defeating bacterial growth is by conducting the salting process according to the protocol. Salting is a preservation process that can prevent or destroy bacteria growing on fish [16].

3.5 Formaldehyde
Using a test kit, a qualitative formaldehyde test on samples of salted fish and anchovies from the market in Banda Aceh was carried out using the colour reagent process. It can be shown that formaldehyde is present in all 26 samples of salted catfish and 26 samples of anchovy. After applying reagent, A and reagent B (test kit), a positive reaction is indicated by a colour change from bright yellow to light purple. The change in colour in the sample suggests that formalin is positive for the sample. Former study exposed that 8 samples of salted fish from several different locations in the markets of Rukoh and Peunayong contained formaldehyde, while 5 out of 6 samples from Ulee Kareng proved to be negative of formaldehyde [5]. Related parties such as government and sosial community may use this data as a basis for chasing the circulation of salted fish with formaldehyde. When it reaches the body, the formaldehyde in salted fish can react chemically with almost all substances in the cells to suppress cell function and induce elevated cell death in the body. These results are in line with research conducted by Mobonggi [17] which states that the formalin test on anchovies in Gorontalo City found all positive containing formalin.

4. Conclusions
The sanitation and hygiene of salted fish is fairly good and does not follow SNI requirements in selected market in Banda Aceh. Eventhough the result is obtained to still satisfy in several tests, and with the discovery of formaldehyde content in salted catfish and anchovies sample, it can be assumed they were not safe.

For further study, a qualitative and quantitative formalin test is suggested to be conducted so that the findings obtained are more precise. Work also aims to look at alternative applications of other retailer-safe preservatives, so that this does not happen again.

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