VOLATILE COMPONENTS OF RAW SNAKEHEAD FISH (*Channa striata*)

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ABSTRACT

The objectives of this research were to identify volatile components of fresh snakehead fish (Channa striata). The experiment was conducted by extracting volatile flavor compounds on fresh fish sample (temperature 100^oC, ± 30 minutes) by Solid Phase Micro-Extraction method (SPME) using 40^oC extraction temperatures and identifying volatile flavor compounds using Gas Chromatography-Mass Spectrometry (GC/MS). Proximate test was also performed on samples which included water, ash, lipid and protein content as supporting data. The volatile components analysis successfully detects 2 volatiles compounds in fresh snakehead fish. The detected components derived from hydrocarbons groups. The result of proximate test of fresh snakehead fish showed that it had 78,3% water content, 1,5% ash, 0,3% lipid and 19,1% protein content.

Keyword: *flavor, fresh, snakehead fish, proximate, volatile compounds,*

1. INTRODUCTION

Indonesia's fishery resources have excellent potential, especially the potential for freshwater fisheries that continues to grow every year. The volume of capture fisheries production in public waters in 2014 was 446,692 tons, an increase of 9.39% when compared with the production volume in 2013 of 408,364 tons. One of the freshwater fish which production are relatively high in Indonesia is snakehead fish. The volume of capture fisheries production in Indonesian public waters in 2014, one of which was dominated by snakehead fish, with a production volume of 39,030 tons (8.74%) [1].

The utilization of snakehead fish (*Channa stirata*) in Indonesia is quite a lot by the community, because of its high nutritional value and delicious flavor. Fresh snakehead fish is used as an ingredient in making crackers, "pempek" and other fisheries product, because it contains high nutritional value [2]. Fresh fish as main ingredients for various products are used due to their specific characteristics on affecting taste and aroma of the end products. Difference fish or main ingredients undoubtedly, would also have different impact on their end products sensory characteristics, namely its flavor.

Flavor is a sensation produced by food ingredients when they are placed in the mouth, especially those caused by taste and aroma [3] combined with tactile sensations. Therefore, flavor is one of the main factors in the acceptance of food products by consumers or it can be said that flavor plays an important role on food acceptance [4], [5]. The components that compose flavor perception are divided into two compounds groups which are known as non-volatile compounds and volatile compounds. Volatile flavor is a sensation that is obtained when smelling a food substance that is felt by the sense of smell in the nose. Each raw material or processed product has a specific volatile flavor with its respective content. The composition of volatile flavor compounds detected in fishery products usually comes from aldehydes, alcohols, ketones, acids and hydrocarbons [6].

Many researches on the volatile flavor composition of fishery products abroad have been carried out. For example, the effect of reheating on volatile and non-volatile compounds found in silver carp (*Hypophthalmichthys* *molitrix*) [6]; Study on changes in volatile compounds in the flesh of fresh fish (yellow fin tuna, sardines, skipjack, Bluefin tuna, chub mackerel, red sea-bream, tuna, puffer fish) during frozen storage [7]; Volatile components of fresh and smoked black bream (*Brama raii*) and rainbow trout (*Oncorhynchus mykiss*) [8] and various other similar topics researches. However, research regarding the composition of volatile flavor of indigenous Indonesian fish in fresh conditions has never been carried out in the past. This information is important in order to study the aroma characteristics of a product or commodity and useful for basic data provision for subsequent applicable studies such as the application of research results to make or modify artificial flavor (seasoning). The objectives of this research were to identify volatile components of fresh Snakehead fish (*Channa striata*).

2. MATERIALS AND METHODS

2.1 Sample's Preparation

Snakehead fish samples were obtained from fish seller around the Gedebage area, Bandung, West Java, Indonesia. The fish are catch around the Rancaekek Regency dam. Samples of snakehead fish were obtained as much as 3 kg and transported alive using oxygen-filled plastic bags to the Fisheries Product Processing Laboratory, Padjadjaran University to initiate sample preparation steps. Fresh snakehead fish sample were washed, descaled, its head were cut-off and removed and finally filleted to obtain the meat portion. The samples were then each weighed 50 grams for identification of volatile compounds analysis and 40 grams for proximate analysis and the rest were stored in a freezer for extra or spare. Samples that have been weighed were then packed using aluminum foil, labeled and wrapped with cling wrap then finally put in a plastic zip-lock. Packaged samples were put in a cool box containing slurry ice, then taken to the Flavor Laboratory of the Indonesian Center for Rice Research, Sukamandi, Subang to analyze its volatile flavor compounds and the Laboratory of Endangered Animal Conservation, Bogor Agricultural Institute for proximate analysis.

2.2 Volatile Component Analysis

Volatile flavor analysis procedures were performed according to [8] with slight modification. Extraction of sample's volatile compounds was carried out by Solid Phase Micro-Extraction (SPME) method to evaporate volatile compounds from the sample, using DVB/Carboxen/Poly Dimethyl Siloxane fiber as an absorbent of sample's volatile flavor compounds. A total of 1.5 g of sample was placed into a 22 ml specific vial for SPME. The extraction temperature of fresh snakehead fish was 40^{o}C for 45 minutes, carried out in a Memmert® water-bath apparatus. Afterward, the fiber was inserted into GC/MS Gas Chromatography instruments (Agilent Technologies 7890A GC System) sample injectors and Mass Spectrometry (Agilent Technologies 5975C Inert XL EI CI / MSD), and subsequently the device was set. The GC column used was HP-INNOWax (30 m x 250 µm x 0.25 µm), and main GC analysis parameters consists of: helium carrier gas, with initial temperature 45^{o}C (hold 2 minutes), increased in temperature 6^{o}C/minute, the final temperature of the tool is 250^{o}C (hold 5 minutes) and total running time was 32,775 minutes.

The results obtained were chromatograms and mass spectra of compounds detected were then compared with mass spectra patterns contained in the data center or NIST library version 0.5a (National Institute of Standards and Technology) on computer database. The components data of volatile flavor compounds were further analyzed using Automatic Mass Spectral Deconvolution and Identification System (AMDIS) software [9] to correct compound mass spectra data.

2.3 Proximate Analysis

Proximate analyses conducted on fresh snakehead fish samples include moisture, ash, protein and lipid content were carried out based on [10] procedures and performed in three replications.

2.4 Data Analysis

The parameters observed in the study were the identification of volatile flavor compounds as the main parameters and the proximate test, namely water, ash, lipid and protein content as supporting parameters. The data obtained on the identification of volatile flavor compounds and the mean results of the proximate analysis of fresh snakehead fish were discussed in a comparative descriptive manner based on semi quantitative determination and compared with related scientific references available.

3. RESULT AND DISCUSSION

3.1 Proximate Analysis

Proximate test results of raw or fresh snakehead fish can be seen in Table 1. The difference in the measurement results can be influenced by the initial content of the raw materials, the type of each commodity being tested and the processing process that the commodity has been through [11].

Table-1. Proximate analyses of fresh snakehead fish (*Channa striata*)[a]

Parameters	Value (%)
Moisture	78,3±0,02
Ash	1,55±0,05
Fat	0,31±0,12
Protein	19,09±0,07

[a] Data are expressed as mean standard deviation with n=3

The fresh snakehead fish sample contained 78.3% water content, this result is more or less the same as previous studies. According to [12] the water content of raw snakehead fish (*C. striatus*) is 77.2% and according to [13] the water content of raw snakehead fish (*C. striatus*) was 70.4%. The differences in the results obtained and the literature, are caused by species and/or environmental differences and also the method of sample preparation. The fresh snakehead fish sample contained 1.55% ash content. According to [12], the ash content of raw snakehead fish (*C. striatus*) is 0.7% and according to [13], the ash content of raw snakehead fish (*C. striatus*) was 1.2%. The ash content in the sample comes from the mineral content in the meat. The ash content in fish can be influenced by species, growth phase and environmental factors [11].

The fresh snakehead fish sample contained 0.31% fat content. According to [14], linolenic acid, oleic acid and linoleic acid are contained in fresh and steamed snakehead fish. The lipid content measurement value could be affected by the meat parts taken from snakefish fillet that ultimately was used in lipid determination analysis. The fresh snakehead fish sample contained 19.09% protein content. The calculation of protein content in this analysis carried out describes the total nitrogen in the food material (crude protein), so it is possible that other components of non-protein nitrogen (NPN) were calculated. According to [15], the measured protein content depends on the amount of ingredients added and is largely influenced by the water content of these ingredients.

3.2 Volatile Components of Raw Snakehead Fish

The results of compound mass spectra analysis showed that volatile compounds group of raw or fresh snakehead fish came from hydrocarbons group. As many as 2 compounds namely limonene with a relative proportion of 81% and 1,3,6-heptatriene, 5-methyl-with the proportion 19% as seen in Table 2 and its chromatogram in Figure 1.

Table-2. Volatile compounds of fresh snakehead fish

Group		Retention Time	Compounds	Area	Proportion (%)
Hydrocarbons	1	14,3729	Limonene	6966	81
	2	14,3623	1,3,6-heptatriene, 5-methyl-	1634	19

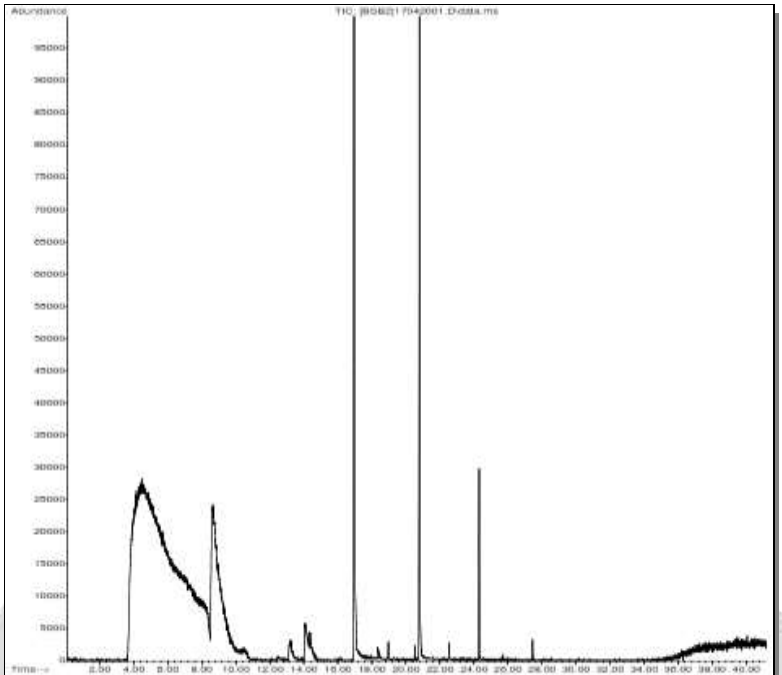

Fig-1. Volatile compounds chromatogram of fresh snakehead fish

Limonene has also been identified in several seafood such as crab, cooked lobster, cooked shrimp and grilled shrimp [16], [17]. Limonene belongs to the terpene hydrocarbon group and according to [18], terpenes are naturally produced, found in essential oils and carry aroma characteristics. These terpenes may come from the food chain of animals, namely algae or plants [19]. According to [20], limonene can be produced by *Chlamydomonas reinhardtii*. Most of the compounds of the hydrocarbon group have relatively high flavor thresholds, but if this group of compounds is present in the sample at high concentrations, it can play a role in the overall flavor [6].

The results of volatile flavor compounds identification showed that fresh snakehead fish sample only had several types of compound. According to [6] and [21], recently formed volatile flavor compounds detected in cooked fish were generally derived from thermal oxidation and decomposition of fatty acids, especially unsaturated fatty acids. However, fresh or raw food samples had a complex food matrices, hence the native volatile compounds were more difficult to extract and identify. One reason that the volatile compound measurement and identification were somehow hindered is due to the bounded moisture content and carbohydrates, lipids, proteins, which were still in their complex forms, hence they are not easily identified as volatile flavor compounds. According to [22], lipids in aroma extracts can hinder the analysis using gas chromatography, as well as proteins because they are good emulsifiers and foam stabilizers. Carbohydrates could often add viscosity, foaming or emulsification properties to the analyzed commodities which later on will cause difficulties in aroma isolation.

Sample preparation and extraction of volatile compounds played a very important role in the identification of volatile flavor compounds, because food such as fish, has chemicals content which alter rapidly once they undergo rigor mortis phase. These changes occur due to degradation and oxidation processes, especially those caused by changes in temperature. The method of extracting volatile compounds for different food ingredients is rather distinctive. This is due to the specific matrix of each food ingredient has. Several things which need to be considered to optimize the extraction yield of volatile compounds are the sample solvent, extraction time and temperature, and also the effect of salting-out. According to [23], in relation to the salting-out and stirring effect, the highest analytical sensitivity for almost all the target compounds extracted was obtained using ultra-pure water saturated in NaCl and also a stirring step. The addition of salt will increase the ionic strength of water by decreasing the solubility of the analyte in the aqueous phase. In addition, stirring will also increase the extraction efficiency.

4. CONCLUSIONS

Based on the results and discussion above, it can be concluded that the volatile flavor compounds identified in fresh snakehead fish meat consist of 2 compounds with limonene dominates the compound’s composition (81%). The proximate content of fresh snakehead fish consist of 78.3% water content, 1.55% ash content, 0.31% lipid content and 19.09% protein content. The difference in the measurement results are influenced by the initial chemical composition of the raw materials, also other internal and/or external factors of the species that being analyzed.

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