Volatile Flavor Compounds Composition of Steamed Fish Nilem (*Osteochilus hasselti*)

Dealitabela[1*] Rusky Intan Pratama [1] Ayi Yustiati[1] Iis Rostini[1]

[1] *Fisheries Department, Padjadjaran University*
Jl. Raya Bandung-Sumedang KM. 21 Jatinangor, Sumedang, Indonesia

ABSTRACT

Nilem fish is one of the freshwater fish commodities that have high protein content and high economic value. Even though it has a high protein content, nilem fish is still less attractive because its meat has a lot of spines, so it needs to be processed to increase public interest. Steaming is one of the recommended cooking methods for fish processing. Steaming affects the composition of flavor compounds in fishery products. Flavor volatile is a chemical component that plays a role in the odor (aroma) that comes from a food ingredient. This research is to study and identify the composition of volatile compounds found in steamed nilem fish. The nilem fish were taken from Cirata Cianjur Reservoir, West Java, then sample preparation was carried out at the Fishery Product Processing Technology Laboratory, Faculty of Fisheries and Marine Sciences, Padjadjaran University. Analysis of volatile flavor compounds was carried out at the Flavor Laboratory of the Indonesian Rice Research Center, Sukamandi, Subang. The analysis of volatile flavor was carried out from February to April 2021. The volatile compounds were analyzed using Gas Chromatography/Mass Spectrometry (GC/MS). Volatile compounds were detected with a total of 40 compounds in the steamed sample and most of the compounds came from hydrocarbons, alcohols, aldehydes, ketones, esters, and others. Proximate analysis was carried out at the Laboratory for Conservation of Endangered and Hopeful Animals-PAU (Inter-University Center) Bogor Agricultural University. Proximate analysis of steamed nilem contains 73,19% of water content, 1.87% of ash, 3.42% of fat, and 21.07% of proteins.

Keywords: *Flavor, nilem fish, proximat, steamed, volatile*

1. INTRODUCTION

Nilem fish is one of the freshwater fish commodities that have high protein content and high economic value. According to official data from the Central Statistics Agency of West Java [1], the production volume of inland general water capture fisheries for this type of nilem fish in 2017 was 4,391 tons, an increase of 30.51% when compared to the production volume in 2016 of 1,340 tons. According to research results from the Center for Development and Quality Testing of Fishery Products (2010), the protein content of nilem fish reaches 38.83%, so it is very potential to be developed into processed fishery products.

Steaming is one of the recommended cooking methods for fish processing [2]. According to Gardjito [3], steaming is one way of processing food through heating using water vapor in a closed container. This is done to keep nutrients from being lost and to keep the texture of the food better. The steaming process aims to maintain the original taste of the food, cooking with this technique can be done without the addition of the slightest fat to reduce the change in flavor.

The flavor is an impression or sensation produced by food ingredients received by the human senses, especially those caused by taste and aroma [4]. The flavor is perceived by taste receptors in the mouth and aroma receptors in

the nose. Flavor can be interpreted simply as the aroma of food. Flavor components that act as aromas are volatile components that are perceived by aroma receptors from the olfactory organs such as the olfactory tissue in the nasal cavity. Flavor compounds contained in fish usually come from derivative compounds dominated by fat and protein.

because consumers will prefer foods with a better aroma. The volatile compounds contained in the ingredients influence the aroma characteristics of a product. The characteristics of the aroma of a product and the volatile components contained in it are some important factors in determining the quality of a food ingredient. Aroma components can affect the organoleptic characteristics of a food material so in the end, it also plays a role in the level of acceptance and consumption of the final product [1].

Research on the composition of volatile content in fishery products as an example is the research of Liu et al. [5] regarding the analysis of flavor content in raw silver carp and steamed results, there is also a study by Pratama et al. [1] regarding the profile of amino acids, fatty acids and volatile components of gouramy (Osphoronemus gouramy) using the extraction of volatile flavor compounds using Solid Phase Microextraction (SPME) and identified by Gas Chromatography-Mass Spectrometry (GC/MS) both fresh and steamed showed the identification of 17 compounds in fresh gouramy and 38 compounds in steamed gouramy from hydrocarbon, aldehyde, ketone, alcohol, ether and ester groups.

The composition of volatile compounds detected in fishery products usually comes from groups of aldehyde, ketone, alcohols, organic acids, and hydrocarbon compounds. Therefore, hydrocarbons, aldehydes, ketones, and alcohols may be the volatile compounds contained in steamed nilem fish.

The purpose of this research is to study and identified volatile compounds composition found in steamed nilem fish.

2. MATERIALS AND METHODS

2.1 Time and Place of Research

This research was conducted in February-April 2021. The study was conducted in the Fishery Product Processing Laboratory, Faculty of Fisheries and Marine Sciences, Universitas Padjajaran, Sumedang Regency, West Java, Indonesia for preparation sample. Volatile components were analyzed at Flavor Laboratory, Indonesian Center for Rice Research, Sukamandi, Subang.

2.2 Research Materials

The tools that used in this research were aluminum foil, cling wrap, cool box, gas chromatography-mass spectrometry (GC/MS), label, gas stove, Kjeldahl set, soxhlet, steamer, fillet knife, zip lock, furnace, digital scale, waterbath. The materials used in this research were fresh fish nilem samples, water, HCl, CuSO4, K2SO4, NaOH, H2SO4, and chloroform.

2.3 Research Methodology

The method used in this research was an experimental method on steamed fish nilem samples. The sample was extracted with the solid phase microextraction (SPME) method to identify volatile flavor compounds using tools called Gas Chromatography-Mass Spectrometry (GC/MS). A steamed fish nilem sample was also tested for its proximate consisting of water, ash, protein, and fat content as proximate analysis data.

2.3 Research Procedures

The first stage of this research is taking samples of nilem fish from sellers in the area around Cirata Reservoir, Cianjur. The sample of nilem fish obtained was 3kg and transported alive using a plastic bag filled with oxygen to the Laboratory of Fishery Products Processing Universitas Padajaran to be prepared.

The procedure for the preparation of sample volatile compounds was carried out based on research modification by Pratama. The preparation process the sample was cleaned first and then cut into fillet shapes. After that the sample was steamed at 100oC, the nilem fish meat was packaged using aluminum foil, then wrapped in cling wrap, and lastly put into zip-lock plastic. The three-layered packaging step is done since air, light, and temperature can change and damage the flavor of the sample. The finished sample is then placed in a coolbox containing a sufficient amount of ice packaged in plastic to keep the temperature cool (10-15°C). The samples were then transported to the laboratory from the Preparation Laboratory in Universitas Padjajaran to the Flavor Laboratory in Sukamandi and then continued to the Integrated Laboratory in Institut Pertanian Bogor, to be analyzed for their volatile compounds and proximate composition.

The procedure for analyzing volatile compounds was carried out based on research modification by Pratama. Analysis of the volatile compounds was done using a series of Gas Chromatography (Agilent Technologies 7890A GC System) and Mass Spectrometry (Agilent Technologies 5975C Inert XL EI CI / MSD) apparatus. Sample extraction was carried out using the Solid Phase Micro Extraction (SPME) method to evaporate volatile compounds in the sample, DVB/Carboxen/Poly Dimethyl Siloxane fiber was used as an absorbent for volatile flavor compounds. The extraction temperature is 80ºC in 45 minutes (in waterbath). The GC column used is HP-INNOWax (30 m x 250 μm x 0.25 μm), helium carrier gas, initial temperature 45 ℃ (2- minute hold), increase in temperature 6 ℃ / minute, final equipment temperature 250 ℃ (hold 5 minutes) for 45 minutes.

Proximate analysis was also carried out on the sample consisting of water, ash, protein, and fat contents based on AOAC (Association of Official Analytical Chemists) procedures

2.5 Data Analysis

The mass spectra of the detected compounds were compared with the mass spectra patterns contained in the data center or NIST library version 0.5a (National Institute Standard and Technology). The data of volatile flavor compounds were analyzed using Automatic Mass Spectral Deconvolution and Identification System (AMDIS) software (Mallard and Reed 1997) to recorrect from the compound mass spectra data. The data of both analyzes were explained in a description.

3. RESULT AND DISCUSSION

3.1 Analysis of Volatile Compounds

The volatile flavor compounds in the steamed nilem fish sample were detected by 40 compounds consisting that consist 8 compounds of hydrocarbon, 25 compounds of aldehydes, 10 compounds of alcohol, 4 compounds of ketone, and 3 compounds, etc.

The group of hydrocarbon compounds detected in steamed nilem fish was 8 compounds, hydrocarbons were the highest group based on semi-quantification in steamed nilem fish samples. detected where 1,3,6-Heptatriene and 5-methyl compounds had a high proportion value of 25.759%. Heptatriene, 5-methyl was the highest organic compound found in steamed nilem fish samples. The volatile compounds of the hydrocarbon group can come from decarboxylation reactions and separation of carbon chains from fatty acids, and secondary reactions from thermal oxidation of carotenoids and other unsaturated fats [6,7,5].

The group of aldehyde compounds detected were 15 compounds which were the highest class of compounds after the hydrocarbon group based on semi-quantification with nonanal as the compound having the largest proportion, namely 12.532%. Nonanal is an aldehyde derived from unsaturated fat which has a characteristic sweet, green and fatty aroma such as the aroma of smoked salmon [8].

Table 1. Volatile compounds identified in steamed nilem fish

Group	RT	Compound	Area	Proportion (%)
Hydrocarbons	14,3418	Naphthalene, decahydro-	224870	0,828

Group	RT	Compound	Area	Proportion (%)
	15,2302	Cyclohexene, 1-methyl-4-(1-methylethenyl)-, (S)-	241999	0,891
	15,4728	1,3,6-Heptatriene, 5-methyl	6994712	25,759
	20,6028	Hexadecane	70747	0,26
	22,6288	Undecane	1597	0,005
	24,1424	Toluene	8610	0,031
	24,5792	Pentadecane	965529	3,556
	28,2222	Nonadecane	1959688	7,216
Aldehyde	8,7047	Pentanal	4355	0,016
	10,893	Hexanal	1903511	7,032
	10,9255	Butanal	405059	1,491
	12,6705	Heptanal	75848	0,278
	14,585	Octanal	340301	1,253
	18,526	2-Undecenal	66830	0,246
	18,5378	2-Heptenal, (E)-	9418	0,034
	18,758	Decanal	69916	0,257
	20,0833	4-Heptenal	31613	0,116
	24,8809	2-Octenal, (E)-	20256	0,074
	28,5593	Tridecanal	47898	0,176
	30,2771	Dodecanal	173845	0,64
	15,5006	2,6-Nonadienal, (E,Z)-	53797	0,197
	15,9262	2,4-Heptadienal, (E,E)-	41483	0,152
	16,6305	Nonanal	3403069	12,532
Alcohol	7,5181	2-Nonanol	5892	0,021
	10,893	1-Hexanol	2295107	8,452
	10,8972	2-Hexen-1-ol, (E)-	1571978	5,788
	12,6457	1-Pentanol	125419	0,461
	14,1818	1-Octen-3-ol	2746185	10,113
	15,9262	2-Octen-1-ol	301630	1,11
	15,9776	1-Octanol	217961	0,802
	16,4575	1-Penten-3-ol	4085	0,015
	18,5236	1-Nonanol	78915	0,28
	29,7311	1-Heptanol	5139	0,018
Ketones	8,112	2,3-Pentanedione	2093	0,007
	14,2007	2,3-Octanedione	1559705	5,743
	14,2172	3-Heptanone, 6-methyl-	646844	2,382
	18,2993	3,5-Octadien-2-one	5920	0,021
Others	8,1303	Methylamine, N, N-dimethyl-	6964	0,025
	14,3541	Furan, 2-pentyl-	429212	1,58
	18,0939	Benzaldehyde, 4-ethyl-	36290	0,133

The group of alcohol compounds identified in steamed nilem fish was 10 compounds with 1-Octen-3-ol as the compound having the largest proportion of 10.113%. According to Whitfield et al. (1982) in Liu et al. [5], 1-octen-3-ol gives mushroom-like and earthy aroma attributes.

There are 4 groups of ketone compounds identified, of which 2,3-Octanedione has the highest proportion value, which is 5,743%. 2,3- Octanedione is described as an aroma that has a metallic feel and can be formed as a result of the oxidation of fats and fatty acids and the degradation of amino acids during processing [9].

The volatile flavor compounds detected in the steamed nilem fish samples were formed during the steaming process. According to Liu et al. [5] and Primary et al. (2013), the volatile flavor compounds detected in cooked fish were caused by thermal oxidation and decomposition of fatty acids, especially unsaturated fatty acids. The variation of numbers and types of volatile compounds are related to variations in the chemical compounds contained in the sample, mostly in the protein and fat, and the remainder is from an aquatic environment where the fish lived.

3.2 Proximate Analysis

Proximate analysis was done on the sample of steamed nilem fish. The proximate analysis included water, ash, protein, and fat content. The results of the proximate analysis are shown in Table 2 below.

Table 2. Proximate analysis samples nilem fish steamed

Samples	Water (%)	Ash (%)	Fat (%)	Protein (%)
Steamed Nilem Fish	73,19±0,01	1,87±0,09	3,42±0,05	21,07±0,18

3.2.1 Water Content

Water is the main component in foodstuffs that can affect durability. Water content is the content or amount of water that has disappeared from the material through a heat process with a certain temperature that does not exceed the boiling point of water [10]. Based on the proximate test on steamed nilem fish, the water content of the sample and its standard deviation is 73,19±0,01% According to research by Utami et al. [11], the water content in steamed nilem fish is 70.97%.

3.2.2 Ash Content

Ash content is an organic substance left over from the combustion of organic material. The determination of ash content is closely related to the mineral content contained in a material, and the purity and cleanliness of the resulting material [12]. Based on the results of the proximate analysis, the ash content analysis on the sample was 1,87±0,09%. According to research by Utami et al. [11], the ash content of steamed nilem fish was 1.87%. The ash content in the sample comes from the mineral content in the meat. The minerals that are usually contained in nilem fish include calcium, iron, magnesium, phosphorus, potassium, sodium, and zinc.

3.2.3 Fat Content

Fat is an important food substance to maintain the health of the human body. In addition, oils and fats are a more effective source of energy compared to carbohydrates and proteins. The results of the fat content on the sample was 3,42±0,05% According to research conducted by Utami et al. [11], the fat content in steamed nilem fish was 8.91%. According to Jacob et al. [13], Fat content is related to flavor components. This can happen because fat has properties that are not heat-resistant so the fat that undergoes the cooking process will melt and even evaporate (volatile) into other components such as flavor.

3.2.4 Protein Content

Protein is a food substance that is very important for the body because this substance in addition to functioning as fuel in the body also functions as a building block and regulator. The results of protein content on steamed nilem fish was 21,07±0,18%. According to research by Utami et al. [11], the protein content of steamed nilem fish was 18.75%. Protein structure can change due to steaming treatment, one of these changes is denaturation which occurs due to an increase in temperature during steaming.

4. CONCLUSIONS

There are 40 volatile compounds found in steamed nilem fish. The compounds found can be categorized into hydrocarbon, aldehyde, alcohol, ketone, and other groups. The group of volatile flavor compounds identified in steamed nilem fish is hydrocarbon (8 compounds), aldehydes (15 compounds), alcohols (10 compounds), ketones (4 compounds), and 3 other compounds. Pentadecane was the largest compound found in steamed nilem fish (48.50%). The steamed nilem fish contained 73.19% water content, 1.89% ash, 3.47% fat, and 21.07% protein.

5. REFERENCES

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