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THE EFFECT OF LIQUID SMOKE ON THE QUALITY AND OMEGA-3 FATTY ACIDS CONTENT OF TUNA FISH (Euthynnus affinis)

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ABSTRACT

Introduction : *the problem faced in smoking fish is primarily related to the deterioration of lipid caused by oxidation, that may cause reduction of omega-3 fatty acid content in fish. This research was aimed at investgating the effect of different method of smoking fish to the organoleptic value, proximate composition and omega-3 fatty acid content. The experiment was carried out in The Laboratory of Coastal Zone Ecodevelopment, Diponegoro University, Jepara. Analysis of omega-3 fatty acid was conducted using Shimadzu Gas Chromatography in The Laboratory of Food Science and Technology, Tokyo University of Fisheries, Japan.*

Material and Methods : *a randomized design was used in this study; filleted skipjack tuna (Euthynnus affinis); approximately 125 gr in weight and about 25 cm in length was used in both coconut shell for the traditional method and liquid smoke from Giulini Chemii for modern method. The temperature of the smoking process was between 40 - 80 ℃. Sensory test and proximate composition were determined in order to support an omega-3 fatty acid analysis.*

Result and Discussion : *the average value of sensory test of traditional smoked tuna was between 3.00-8.33; liquid smoked tuna was between 6.67-9.00. The protein composition was 38.98 % and lipid was 2.71% for the traditional product and 32.21% and 2.06 % were obtained in liquid smoked tuna. Analysis of DHA resulted in 17.6 % (traditional) and 20.9 (liquid). The results showed a significant difference between two products. The product of liquid smoked fish had better appearance, longer shelf life and higher omega-3 fatty acid content.*

Keywords: Smoked fish, Traditional, Modern, Omega-3 fatty acid

I. INTRODUCTION

Smoking is one of the oldest methods of processing and preserving of fish.. Smoking process causes changing of shelf-life. Fish becomes glossy, specific in odor, taste, appearance with an attractive golden-yellow color. The preserving effect of smoking on fish product is obtained by the combination process of drying, salting, and deposition of antioxidant (phenolic compounds) and antimicrobial constituents from smoke to the fish.

Such as protein, lipid is also an important fish nutrition because it naturally produces fats and oils containing a greater proportion of highly unsaturated fatty acid. Currently, special interest has been focused on the omega-3 fatty acids found in fish oils because these polyunsaturated fatty acids have beneficial effects on human health and may reduce cardiovascular disease and rheumatoid arthritis.

Skipjack tuna (Euthynnus affinis) is one of the species which contain high omega-3 fatty acids. So far, the study on the effect of smoke to the composition of omega-3 fatty acids is very few. The objectives of this research is to compare the quality and omega-3 fatty acids content of smoked fish resulting from different methods i.e. traditional and modern method.

The problem faced in smoked fish, is primarily related the deterioration of lipid caused by oxidation. Oxidative deterioration happens mostly in majority from all the process of salting, heating, smoking and exposure of oxygen to the fish. These processes may cause the reduction of omega-3 fatty acids content in fish. In order to minimize lipid oxidation and reduction of omega-3 fatty acids, several factors including freshness of raw material and smoking process must be considered.

II. MATERIALS AND METHODS

The materials used in this study were: (1) filleted skipjack tuna (Euthynnus affinis); approximately 125 grams in weight and about 25 cm in length; ; (2) coconut shells for traditional methods; (3) liquid smoke from Giulini Chemiie for modern method. The procedure can be seen in fig. 1.

Observation was carried out by analysis of DHA content in smoked fish, both produced traditionally, using liquid smoke. Chemical analysis of protein, lipid, ash and moisture content and also organoleptic or sensory evaluation i.e.: appearance, flavor, odor and texture were also investigated. The differences of data matric quality and omega-3 fatty acid are analyzed statistically by using t-test.

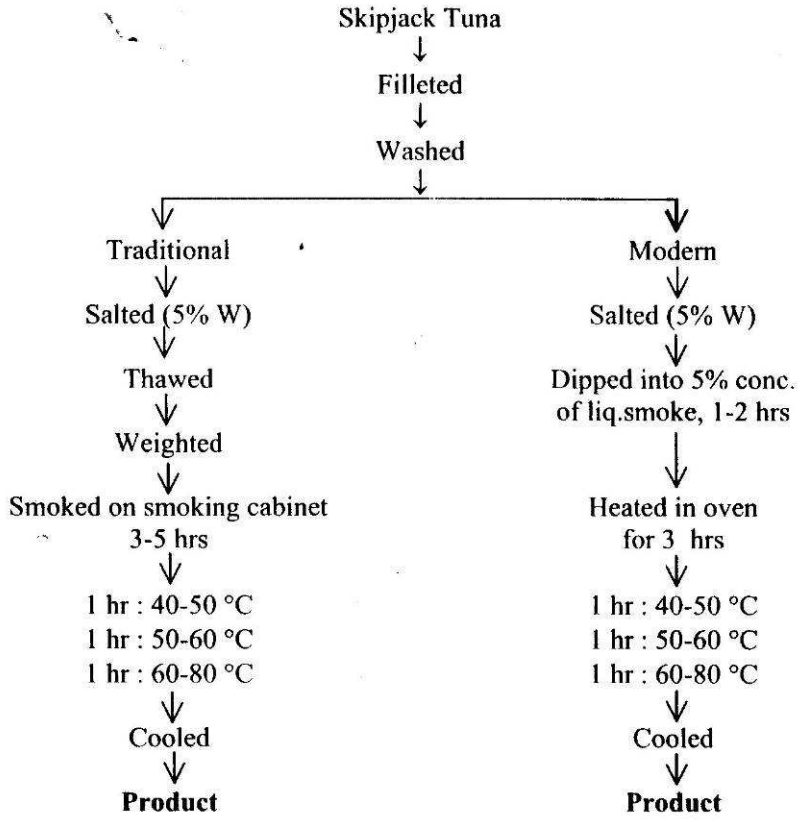

Figure : 1. Procedure of smoking fish.

III. RESULTS AND DISCUSSION

3.1. Raw Material.

The fish used in this experiment was bought from Dema'an Fish Landing Area in Jepara. The result of sensory test is presented in table 1.

The table shows that Tuna fish used in this study was fresh, as the organoleptic values given by panelists were high. The range of the value is between 1-9, while an acceptable value is 6.

3.2. Chemical Composition of Raw Tuna

Chemical composition of Tuna used in this experiment is presented in table 2 .

Table: 1. Organoleptic Test of Tuna.

Panelists	Eye	Gill	Belly	Texture
1	9	7	9	9
2	8	7	8	8
3	8	6	7	7
4	7	6	7	7
5	8	8	9	9
6	7	7	9	9
7	8	7	8	8

Table: 2. Chemical composition of Tuna.

Parameter	Percentage (%)
Moisture	75.85
Protein	23.57
Lipid	0.25
Ash	1,31

The proximate composition above shows that lipid content of Tuna seems to be lower comparing to reference (± 5%). According to Connell (1990), red muscle pelagic fish contains various amount of lipid from < 1% - 25 % during breeding to feeding period.

3.3. Sensory Analysis of Smoked Tuna

Difference test was calculated to evaluate the different of quality between two products of smoked fish treated traditionally and by using smoking cabinet, and the result is presented in table 3.

The data shows that the appearance of the two products during the day-1 were generally not different, eventhough the organoleptic value of traditional smoked Tuna seems to be lower compared to smoked Tuna by using liquid smoke. The two products show significant differences of organoleptic values after storage in 3 days and very significant difference in the day-6.

Burgess et al (1965) reported that fish is smoked nowadays in order to give it a

pleasant aroma rather than to preserve it. In traditional product, the strong tarry and salty flavor is appeared. Modern products are therefore salted and smoked mainly to give them a mild, savoury flavor and although the combined effects of salting, smoking and drying alter their texture, they will not be kept in edible condition for more than a week or so at ordinary temperature.

The sensory values of the two products seem to be not significantly different, especially in the day 1. This means that liquid smoke is suitable to use as a substitute of the traditional smoked fish, because the smoke composition of sawdust and liquid smoke is most likely the same, except that the carcinogenic compound of liquid smoke has been removed (Baltes and Bange, 1977). The result of difference test of chemical composition of smoked Tuna is presented in table 4.

Table 4 shows the composition of moisture, lipid, protein and carbohydrate between two products which were very significantly different (P<0.01). This is caused by the temperature of traditional method which was higher compared to the modern method. According to Burgess (1965) the traditional kiln suffers from a number of disadvantages. One is that it is difficult to control warm when smoke rising up, and in somewhat unpredictable manner. More over, fish at the bottom of the kiln will dry more rapidly than that at the top. Liquid smoke is easier to apply for uniformity in flavor, color and preservative action.

3.4. Omega-3 Fatty Acid Content

The omega-3 fatty aid obtained in this study was Docosahexaenoic Acid (DHA); the result is presented in table 5.

Table: 3. Difference test of Organoleptic/ sensory analysis smoked Tuna.

No	Parameter	Traditional		Modern		Probability (P)	Noted
		n	Average	n	Average		
1.	Appearance:						
	a. Day 1	6	7.67	6	9.00	0.1449	(P>0.05)
	b. Day 3	6	6.33	6	7.00	0.0101	(P<0.05)
	c. Day 6	6	4.67	6	7.00	0.000037	(P<0.01)
2	Odor :						
	a. Day 1	6	7.33	6	8.33	0.0924	(P>0.05)
	b. Day 3	6	7.00	6	7.67	0.1449	(P>0.05)
	c. Day 6	6	5.33	6	6.67	0.0179	(P<0.05)
3.	Taste :						
	a. Day 1	6	8.33	6	8.33	1.0000	(P>0.05)
	b. Day 3	6	6.67	6	7.00	0.3409	(P>0.05)
	c. Day 6	6	4.67	6	7.00	0.000037	(P<0.01)
4.	Texture :						
	a. Day 1	6	8.00	6	9.00	0.0493	(P<0.05)
	b. Day3	6	6.00	6	7.00	0.0493	(P<0.05)
	c. Day 6	6	3.00	6	7.00	-	(P=0)

Table: 4. Proximate composition of smoked Tuna.

Nc	Parameter	Traditional (%)		Modern (%)		Probability (P)	Noted
		n	Average	n	Average		
1.	Moisture	3	50.41	3	55.45	0.00314	(P<0.01)
2.	Lipid	3	2.71	3	2.06	0.00388	(P<0.01)
3.	Protein	3	38.98	3	32.21	0.0000039	(P<0.01)
4.	Carbohydrate	3	3.44	3	5.76	0.000681	(P<0.01)
5.	Fiber	3	0.42	3	0.36	0.0653	(P>0.05)
6	Ash	3	4.04	3	4.16	0.1234	(P>0.05)

Table: 5. Omega-3 Fatty Acid Composition of Smoked Tuna

Fatty Acid	% Relative		
	Traditional	Modern	Raw Tuna
C 22 : 6 (DHA)	17.6	20.9	18.6
Total Lipid	2.71	2.06	0.25

From the data above, it can be seen that smoked Tuna by using liquid smoke (modern method) has lower lipid content but the percentage of omega-3 fatty acid seems higher compared to the traditional smoked Tuna. In general, the quality of the two products shows a very significant difference. This is proved by the modern method; the quality of the product was better.

Study by Sutino (1997) showed that the DHA value of smoked mackerel (Rastrelliger sp) was between 18.21% - 20.36. Teruaki Murase and Hiroaki Saito (1996) found the DHA value in the lipid content of Albacore (Thunnus alalunga) was in between 14.2% (in liver) and 31.1% (in heart). According to Winarno (1993) variation of omega-3 fatty acid content in fish was influenced by food (foodchain) intake of the fish.

IV. CONCLUSION

Smoking fish by using modern method resulted better quality of the products. Besides, this method was easier in controlling of the smoking process. Eventhough during the day 1 there was no difference in appearance, odor and taste, except the texture, after the day 3 and 6 the degradation seems faster in the products traditionally treated. The composition of omega-3 fatty acid of smoked Tuna by modern method (using liquid smoke) was

higher compared to that of the traditional smoked fish.

REFERENCES

Baltes, W. and Bange, J., 1977. The Detection of Liquid Smoke Aromas or Smoke Flavorings in Foodstuffs. Acta Alimentaria Polonica. Vol. 3 No. 3.

Burgess, G.H.O *et al*, 1965. Fish Handling and Processing, Edinburgh. HMSO.

Chen Lan Bo and Issenberg, P., 1972. Interaction of Some Wood Components with Aminogroup in Protein. Journal of Agricult. Food Chemistry. Vol. 20, No. 6 pp. 1113-1115.

Clifford, M.N.; Tang, S.L. And Eyo, A.A., 1980. Smoking Foods. Journal of Process Biochemistry. June/ July.

Clucas, I.J. and Ward, A.R., 1996. Post-Harvest Fisheries Development. A Guide to Handling, Processing and Quality. National Resources Institute. United Kingdom.

Horner, W.F.A., 1992. Preservation of Fish by Curing (Drying, Salting, and Smoking). In Fish Processing Technology (Edited by Hall, G.M.) Blackie Academic Professional, London).

Sikorski, Z.E., 1990. Smoking in Seafood Resources, Nutritional, Composition and Preservation. CRC. Press, Florida.

Sutino, 1997. The Effect of Vacuum Packaging on The Omega-3 Fatty Acid Content of Mackerel (Rastrelliger sp) . Faculty of Fisheries and Marine Sciences. Diponegoro University. Semarang.

Teruaki Murase and Hiroaki Saito, 1996. The Docosahexaenoic Acid Content in The Lipid of Albacore (Thunnus alalunga) Caught in Two Separate Localities. The Japanese Society of Fisheries Science. Tokyo, Japan.

Winarno F.G., 1993. Chemistry and Nutrition of Food. Gramedia. Jakarta.