Investigation on quality of smoked Scad Mackerel (*Decapterus ruselli*) processed using different fuels

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Abstract Scad mackerel (*Decapterus ruselli*) possessed potentiality as a valuable fisheries commodity in Maluku, mainly due to its abundant stock. As commonly found in fisheries products, the scad mackerel is also perishable; besides, the fish has a small quantity of flesh and undesirable taste, which make it receiving rejections from local communities. In light of this constraint, preservation of fish using smoking method is acceptable, enabling to combine heat and chemical substances as product of burning. The experiment aimed at investigating the quality of smoked scad mackerel treated with different fuels. Our experiment was arranged according to completely randomized design with two treatments, i.e. fish forms (whole (A); butterfly (B)) and fuels (coconut shell (1); sawdust (2); coco fiber (3)). The smoked fish was then evaluated for chemical composition (moisture, ash, protein) and preference (appearance, odor, form, texture). The results showed that the highest score for each parameter was achieved in different treatments as follows: appearance of 7.95 (A1), odor of 8.00 (A1), form of 7.0 B3 (7.9), texture of 7.95 (B3), moisture content of 66.68 (B1), ash content of 3.98 (A3) and protein content of 49.89 (B3).

1. Introduction

Scad mackerel (*Decapterus ruselli*), locally named as *momar* in Maluku, potentially produces a great economic benefit to local residents through a proper processing technology. Besides, the fish can be continuously captured throughout the year, ensuring the supply continuity. However, production of food from the fish is hampered with its perishability and less favorable taste; in addition, local people reject the fish for the low portion of flesh [1].

In order to reduce perishability, fish is smoked, often combined with salted and heat treatments. Fish smoking is a common method with the main aim of extending shelf life due to smoke produced from burning process. However, smoking process is currently not only addressed to prolong storability of fish, but also designed to produce flavor, color, and taste [2]. For this reason, some of the smoking methods are researched regarding variability of fuels for generating smoke, including sawdust, coconut shell, coco fiber.

Scad mackerel is rich in protein, estimated to reach 26.31g/100g. Smoking of scd mackerel can help to improve economic value due to physiochemical changes in the fish such as flavor, color, and aroma, thereby increasing its acceptability [2].

The fuel used in burning process becomes a foremost concern in fish smoking process. It is suggested that the desirable effects on smoked fish quality can be achieved through the use of proper fuels, namely hard wood, such as mangrove, rasamala, as well as sawdust of teak wood, and coconut shell, which are revealed to produce high quality of smoked fish. The quality of smoked fish is evaluated according to proximate components (moisture, ash, protein), and hedonic test. Quantification of moisture, protein, and ash is often needed to ensure that
the process can maintain nutritional level that still fits the food standard and commercial purposes [2] [3]. In addition, phenolic compound is an important indicator responsible for flavor profile, as well as bacteriostatic and antioxidant properties [4].

This present work aimed to evaluate types of fuels (coconut shell, sawdust, coco fiber) with regard to quality of smoked fish, i.e. proximate composition (moisture, ash, and protein) and preference. This work is expected to provide wide benefits for smoked fish industries related to improvement of quality and consumer acceptance.

2. Experimental Stages

The experiment was conducted in two stages. First, fish brining was made at various concentration of salts: 5%, 10%, and 15%. In this part, fish salted at 5% of salt was chosen for the second stage. In this stage, whole fish (A) was smoked by burning coconut shell (1); sawdust (2); and coco fiber (3).

2.1 Material and Methods

Smoked fish was prepared in Laboratory of Fisheries Processing, Tual State Fisheris Polytechnic. Sample analysis was conducted in Laboratory of Chemistry, University of Pattimura, Ambon. The experiment was carried out in May 2019.

2.2 Sample Preparation

Fresh scad mackerel was smoked according to method [5] with modification. The fish was submerged in 5% salt solution (5 g salt in 950 mL water) for 30 min, then drained at room temperature for about ± 30 min. Subsequently, the fish was smoked in a smoking cabinet at following procedures: A1 = whole fish, coconut shell; A2 = whole fish, sawdust; A3 = whole fish, coco fiber, for about 1 h.

2.3 Proximate Analysis and Hedonic Test

The proximate composition was determined according to [6]. Determination of moisture content was carried out using gravimetric procedure, while protein content was quantified using Kjeldahl. In case of ash, sample was furnaced at 525 °C for 18 h to quantify total amount of ash. For hedonic test, the panelists were asked to give score using 9-point hedonic scale on 4 parameters (appearance, odor, taste, and texture) of the sample. The 1-9 scale was described as follows: 1 = dislike extremely, 2 = dislike very much, 3 = dislike moderately, 4 = dislike slightly, 5 = neither dislike nor like, 6 = like slightly, 7 = like moderately, 8 = like very much, 9 = like extremely [7].

Statistical Analysis

Analysis of variance (ANOVA) was employed to evaluate data, while significant difference between means was then verified using Duncan test [8]. For hedonic test, the data were statistically evaluated using Kruskal Wallis at confidence of 95%. This statistical analysis was carried out in SPSS version 17.

3. Results and Discussion

3.1 Proximate Composition

The proximate composition of smoked scad mackerel was presented in Table 1. The use of different fuels showed significant impact to moisture level (p<0.05). Moisture content of fresh scad mackerel reached 72.5%, then it reduced at a certain level after exposed to high temperature. Smoking process allows to induce water removal. The degree of moisture removal positively relates to temperature and period of heat exposure. Besides, reduction of water in fish results from addition of salt prior to smoking process [4]. Similarly, previous study [3] revealed that water content in rainbow trout (Oncorhyncus mykiss) fillet smoked at 80-90 °C for 3 h depleted up to 11.1% (70.3% in fresh fillet, 59.5% in smoked fillet).

Quantification of ash content can represent amount of mineral in food, thus it may indicate its nutritional status. Different fuels showed significant effects on ash content of smoked scad fish (p<0.05). The longer smoking process leads to more reduction of organic elements such as carbon that compose protein and fat, and elimination of sulphate and phosphate in protein. [8] reported that ash content in skipjack fish smoked using rice hull was 2.38%, while [9] reported ash content of 2.34% in
catfish (*Arius thallasinus*) smoked for 4 h. Additionally, ash content reached 3.43% in boneless milkfish (*Chanos chanos forsk*) smoked with liquid smoke from rice hull for 3 h [2].

In this experiment, the highest protein content was attributed to fish smoked with coco fiber (44.98%), then sawdust (42.31%). In contrary, the lowest one was found in sample treated with coconut shell. The reduction of nitrogen as specific element in amino acids seems to have close relation with heating time. Longer heating time would produce more destruction on protein structure [10]. High temperature is responsible for denaturation and coagulation of protein, causing transformation of its original structure into smaller one. Such structural deformation drastically alters the properties of protein, which make it less stable towards surrounding changes [11]. [13] showed that smoking treatment significantly promote the increment of macro nutrients, observed in *Peneus notiali s* (65.76% in fresh fish, 67.00% in smoked fish) [12].

### Table 1. Proximate composition of smoked scad mackerel

| Group of treatments          | Moisture content (%) | Ash content (%) | Protein content (%) |
|-----------------------------|----------------------|-----------------|---------------------|
| Fresh scad mackerel (untreated) | 72.5                 | 1.45            | 26.31               |
| Coconut shell               | 66.09±0.841          | 3.04±0.870      | 39.84±4.929         |
| Sawdust                     | 63.44±2.242          | 3.50±0.488      | 42.31±5.671         |
| Coco fiber                  | 64.02±2.503          | 3.50±0.679      | 44.98±6.944         |

Note: different superscripts following the means in similar column indicate significant difference.

### 3.2 Hedonic Profile

As depicted in Figure 1, smoking process using coconut shell reached the most satisfying results in terms of color (brown to yellowish in color), taste, and smoky taste. Chemically, the changes in taste and aroma in smoked fish is produced from carbonyl and phenol compounds present in smoke [13] found that carbonyl and its derivatives contributed to formation of color, taste, and aroma of smoked fish.

### 4. Conclusion

Smoked scad mackerel treated with coconut shell for production of smoke showed the most desirable characteristics based on hedonic test. Further studies on storability of the product processed with coconut shell could be envisaged to produce more scientific evidences.
Acknowledgements

Authors would like express sincere gratitude to staffs in Laboratory of Fisheries Processing, Tual State Fisheries Politechnic, and Laboratory of Chemistry, University of Pattimura, Ambon, for technical assistance and experimental facilities.

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