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Original Paper

ANALYSIS OF THIOBARBITURIC ACID AND BENZO(α) PYRENE VALUE OF SMOKED NILE TILAPIA (*Oreochromis niloticus*) USING DIFFERENTLIQUID SMOKES

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ABSTRACT

The purpose of this research was to find the different influence of corn cob (LS_A) and coconut shells (LS_B) liquid smokes to the changing of thiobarbituric acid (TBA) value, benzo(α)pyrene (BP), and organoleptic value of the smoked nile tilapia during storage. The result indicated that the smoked nile tilapia which used liquid smoke corn cob had higher organoleptic value than using coconut shells. The result of organoleptic 8.60 (LS_AH_0), 8.24 (LS_BH_0), 8.02 (LS_AH_5), 7.88 (LS_BH_5), 4.91 (LS_AH_{10}), 4.56 (LS_BH_{10}) and were rejected on 10 days storage. The smoked nile Tilapia which was processed using liquid smoke of corn cob (LS_A) and vacuum packed had higher organoleptic value than those which were processed by liquid smoke of coconut shells (LS_B) during the storage. The different of liquid smoked gave very significant effect to TBA value ($P<0.01$). The duration of storage gave very significant effect to TBA value ($P<0.01$). The interaction between liquid smoke and duration of storage gave very significant effect ($P<0.01$) at 10^{th}, 5^{th} days, whereas at 0 day did not give very significant effect ($P>0.01$). TBA value of smoked nile tilapia using liquid smoke of corn cob (LS_A) higher than using liquid smoke of coconut shells (LS_B) for each storage (LS_AH_0 : 0.76; LS_BH_0 : 0.74; LS_AH_5 : 1.02; LS_BH_5 : 0.95; LS_AH_{10} : 1.42; LS_BH_{10} : 1.32). The result on polycyclic aromatic hydrocarbons (PAHs) of smoked nile tilapia using corn cob and coconut shells liquid smoke showed that there was no benzo(α)pyrene detected.

Keyword : TBA value, BP value, Nile Tilapia, Liquid Smoke

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INTRODUCTION

Nile tilapia fish (*Oreochromis niloticus*) is one of fresh water species which is preferred by many people because it has thick meat, delicious and has no cholesterol (Suyanto, 2008). The preservation effect of smoke on fish has been known for many years. The main functions of smoke are to develop aroma, flavour, and colour, to preserve, to create new products, to form a protective skin in emulsion-type and to protect the products from oxidation (Coronado, *et al*., 2002).

Traditional smoking technique is now being substituted by the use of liquid smoke. Smoke flavourings have been used for ± 50 years as preservative and aromatisers of fish. Liquid smoke have several advantages *i.e.* : easier to apply uniformity, much cheaper, no environmental pollution and free of harmful compounds such as Polycyclic Aromatic Hydrocarbons (PAHs) (Swastawati, 2007). Recently, liquid smoke of different composition are available and can be combined to obtain products with very different sensory characteristics.

Thiobarbituric Acid (TBA) is one of the most common method used as an

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indicator parameter of lipid oxidation. TBA value is a measure of malonaldehyde concentration in the sample. Malonaldehyde is often bound to protein and the conditions for its optimal release are often hard to determine (Fernandez, *et al.,* 1997; Shahidi, 1994).

PAHs are generally considered to be carcinogenic compound and, as these also end up in the finished product after smoking, use of the method can be questioned. The carcinogenicity of several PAH compounds is known. The most thoroughly studied PAH compound is benzo (α) pyrene (BP) (Sikorski, 1988).

This research is aimed to analyze TBA and BP value of smoke nile tilapia that have been produced (*Oreochromis niloticus*) using corn cob and coconut shells liquid smokes.

MATERIALS AND METHODS

Liquid smoke

Two liquid smokes (LS_A and LS_B) have not been used to smoke nile tilapia fish (*Oreochromis niloticus*). LS_A and LS_B contained similar proportions of chemical compound mainly of phenol derivatives and organic acids.

Smoking procedures and treatments

Nile tilapia fish has length about 18 – 23 cm and weight about 120 – 150 gram were obtained from "Barokah fishing area" located in Tembalang-Semarang. The liquid smoke concentration used was 3% ($^{V}/_{V}$) and brine concentration used was 10% ($^{W}/_{V}$). The fish were dipped into brine for 15 minutes and dehydrated in an oven of ± 40-80^{0}C for 5 hours. Each smoked fish was then vacuum packed in an oxygen impermeable bag and stored at room temperature in 0, 5 and 10 days before analysis.

Laboratory analysis

TBA value was determined by the Tarladgis method (Sudarmadji, *et al.,*2003), mean while BP value was determined by using LIPI (2000) and Holden and Marsden (1969) methods. Sensory analysis of fish smoke was determined by using SNI No. 01-2725-2006 and flesh fish sensory analysis was determined by using SNI No. 01-2729-2006. A paneli of ten trained panelists performed the product sensory assessment. The quality indicates of smoked nile tilapia fish that were selected in preliminary experiments from the following set: appearance, texture, colour and flavour.

Statistical analysis

The data of TBA value was analyzed statistically by using ANOVA (Nasir, 2005). Means were compared by the split plot in time method. Significance was set at 95-99%. All calculations were performed using SPSS 15.0.

RESULT AND DISCUSSIONS

Thiobarbituric acid Value of Smoked Nile Tilapia Fish

The mean TBA values of smoked nile tilapia fish : LS_A and LS_B after 0, 5 and 10 days of storage are presented in **Table 1**.

TBA values for sample A higher value sample B along the storage (0, 5 and 10 days). The differences were statistically very significant ($P<0.01$). The duration of storage has very significant effect to TBA value ($P<0.01$). The interaction between liquid smoke and duration of storage gave very significant effect ($P<0.01$) at 10^{th}, 5^{th} days, whereas at 0 day did not give significant effect ($P>0.05$).

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Table 1. TBA value of smoked nile tilapia fish during storage

Smoked treatments	During storage		
	H_0	H_5	H_{10}
A	0.76±0.01	1.02±0.07[a]	1.42±0.02 [a]
B	0.74±0.02	0.95±0.02 [a]	1.32±0.02 [a]

Note : Average of 3 replication ± standart deviation
[a] : Very significant effect (P<0.01)
A : Tilapia fish using corn cob liquid smoke
B : Tilapia fish using coconut shells liquid smoke

TBA values of smoked tilapia using LS_A were higher than using LS_B for each storage. The thershold of TBA values for detecting rancidity varies from 0.3-1.0 MA/kg in beef or pork (Melton, 1983) to 1.98-4.40 MA/kg in fish flesh (Trout, *et al.,* 1998). These thershold ranges TBA should not be considered as a general reference for thershold of rancid odour in meats because TBA value was influenced by many factors including animal species, dietary status and age of animal, whether the meat was raw or cooked and the type of TBA methods used for analyses (Frankel, 1998).

Benzo(α)pyrene

PAHs constitute a large class of organic substances containing two or more fused aromatic rings made of carbon and hydrogen atoms. BP was the first PAHs to be identified as carcinogen and as consequence, has been studied most (Simon *et al,* 2006). The content of PAHs compounds in smoked nile tilapia was slightly difference **Table 2.**

Table 2. PAHs compounds in smoked nile tilapia fish (ppb)

No	PAH	A	B
1.	Methyl-Naphthalene	0,853	1,009
2.	Acenaphthylene	ND	ND
3.	Acenaphthene	ND	ND
4.	Fluorene	ND	ND
5.	Phenanthrene	ND	ND
6.	Anthracene	ND	ND
7.	Fluoranthene	2,441	25,318
8.	Pyrene	ND	4,309
9.	Benzo (α) Anthracene	ND	ND
10.	Chrysene	ND	ND
11.	Benzo (b) Fluoranthene	ND	ND
12.	Benzo (k) Fluoranthene	ND	ND
13.	**Benzo (a) Pyrene**	**ND**	**ND**
14.	Indeno (123-cd) Pyrene	ND	ND
15.	Benzo (ah) Anthracene	ND	ND
16.	Benzo (ghi) Pyrylene	ND	ND

Note: ND=Not Detected

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The result on PAH of smoked nile tilapia using LS_A and LS_B showed that there was no BP detected. Study by Siskos *et al.,* (2007) found that traditional cold-smoked rainbow trout fillet (*Oncorhynchus mykiss*) consits of 3.4 µg (fresh weight) of BP. Meanwhile, samples treated by liquid smoke were found free of BP. The acceptable daily intake (ADI) for BP from food was 47 ng/day or 17 µg/year, this means that from a health perspective a person should not eat more than 5 kg of traditionally cold smoked fish annually if fish contains of BP equal amount to 3.4 µg (Hattula *et al.,* 2001).

Sensory Evaluation of Raw Material

Sensory evaluation was a method of trial which using human five senses as the prime devices to measure the acceptance of food. The test of organoleptical quality of flesh nile tilapia was conducted by 10 panelist. The evaluation of fresh nile tilapia quality was based on fresh fish organoleptical *score sheet* SNI No. 01-2729-2006 which had range of value 1-9.

According to the result of calculation of certaint interval, it was found that fresh nile tilapia fish which used in fish smoking had average organoleptical value 8.34 with certainty interval $8.202 < \mu < 8.518$. It was characterized by bright and protruded eyes, clear cornea, bright red gill, clean mucus layer, translucent meat slices, fresh odor, compact consistence and elastic when being pushed by finger (Adawyah, 2007). Minimum requirement of fresh fish for processing for processing according to Indonesia National Standart (SNI) No. 01-2729-2006 was 7.

Organoleptic Value of Smoked Nile Tilapia Fish

Organoleptic value of smoked fish was necessary to measure the acceptance of consumer. The evaluation of smoke nile tilapia quality was based on smoke fish organoleptical *score sheet* SNI No. 01-2725-2006 which had range of value grade 9 (good) to grade 1 (bad).

Table 3. Organoleptic value of smoke nile tilapia fish during storage

Spesification	Day-0		Day-5th		Day-10th	
	LS_A	LS_B	LS_A	LS_B	LS_A	LS_B
Appearence	8,33±0,13	8,20±0,13	7,53±0,13	7,40±0,13	6,07±0,13	5,67±0,23
Oddour	8,07±0,13	7,93±0,13	7,27±0,13	7,27±0,13	3,80±0,13 [a]	3,40±0,23 [a]
Flavour	8,73±0,13	7,67±0,13	7,53±0,13	7,40±0,13	3,67±0,13 [a]	3,27±0,13 [a]
Texture	8,47±0,13	7,67±0,13	7,67±0,13	7,13±0,13	5,93±0,13	5,13±0,13
Mould	Not shown		Not shown		Not shown	
Slime	Not detected		Not detected		Not detected	
Average	8,60±0,38	8,24±0,62	8,00±0,79	7,87±0,88	4,91±2,73	4,58±2,72

[a] : Very significant effect ($P<0.05$); means without a letter are not significant effect

In general LS_A sample showed higher sensory score than LS_B at all times of storage. Research by Ganulalan *et al.,* (2003) showed that smoke by dipping in liquid smoke and brining mix has influence on accept once sensory by panelist.

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CONCLUSIONS

Smoking fish processed using different liquid smoke and stored in different line gives significant effect toward the change of thiobarbituric acid, *benzo(α)pyrene* and organoleptical values. Both corn cob and coconut shells liquid smokes were acceptable by panelist. However, corn cob liquid smoke was prefer by panelist in terms of it's specific taste.

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