3.1.2 Alcohols

Volatile compound analysis was succesfully detected alcohols group of compound which generally be formed through the secondary decomposition of fatty acid hydroperoxides [10]. Several compounds from this group with highest proportion values were 1-hexanol, 2-ethyl- (4.96%), 2,3 butanediol (2.30%) and ethanol, 2 butoxy (0.58%). The 1-hexanol, 2-ethyl- was also identified in [5], study specifically in volatile composition of fresh patin catfish and fresh and steamed mackerel samples. The alcohol component generally produces sweet, fruity, alcoholic, balsamic, and green aroma descriptor depending on the molecular structure [11].

3.1.3 Hydrocarbons

Hydrocarbon groups (mostly aliphatic, cyclic and aromatic) were identified in this studied sample. Hydrocarbon compounds could be derived from the decarboxylation reaction and the carbon chain reaction of fatty acids and thermal oxidation of unsaturated fatty acids [12]. Type of compound with has the highest proportion value in this compound group is nonane, 3,7-dimethyl- (4,93%). This compound was also discovered in [13], study regarding identify and quantify the principal volatile compounds from freshly harvested adductor muscle and from total lipids of the sea scallop specifically in lipids found in the seashells of the *Placopecten magellanicus* species.

3.1.4 Ketones

Ketones could be produced from microbial oxidation, amino degradation or lipid oxidation. The ketone group of compounds could also derived from thermal oxidation or degradation process of unsaturated fatty acids, amino acid degradation or oxidation of microorganisms [3]. Cyclobutanone, 2,3,3-trimethyl- (0,27%) and acetophenone (0,18%) were the identified volatile compounds which have high proportion compared to other ketones in this flavor powder sample. Cyclobutanone, 2,3,3-trimethyl- was previously found in Spanish mackerel broth [14]. Acetophenone compound is an organic compound which classified as aromatic ketone. Acetophenone compound was previously identified in traditional fermented smoked fish (*Katsuobushi*). The aroma produced by the spray dried flavor powder samples tends to have a fishy and sweet aroma. The flavor powder aroma can be retained due to the addition of maltodextrin which also act as a filler. This is consistent with the statement from [15], which stated that maltodextrin could protect the stability of the aroma during the drying process using a spray dryer. According [5], study, ketone compounds group which were detected in samples were known to contribute to the sweet aroma of *crustaceans*.

3.1.5 Organic Acid

The organic acids compound group which generally found in fishery products could act as an antibacterial and antioxidant compound. This report is similar with [16], which stated that organic acids produced from the pyrolysis process could serves as an inhibitor of bacterial growth. Organic acid volatile compounds with the highest proportion value is acetic acid (0.45%). Acetic acid is a compound which commonly derived from lipid oxidation [4]. Acetic acid are generally responsible for the increased of unpleasant odors during the storage process [17]. Acetic acid was previously identified in traditional smoked fish in Indonesia, *ikan pe,* made from marine water stingray. Acetic acid compounds are also found in fish sauce which has vinegar-like aroma [18].

3.1.6 Esters

Esters may be developed from lipid metabolism through acid esterification with alcohol [19]. Ester compounds which has the highest proportion were acetic acid, methoxy- (2.72%), sulfurous acid, 2-pentyl undecyl ester (1.40%) and sulfurous acid, hexyl tridecyl ester (0.45%). The class of ester compounds found in fish are generally originates from acid and alcohol esterification which was previously formed from lipid metabolism [5]. An acetic acid, methoxy, is commonly derived from one of the methyl hydrogens which is replaced by a methoxy group.

3.1.7 Other compounds

Pyrazine trimethyl (14.04%) is a compound with the highest proportion value in Spanish mackerel flavor powder compared to other types of compounds. Pyrazine compounds are commonly formed during boiling and drying process due to the applying of heat [20]. Pyrazine compound, trimethyl- was also discovered in [21], study of pyrazine and volatile compound in cocoa beans that generally pyrazine, trimethyl- gives a distinctive popcorn aroma and is often found in the fermentation process, extraction results of palm sugar, cocoa bean products, and fish sauce. Compound which categorized in other group of compound is generally nitrogenous, furans or sulfurous types of compound.

3.2 Proximate analysis

The proximate analysis provides general information regarding sample's chemical composition, the nutritional content. The difference in the results showd could be influenced by the raw material chemical composition, commodity type the processing stages. Proximate analysis comprise of water content, ash content, lipid content, and protein content. The Spanish mackerel flavor powder proximate analysis results are shown in Figure 2.

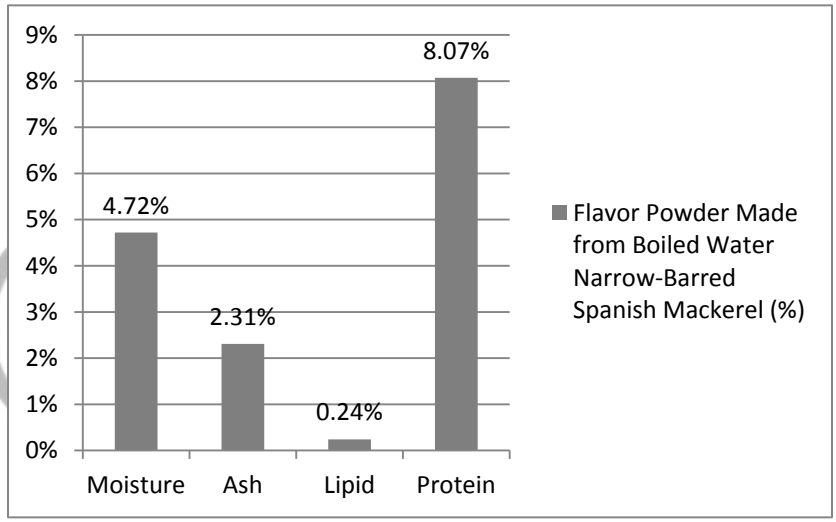

Figure 2. Proximate analysis results of narrow-barred Spanish mackerel flavor powder (%)

3.2.1 Moisture Content

Moisture content determination is the most commonly perform analysis in fisheries commodity. The amount of water or moisture in food often determines the nutritional value, taste characteristics, and the shelf life stability throughout storage. Analysis result shows that the Spanish mackerel flavor powder has 4.72%. The analysis result indicates that sample's moisture content exceeds the Indonesian National Standards [22] moisture content limit for flavor powder (chicken based), which established at a maximum value of 4.0%. The moisture content value of samples exceeds the maximum limit specified, this can be determined related to the addition of fillers containing maltodextrin. Maltodextrin has hygroscopic properties which are the ability to absorb air thereby increasing water content with Maltodextrin added [23].The moisture content of a dry product such as flavor powder could be influenced by the environment moisture and humidity. The product dry surface and hygroscopic characteristic of a dry product are able to absorb moisture from the surrounding environment possibly during the preparation or storage of samples.

3.2.2 Ash Content

The ash content analysis result in Figure 2 shows that the sample has an ash content of 2.31%. This measured content value could be affected by initial raw material mineral content which also depends on raw material type and combustion method. Ash content of food shows the total minerals contained in it. Marine

water fish meat is known to have high minerals content [24]. Ash content measured in fisheries commodity could be influenced by species, growth phase and various environmental factors.

3.2.3 Lipid Content

The analysis results of lipid content in Figure 2 shows that the Spanish mackerel flavor powder has a lipid content of 0.24%. Based on [22], a flavor powder (chicken based) should have a minimum of 2% lipids. The measured lipid content value could affect by raw material types, and also filleting process thus the fat rich portion from the belly part of the fish were separated. Lipid content and water content have a negative correlation, hence if the lipid content in a product is at a low level then the water content value should be high. Furthermore, a decrease in the lipid content value could be caused by an oxidation reaction. According to the study of proximate compotition Spanish mackerel [25], the chemical composition of freshwater and marine water fish shows differences. Most marine water fish have lower lipid content compared to freshwater fish. Low levels of lipids could be affected by environmental factors and water and fat loss during the heating involve process [5]. Lipid content in fish meat directly affects the aroma and taste intensity [5].

3.3.3 Protein Content

Proteins are macromolecules which constitutes from a series of amino acids. Volatile ketones group could be produced from the degradation of amino acids apart from lipid oxidation. The protein content analysis result in Figure 2 shows that Spanish mackerel flavor powder has 8.07% protein. Based on [22], flavor powder should have a minimum 6% protein. The amount of protein content could be affected by the heating involved process. The protein content measured would depends on the number of ingredients added and is largely influenced by the water content of the material. Heating processes such as boiling and drying can have an effect on the structure and functional properties of proteins in the material. This change is partly due to the denaturation of the protein caused by temperature changes during the heating process [26]. Various types of volatile compounds detected and identified from the sample are mostly derive from protein and lipid components, thus the types of volatile compounds are related to the sample's chemical compounds variability contained [5].

4. CONCLUSIONS

Groups of compounds that were detected in the Spanish mackerel flavor powder generally derived from aldehydes, alcohols, hydrocarbons, organic acids, ketone, ester, and others (nitrogenous compounds and furans). The volatile components identification result of flavor powder had successfully detected 87 types of compounds with pyrazine, trimethyl- (14.04%) is the highest proportion compound in this sample. Proximate analysis results showed that the Spanish mackerel flavor powder has moisture content of 4,72%, 2.31% ash content, 0.24% lipid content and 8.07% protein content.

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