The Quality and Food Safety of Dry Smoke Garfish (Hemirhamphus far) Product From Maluku

Alfonsina Marthina Tapotubun¹, Fredrik Reiuwpassa¹, Yolanda M.T.N. Apituley², Hellen Nanlohy², Theodora E.A.A. Matrutty¹

¹Fisheries Technology Study Program, Faculty of Fisheries and Marine Science, Pattimura University
²Fisheries Agrobusiness Study Program, Faculty of Fisheries and Marine Science, Pattimura University

Email: am.tapotubun@gmail.com

Abstract. Dry garfish is product of smoked process of “ikan julung” (Hemirhamphus far) and slowly the product getting dry, stiff and its colour become gold yellow-brown. The aim of this study is to find out quality and food safety of dry smoked “julung” from Maluku. The sample of this study is taken from production Keffing village, East Seram Regency, Maluku. Parameters to be analyzed are degrees of protein, fat, water, ash, TPC, Escherichia coli, Salmonella, Vibrio and total Staphylococcus aureus used standard analysis method for proximate (AOAC. 2005), sensosy parameters (BSN.2009) and food safety (BSN. 2006). Spreadsheet Ms Excel (Microsoft Inc., USA) is used for data processing; data is being analyzed descriptively to be interpreted in the research report. Dry smoked “julung” Keffing village, Maluku meet the good quality and food safety, that are ingredient degrees of water content 12.43%, protein 61.55%, fat 12.58%, ash 9.3%, TPC [6,8]x10¹ CFU, total Staphylococcus sp [1,7] x 10², total E.coli 6.4 APM/g. and negatively for Salmonella and Vibrio.

1. Introduction
Julung fish (Hemirhamphus far) is a small pelagic live in groups around the coral coast to offshore area, mainly while spawning. Julung can be found in East Indonesia Sea with high degrees of salt and tend to be oceanic [20]. The product of julung (Hemirhamphus far) in Maluku increase annually. In 2013 the production was 7.305 tonnes and in 2015 it was raised to 11.619.6 tonnes, with the highest production from the East Seram Regency, which was 8.739.8 tonnes [5].

Fisherman community in each area has capability to use their sea product by process the product to become various processing product based on their knowledge and local wisdom. Maluku as one of huge fishing area, has significant property of traditional fish processing products, one of them is Julung product. Traditional fish processing product is fish product that is processed, based on habitual heredity, using simple tools with simple performance but has a unique taste, usually unpacked and has not well preserved.

Smoke 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 water layer of the surface body of fish. As a result the unique taste and aroma are formed, as well as the
goldy brown. The basically smoked process of fish is a unification of salting, drying and smoked processing fish. The aim of these processes is to abolish bacteria and to support the adhering smoke particles of the natural burning [1].

The smoke process not only being a processing method to raise well-preserved of the fish product but also to get the taste, aroma, and color that fit consumers desire [17, 20]. Smoke can increase the long lasting of fish, as a combine of dehydration influence, activity of anti-microbe and antioxidant in several smoke constituent, especially: formaldehyde, carboxyl acid, and fennel. Fenol and acid are compound of anti-microbe.

Dry Julung is an output of smoke process of Julung fish (*Hemirhamphus far*), by doing it slowly until it dry, hard and goldy yellow. Dry julung fish is a traditional processing of fisherman community in East Seram Regency [21, 25]. In Manado, the smoke julung fish is known as “ikan roa” or “julung-julung asap” named *Galavea*, which is one of the traditional fish processing product consumed by people for generation [19].

The sale of this product is held in traditional market, unpacked, full body condition using waya (20 pieces each) or being tied less (5 pieces each). During distribution and temporary storage, the product is only packed in a sack or cardboard box, so it will not be protected from environment influence. The product that being storage in opened condition will be potentially contaminated result in quality downgrade or be an unhealthy product. So far, the study of food quality and safety of traditional dry julung is less and dominated by fish from Manado [9,19, 25]. The aim of this study is to know the quality and safety of dry smokes julung, as one of traditional food processing in Maluku.

2. Methodology

2.1. Material and Tool
The main material used in this study is dry smoke julung fish, produced in Keffing Village, East Seram Regency. The analysis materials are filter papers (Whatman 42), HCL (Merck), NaOH (Merck), H2SO4 (Merck), petroleum benzene (Merck), fenol (Merck), ethanol (Merck), active carbon (Merck), litmus papers (Mercerry-negel). The tools are scales (Apel-PD-3000UV), oven (Memmert), ash oven (Heraeus), hot plate (Cimarec), desiccator, reflux tools, distillation dan destruction (Pyrex).

2.2. Research Methods
This study used descriptive research method, in two (2) steps. The first step, sample collection, and direct observation at Keffing Village. The second step is quality analysis and safety of food.

2.3. Analytic Parameters
Parameters for quality analysis, using standard methods are water content (oven method), protein content (Kjeldhal method), fat content (Soxhlet method), dust content (dusting method) [3]. Valuation of organoleptic quality is organize using 30 half trained panelist using smoke fish sensory score sheet SNI [6]. Safety food analysis, that are Total Plate Count, *Escherichia coli*, and *Salmonella, Vibrio* sp and *Staphylococcus aureus* using SNI method [7].

2.4. Data Analysis
Data is processed using spreadsheet *Microsoft office Excel* (Microsoft Inc., USA), and being analyzed. Descriptively to evaluate proximate, sensory parameter and food safety.
3. Result and Discussion

3.1. Production process of dry smoke julung fish
Dry garfish or dry julung, is a traditional processing of julung, using cold smoke process to the julung fish (Hemirhamphus far), which is done with the combination of hot and cold smoke process. Hot smokes to ripe the fish meat, and the cold one to dry the smoke fish. Smoke proceed and drying the fish, hard and change the colour into goldy brown. Production area of this product in Maluku is in Keffing, East Seram Regency. The process of dry smoke julung fish is done hereditary, which is clamped using pieces of bamboo, and then being smoked in a rack called para-para, and being combination of hot smoked and cold smoked.

Julung fish has a long slim body. Therefore a single smoke process is difficult to be held, there is why bamboo clamp is used to ease the process. Generally the traditional smoke process in East Seram Regency is as follows: Julung fish is washed using clean sea water and put it in waya made of bamboo and being clamped (20 pieces of julung in each waya) then being leak for a view minutes before smoking process. Fish clamped in waya is then put in rack and the smoke process is started in lowest rack near the heat resource. After it ripe, waya is moved to the top level rack of the fireplace and covered with gunny sack and smoked using small fire until it dry. This cold smoked process is held until it was delivered to the buyer or to distribute to town in the Province of Maluku and another city.

Space between first rack and fire resource in the smoke fireplace is 1 meter, while in the smoke fireplace there is 2 rack, with 1 meter space between them. The upper rack is used for cold smoke process and temporary storage until the products are distributed.

![Figure 1. Smoked Dry Julung Fish of Keffing, East Seram Regency, Maluku](image)

The dry smoked julung produce traditionally in Maluku, generally sold in its original form and without proper packing, while distribution and temporary storage are done in a sack or reuse cardboard box. [12] Before distributed and delivered to the market, the product was in the storage which is potentially contaminated with external factors that cause quality decreasing, damage during storage (humidity, storage, packing, etc).

Chemical Quality Composition

In general, product of smoke julung, processed traditionally in Keffing, East Ceram, Maluku, could be said well in quality. Analysis results show that quality composition of dry smoke ruling from the two village does not show any difference (Table 1). The reason is that the methods of handling and smoke process on those two villages are similar. This result is better compared to the same dry smoke julung at the different times and places [9, 19, 25].

The quality of smoke fish is influenced by several factors: smoke process, kind of fuel for the fireplace, smoke composition, temperature, humidity, velocity and density of smoke [24]. [2] mentioned that processing method, fresh fish quality, and storage, also influence the proximate of the smoke fish.
Table 1. Quality Profile of Dry Smoke Julung Fish Product

| Quality Parameter | Content |
|-------------------|---------|
| Water (%)         | 12.43   |
| Protein (%)       | 61.55   |
| Fat (%)           | 12.58   |
| Ash (%)           | 9.30    |
| pH                | 6.05    |

This result shows that water content of traditional smoke julung is low so that it can be categorized as dry product. This result is similar to the same product sales in traditional market in Manado that is 12.1 % [19], but lower than dry smoke tandipang fish from Sulawesi 15.2 % [14], and three kinds of traditional smoke fish from Sokoto Nigeria i.e. 17.15 -19.13 % [17]. Low content of water, is a result of high-rise smoke process of the product: firstly hot smoke (temperature 80 – 100°C) for less than one hour, then continued with cold smoke treatment (temperature 29 – 35°C) for about 24 hours. This cold smoke was held at the top level the rack far from the fireplace, to dry the smoke julung, until it delivered to the buyer. The temperature of the cold smoke process is about 30 - 40°C [10] and hot smoke temperature is more than 100°C and until temperature of the fish flesh becomes 60°C [27].

One of the factors related to the long lasting of the processing product is water content. The water content in the smoke fish will affect the storage period of this product [19]. The lowest water content, the slowest growing of the microbe, reversely the higher water content will accelerate the grow of the microbe because water is a good media for the microbe to grow so that the spoiled process will be faster [25].

Protein content related to water content. The lower water content, protein becomes concentrated. The protein content of the dry smoke julung in this study is 61.56%. This value is higher than the previous study by Sormin et al. [25], protein content of dry smoke julung is 56.1%; and protein content of smoke fish of three kinds of fish (Clarias gariepinus, Mormyrus rume, Heterobranchus longifilis) is 53.54 – 58.05 [17]. The protein content of fish after smoke process is higher than the fresh fish [4, 11, 17].

Ash content of three kinds of smoked being observed by [17] is between 7.18 – 7.41%. The increase of dust content after the smoked process is a result of the lost of humidity during the process [16]. The result of this study shows that the fat content of the smoke julung is quite high. Fat existence in the food gives the delicious taste because it influent the taste. Fish contains small amount of fat, compare to protein, but it contributes to the taste and aroma of the smoke fish [26].

3.2. Sensory Assessment
Smoke fish is a traditional processing product which is favor to the consumer for its unique taste and aroma, as a result of smoke processing treatment. The study shows that panelist gives the highest assessment to all of sensoric parameter, which is appearance, smell, and texture of the dry smoke julung. This high assessment is an appreciation to the perform of dry smoke julung of the Maluku. Sensoric specification is valued based on smoked fish score sheet.
Consumer likes of the smoke fish are related to the appetite in certain region, mainly in coastal area. This influence assessment decision toward the product. The result shows that the dry smoke julung from Maluku, get the high sensory assessment, that is 9 to 7, based on panelist assessment, and can be seen in the following table:
Table 2. Average assessment panelist toward sensory parameter of dry smoke julung

| Sensoric parameters | Average |
|---------------------|---------|
| Appearance          | 8.4     |
| Odour               | 8.6     |
| Taste               | 8.4     |
| Texture             | 7.6     |

Most of the panelist give the rate 9 and 8 to the appearance, odor and taste of the sample, and to the texture parameter, the greatest assessment are 7, because the score sheet used is one that usually used to produce soft smoked fish. [8] revealed that fenolic compound combined with different smoking methods will give direct effects to the sensory of smoked fish. Panelist assessment percentage to the sensory parameter of smoked julung fish is described in the following Table 3:

Table 3. Percentage to the Sensoric Parameter of Smoked Julung Fish

| Scale | Appearance | Odour | Taste | Texture |
|-------|------------|-------|-------|---------|
|       | Sum       | %     | Sum   | %       | Sum    | %     | Sum   | %     |
| 9     | 15        | 46.7  | 17    | 56.7    | 12     | 40    | 6     | 56.7  |
| 8     | 13        | 43.3  | 13    | 43.3    | 16     | 53.3  | 7     | 23.3  |
| 7     | 3         | 10    | 0     | 0       | 2      | 6.7   | 17    | 20    |

Dry smoked julung fish is bright gold yellow-brown in color, whole flesh and compact production. Appearance specification of smoked julung fish according to the score sheet is, whole, clean, orderly (neat), glitter based on genre. Waya that used to put julung fish in stack is effective to assure the wholeness and orderly of fish during the smoked process. Volatile compound from the smoke like carbonite and phenol in the smoked fish will react to the protein component and form the specific color, taste and aroma [13]. The color of the smoked julung is goldy yellow-brown. [19] stated that appearance of the product usually related to the color and the wholeness of the product. Smoked component adhere to the fish during smoked process result in fish with the color mentioned above and shine. After the smoked process the color becomes goldy yellow-brown and shine [26]. The volatile compound from the smoke, like carbonyl and fennel at the smoked fish will react with protein component of the fish and generate specific color, taste and aroma [13]. Appearance is one of the determinating factors for the consumer to make their decision toward smoked fish.

The dry smoked julung fish has aromatic smoke odor. Specification description of its odor, result of panelist assessment based on the score sheet of aromatic to the less aromatic, specifically without additional odor. A smoked process can eliminate the putrid odor of the fresh fish, and change it to the aromatic and smoked smelly. The smoked process results in specific smoked aroma of the fish [26]. Odour quality criteria of the smoked fish are, soft smoked smelly until strong smelly, no rancid, no spoiled, smell, no strange smell, no sour smell, and no sweaty smell [27]. Substances that dominate the odor existence are smoked components that are adhered to the product, like fennel.

Smoked fish have a smoked delicious taste while being eaten. Dry smoked julung fish taste description in this study are: tasteful to the delicious. Kind specific with no additional taste. The smoked taste is in favor of consumers, especially those who are familiar with smoked production. The dry smoked julung which are produced traditionally using cold smoked with long period, enable absorption of smoked substances in the limb of the fish and result in unique smoked taste in favor of the consumer. The smoked process, not only is a method of long-lasting but also to improve the taste to meet the consumer's favor [23]. Fenol and Carbonyl content in smoked fish contribute to its taste [18, 26]. Its taste is influenced by the time of the smoke process and the fireplace.

Traditional dry smoke Julung fish from Maluku, have a hard texture and crispy, because of less water content during the cold smoked process. The texture assessment description of the dry smoke...
julung is dense, compact, dry enough to too hard, brittle, dry. The smoke fish texture is related to the water content. Cold smoked process treatment more than 24 hours will reduce water content significantly, and the fish flesh becomes harder. The lower water content, the harder texture of the smoked fish. The dry and hard texture of the fish according to water content of the product is 12.43%. [19] stated that the longer time of smoked process, the lower water content and product become dry and hard.

3.3. Food Safety
The results show that Escherichia coli bacteria assessment is beyond the top maximum margin of Indonesia National Standard (SNI). This condition shows the existency of E. coli contamination at the dry smoked julung, that possibly come from processor, intersecting contamination, fly or insect that infects the product. Contamination may occur easily because stack of fish is put in the rack on the fireplace and only the top part is covered by gunny sack.

Process person, tools, water for cleaning, and insect are source that causes contamination, so product should be protected with proper packing. In the food quality and safety requisite of smoked fish, Indonesia National Standard (SNI) establish SNI for maximum E.coli content should be less than 3 APM/g [6]. For this condition, the process of dry smoked julung fish before it consumed should be done properly with high temperature to reduce bacteria E. coli so that product can be consumed safely. State that in the temperature ≥ 70 °C is good enough to kill E.coli bacteria.

The maximum standard of TPC for food safety of smoked fish is 1,0x10^5 colony/g, E.coli less than 3 APM/g, Salmonella and Vibrio cholerae negative, Staphylococcus aureus maximum 1,0x10^5 [6]. Amount of microbe in the food influences its velocity of damage. The simple smoked fireplace and opened will make bacteria easier to contaminated smoked fish.

### Table 4. Safety Profile of Dry Smoked Julung Fish from Maluku

| Food safety parameter | Content               |
|-----------------------|-----------------------|
| TPC (CFU/g)           | [6,7] x 10^1          |
| *E. coli* (APM/g)     | 6.4                   |
| *Salmonella* (per 25 g) | Negative            |
| *Vibrio* (per 25 g)   | Negative              |
| *Staphylococcus* sp (colony/g) | [6,1] x 10^1 |

Food safety becomes the need of modern community to decide kind of food would be consumed, to assure the health of foods. Bacteria contamination in product will accelerate the damage of the product, result in it become unhealthy. In general the result of this study shows that safety of dry smoked julung fish from Maluku is good enough, except at Escherichia coli parameter.

4. Conclusion
Dry smoked julung fish of Maluku has the good quality and safety, that are: water content 12.43%, protein 61.55%, fat 12.58%, ash 9.3%, TPC [6,8] x 10^4 CFU/g, total *Staphylococcus* sp [1,7] x 10^2 colony/gram, *Salmonella* bacteria, dan *Vibrio* negative but *Escherichia coli* positive.

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