Assessment of fish smoke quality with different storage treatment at home industry fishermen in Ternate City

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Abstract. Along with the development of technology and innovation, information and business competition, home industry from the fishery sector start to improve their product. Renewable fish smoke technic and good quality packaging are some of the technic used in order to increase fish product quality and expire time of the product. Many home industries in the fishery sector, particularly in North Maluku, still lacks behind in fish product quality and cannot meet market demand. The objective of this study is to study the effect of fish product preservation treatment on the microbial quality of the fish. Four preservation treatments with three replicates were used in this experiment i.e. non-vacuum smoke fish treated for 3 days and 7 days and vacuum smoke fish treated for 3 and 7 days. The complete randomized design was used to test the microbial quality of fish product treated. The result showed that there is a difference in microbial quality between non-vacuum and vacuum smoke fish. Fish smoke with non-vacuum and vacuum packing did not meet SNI total plate count standard quality requirement.

1. Introduction
The North Maluku Province is as archipelago province which comprises of 805 islands, most of it classified as a small island. The province situated at 3º North to 3º South and 124º – 129º E. Total area of North Maluku Province is 145,801.10 km2, consist of 113,796.53 km2 (78.05%) of seawater and land of 32,004.57 km 2 (21.95%). With this geographic condition, fisheries and other marine resources are the most potential resources for this province [1]. The economic growth rate from the fishery sector is quite significant with the average between 2014 – 2017 was 8.49% but if this is compared to total Product Domestic Bruto it contributes only 7.40%. [2].

Majority of fishers from North Maluku are classified as artisanal fisher characterized by limited fishing gears, fishing vessels, capital, and skills [3]. The contribution of marine resources to the local fisher livelihood is considered low. Fisheries sectors from this province consist of capture based fishery, mariculture, and fish processing [2]. In term of fish processing technology, smoke fished is the main product and conducted mainly by the local community.

Smoke fish is a traditional processing method, combined with salting, drying and pouring natural chemical compound through the burning output which results in heat and composes smoke compound in the form of steam. This process, result in adhering smoke compound to the fish and fused in the water layer of the surface body of fish. As a result, the unique taste and aroma are formed, as well as the golden brown colour [4].

Most of the livelihood of local fishers community from Ternate is traditional fisher. In addition to the captured based fishery, the fishermen of this community increasingly engage in fish processing industry with the most frequent activity is in fish fumigation technique. This fish processing is mainly a home industry conducted in traditional and semi-modern ways. The importance of artisanal fisheries
in national development is through the demonstration of the economic and social contribution of the fisheries sector to sustainable livelihoods and poverty reduction to communities [4].

Fish processing technology of artisanal fishermen from Ternate is still behind recent development and innovation in fish processing technic. Many are still in traditional way process which affect their product that could not cope with market challenges pressure both regional and national even international. Equity and just management are urgently needed to develop local fisher through education and training to improve their knowledge and skill to be able to face the challenge in marketing good quality of the fish product.

The objective of this study is to analyze the quality of smoke fish product from home industry conducted by a local community of Ternate City.

2. Materials and Method

2.1. Study sites
The experiment was conducted at the traditional fish market at Ternate City and the Tanawan House Industry in Tanah Tinggi Ternate Village. The microbiological quality testing was carried out at Class II Ternate Quarantine Fish Laboratory.

2.2. Sampling and handling procedure.
Microbiology test was conducted to determine whether there are quality differences between smoke fish stored at not-vacuum packaging for 1 day (A1) and 3 days (A2) storage time with smoke fish stored at vacuum packaging for 3 days (B1) and 7 days (B2), as well as 0 day storage (A0) as a control. Each treatment was carried out with 3 repetitions. The parameter used in the test is the total plate count (TPC) and then compared to Indonesia National Standard quality (SNI 2725: 2013), the standard which prescribes requirements for the quality of smoked fish [5].

2.3. Data analysis
One way analysis of variance (ANOVA) was used to test the mean difference between treatment [6, 7]. Transformation was made to meet the assumption of ANOVA. The null hypothesis (H₀) for this experiment was there is no difference between all treatment and the alternative hypothesis (H₁) was there is at least one treatment which is not the same.

3. Results and Discussion
The result of Total Plate Count (TPC) test for four treatments of smoked fish and control treatment each with three replications is shown in Table 1. This table shows that there are differences in TPC between the treatment with treatment A2 having the highest TPC and the lowest one was the control treatment (A0). Test for differences between the treatments (ANOVA) shows high significant differences between the treatments (Table 2).

| Observation | A₀ | A₁ | A₂ | B₁ | B₂ |
|-------------|----|----|----|----|----|
| 1           | 1.5 x 10⁵ | 3.5 x 10⁸ | 6.3 x 10¹¹ | 1.9 x 10⁵ | 6.1 x 10⁵ |
| 2           | 1.4 x 10⁵ | 3.6 x 10⁸ | 6.2 x 10¹¹ | 1.9 x 10⁵ | 6.1 x 10⁵ |
| 3           | 1.6 x 10⁵ | 3.5 x 10⁸ | 6.3 x 10¹¹ | 1.7 x 10⁵ | 6.2 x 10⁵ |
| Mean        | 1.5 x 10⁵ | 3.53 x 10⁸ | 6.27 x 10¹¹ | 1.83 x 10⁵ | 6.13 x 10⁵ |
Table 2. One way Anaova test for differences between smoked fish treatment

| Source of Variation | SS     | df  | MS    | F     | P-value | F crit |
|---------------------|--------|-----|-------|-------|---------|--------|
| Between Groups      | 98.1951| 4   | 24.5488| 72,139.83 | 0.0000  | 3.48   |
| Within Groups       | 0.0034 | 10  | 0.0003 |       |         |        |
| Total               | 98.1985| 14  |       |       |         |        |

Indonesia National Standard for smoke fish quality (SNI 2725:2013) stated that the maximum of TPC is $5.0 \times 10^4$ CFU/g [5]. This result shows that even the control treatment has the average of TPC higher than the standard required by SNI. All the treatment has higher TPC required by SNI for smoke fish. The highest TPC was associated with non-vacuum as well as with storage time where long storage time tends to increase the bacterial concentration. A study on the bacterial and fungal population assessment on smoke fish has shown an increase in microbial loads in smoke fish species with the increase of storage time [8].

In many artisanal fisheries, freshly fish caught quite often treated with unhygienic ways and this creates the fish to microorganisms such as Salmonella and Aspergillus. Processed fishes are also prone to microbial attack especially in artisanal fishery due to an unhygienic method of processing and preservation. During the smoke drying period, smoking kilns used in artisanal fishery and overloading of the fishes on the trays lead to improper processing which in turns encourage fungal attack [9]. Fish and fish products spoil by different specific spoilage organisms (SSO) depending on the final treatment or preservation and storage temperature [9]. Fish and shellfish products can be a source of microbial hazards including *Listeria monocytogenes*, *Salmonella* spp., *Clostridium botulinum* etc. due to the unhygienic handling, marketing, and storage or due to the partial removal of water activity during production [8]. The fish product contains relatively high protein with the water content of 10 – 60% and if processed in a less sanitary condition and unhygienic ways will vulnerable to microbial damage [10].

Study on total microbial and detection on Salmonella on skipjack smoked fish sold in the traditional market at Ambon area found the total plate count range between $4.5 \times 10^1$ to $9.5 \times 10^2$ [11]. Another study on quality and food safety of dry smoke Garfis (*Hemirhamphus sar*) from artisanal fishermen of Keffing Village of Seram, Maluku Province found TPC to be $6.8 \times 10^1$ CFU [12]. The TPC from these studies is still in the SNI range for smoked fish. The fish products from these two villages also come from artisanal fishermen. The low of TPC could be due to a curing temperature that can inactivate Salmonella [11]. The process of fish fumigation in Indonesia at first was still done traditionally using simple equipment and lack in sanitation and hygienic aspects which could have an impact on health and the environment. The common environmental impact as a result of smoked fish processing activities is air pollution which arises from smoke during fumigation [13].

Though fish smoked quality obtained from this study has not met the SNI requirement yet but able to show that fish smoke treated with vacuum packing has lower TPC but increased greatly in TPC number if storage time is increased. Higher TPC found in this research could be due to the handling process. Freshly fish used could have had high microbial content before experiencing smoke process and vacuum. The preservation with fumigation must be followed by other preservation methods, especially when smoked fish will be stored for a relatively long time. Cleanliness, length of fumigation, choice of raw materials, fuel and sterility of the production kitchen are factors affecting some fish product [14].

In case of a local community in Ternate engage in smoke fish processing, basic training in fish processing technology should be conducted towards these fishers to empower them apart from facilitating them with proper fish processing equipment in order to increase fish product quality. This will enable them to compete with other competitor and in turn, will increase their income and welfare.
4. Conclusion
Based on the results found from this study, some conclusion can be summed up as follows:
1. Smoked fish products from local community from Ternate do not meet SNI standards requirement even at 0 days storage (A0)
2. There is a significant difference between all treatments with 0-day storage having the lowest TPC whilst no-vacuum smoked fish store for 3 days having highest TCC.
3. Efforts are needed to improve the knowledge and skills of home industry fishermen in processing the product in order to produce good product quality.

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References
[1] BKPM Maluku Utara 2018 The Potency of North Maluku Province. http://www.bkpmprovmalut.net/potensi-di-tiap-kabkota-provinsi-maluku-utara/ (accessed: 19 November, 2018).
[2] BPS – Statistic of Maluku Utara Province 2017 North Maluku Province in Figures ISSN: 2356-0592 p 408
[3] Sonjiwe A, Musuka C G and Haambiya L 2015 The contribution of artisanal fisheries towards livelihoods and food security among communities of Chanyakya fishing camp in Kafue District of Lusaka Province. International Journal of Forestry and Horticulture (IJFH). 1(1) 22-31 ISSN 2454-9487.
[4] Sarpong D B, Quaatey S N K and Harvey S K 2005 The Economic and Social Contribution of Fisheries to Gross Domestic Product and Rural Development in Ghana FAO of the United Nation Sustainable Fisheries Livelihoods Program Final Report p 53.
[5] BSN 2013 Ikan Asap dengan Pengasapan Panas SNI 2725:13. ICS 67.120.30. Badan Standarisasi Nasional.
[6] Fowler J and Cohen L 1990 Practical statistic for field biology (New York: John Willey & Sons) p 227.
[7] Zar J H 1999 Biostatistical Analysis 4th Edition (New Jersey USA: Prentice Hall International, Inc) p 663.
[8] Dutta M, Priyanka Rani Majumdar P R, Ul-Islam M R and Saha D 2018 Bacterial and fungal population assessment in smoked fish during storage period. J Food Microbiol Saf Hyg. 3(1) 7. doi:10.4172/2476-2059.1000127.
[9] Ayeloja A A, George F O A, Jimoh W A, Shittu M O and Abdulsalami A A 2018 Microbial load on smoked fish commonly traded in Ibadan, Oyo State, Nigeria. J. Appl. Sci. Environ. Manage. 22(4) 493-497. DOI: https://dx.doi.org/10.4314/jasem.v22i4.9.
[10] Heruwati ES 2012 Pengolahan ikan secara tradisional, prospek dan peluang pengembangan. Jurnal Litbang Pertanian 2 (3) 12-13.
[11] Mailoa M N,Sabahanunn S T and Halid I 2013 Analysis of total microbial and detection Of Salmonella on smoked fish. JISTR. 2(6) 29-31. ISSN 2277-8616.
[12] Tapotubun A M, Reiuwpassa F, Apiturey Y M T N, Nanlohy H and T E A A Matruty 2017 The quality and food safety of dry smoke Garfish (Hemirhamphus far) product from Maluku IOP Conf. Series: Earth and Environmental Science 89 (2017) 012010. +8. doi :10.1088/1755-1315/89/1/012010.
[13] Sulistijowati R, Djuinaedi S, Nurhajati J, Afrianto E and Udin Z 2011 Mekanisme Pengasapan Ikan (Bandung: Unpad Press).
[14] Nastiti D 2006 Kajian Mutu Produk Ikan Manyung (Arius thalasinnus) Panggang di Kota Semarang Thesis (Semarang: Program Pascasarjana Universitas Diponegoro).