

Full Length Research Paper

Physical, chemical and organoleptic characteristics of smoked skipjack tuna (*Katsuwonus pelamis*) produced in Kendari-South East Sulawesi

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Physical, chemical and organoleptic characteristics of smoked skipjack tuna (*Katsuwonus pelamis*) produced in Kendari-South East Sulawesi had been studied. Samples were collected from four producers where direct smoking method was used. Three of the smoked fish producers used coconut shell (*Cocos nucifera*) as smoke resource, while one producer used a combination of coconut shell (*C. nucifera*) and “bakau”-mangrove wood (*Rhizophora* sp.) for smoke resource. It was found that colour (L^* , a^* , b^* values), texture, water activity, protein, fat and ash contents were not significantly different ($P > 0.05$) between samples, however only moisture contents were significantly different ($P < 0.05$). The sensory evaluation score showed no significant difference ($P > 0.05$) between organoleptic properties and it can be concluded that smoked skipjack tuna from Kendari were accepted by the panelists.

Key words: Skipjack tuna, smoking process, quality traits.

INTRODUCTION

Preserving fish by smoking process has been practiced for centuries, especially in developing countries. Palm et al. (2011) defined smoking process as a penetration process of volatile compounds from smoking resources into fish flesh. The end products of this processing method as reported by Abolagba and Igbinevbo (2010), Bower et al. (2009) and Kumolu-Johnson et al. (2010) characterized by specific taste and aroma, had a long shelf life due to antibacterial activity and reduced enzymatic activity.

Phenol as one of smoke components act as antioxidant agent, while other components are organic acids, alcohol, carbonyl, hydrocarbon and nitrogen compounds such as

nitrooxide (Bower et al., 2009), whilst the compounds found at the surface which possibly also penetrate into fish flesh were aldehyde, keton, ester and ether (Gómez-Guillén et al., 2009). Some researchers had reported the factors might affect the physical, chemical and organoleptic characteristics of smoked fish. Oduor-Odote et al. (2010), Abolagba and Melle (2008), Ahmed et al. (2010) and Birkeland and Skåra (2008) noted the effect of different smoke resources, while Kumolu-Johnson et al. (2010) reported the effect of fish feed quality and processing method on smoked fish quality. Sigurgisladottir et al. (2000) stated that salting and smoking method also had an effect, and Vasiliadou et al. (2005) claimed that the fish form might affect the end products. Røra et al. (2004) also found that location or areal where samples were obtained, and season, as well as smoking method, affected smoked fish quality.

Kendari, a city located in South-East Sulawesi

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Table 1. Means of physical and chemical characteristics of smoked skipjack tuna produced in Kendari city.

Parameter	Producers			
	1	2	3	4
L*	40.40±7.68 ^a	45.38±4.05 ^a	42.07±1.09 ^a	44.90±3.29 ^a
a*	12.15±1.79 ^a	13.42±0.68 ^a	11.93±1.15 ^a	11.98±1.97 ^a
b*	14.53±5.53 ^a	17.65±1.73 ^a	14.10±2.26 ^a	14.53±3.93 ^a
Texture (N)	9.33±3.95 ^a	7.30±1.10 ^a	6.17±3.39 ^a	10.10±3.63 ^a
a _w	0.93±0.01 ^a	0.95±0.01 ^a	0.95±0.01 ^a	0.94±0.01 ^a
Moisture content (%)	65.00±1.59 ^a	63.46±0.90 ^a	65.29±2.66 ^a	68.47±1.51 ^b
Protein content (%)	28.13±1.44 ^a	28.80±2.28 ^a	27.27±0.26 ^a	26.42±2.09 ^a
Fat content (%)	4.30±0.84 ^a	3.75±0.59 ^a	4.07±0.34 ^a	3.70±0.84 ^a
Ash content (%)	1.61±0.11 ^a	1.62±0.01 ^a	1.58±0.12 ^a	1.48±0.03 ^a

Means ± standard deviation followed by the same superscripts in the same row were not significantly different ($P > 0.05$); L* (lightness), a* (redness), b* (yellowness).

Province, is one of smoked fish producers, and skipjack tuna (*K. pelamis*) is the major fish smoked in this area. In general, this species are very popular as omega 3 (polyunsaturated fatty acids/ ω -3 PUFA) resources, as noted by Chin and Dart (1995), where this fatty acid has a health benefit. Although an intensive studies has been carried out on the effect of smoking process on quality traits of different fish species (Swastawati, 2004; Koral et al., 2010; Kumolu-Johnson et al., 2010; Vasiliadou et al., 2005; Gómez-Guillén et al., 2009; Olabemiwo et al., 2011; Sigurgisladottir et al., 2000; Ahmed et al., 2010; Stephen et al., 2010; Oduor-Odote et al., 2010; Fuentes et al., 2010), however the information of quality traits of smoked skipjack tuna (*K. pelamis*) produced in Kendari-South East Sulawesi are very scarce. Therefore, the aim of this study was to find out the physical, chemical and organoleptic characteristics of smoked skipjack tuna produced in Kendari.

MATERIALS AND METHODS

Samples collection

Smoked skipjack tuna fish samples were obtained from four different smoked fish processors in Kendari city, and from each producer were bought 1 to 2 kg smoked fish. These samples were bought three times at seven days interval, and before laboratory analysis, smoked fish samples were packed in polyethylene pouches and stored at 4°C according to the method of Fuentes et al. (2010) and Wretling et al. (2010).

Laboratory analysis

Colour of smoked fish samples were measured using color reader CR-10 (Konica Minolta Sensing, Japan) following the method as described by Fuentes et al. (2010), texture as tensile strength were measured using Instrument/Digital Force Gauge (Imada/ZP-200N, Japan) following the method as described by Gómez-Guillén et al. (2009). Water activity (a_w) of samples were measured following the method as described by Fuentes et al. (2010) using a_w meter

(Pawkit, Decagon Pullman WA 99163, USA). Moisture, protein, fat and ash contents were determined following the methods no. 950.46, 992.15, 960.39, and 938.08 (AOAC, 2005), respectively. Organoleptic test was carried out after the samples were kept for 1.5 h at room temperature before served to the panelists. Hedonic scale scoring (1 = dislike very much up to 7 = like very much) method and 30 untrained panelists were used to test the samples.

Statistical analysis

Data obtained were analyzed using one-way analysis of variance (ANOVA) followed by Duncan Multiple Range Test, using Microsoft Excel. Data were expressed as mean of three determinations ± standard deviation, and a significance difference was considered at the level of $P < 0.05$ (Yitnosumarto, 1991) while data of organoleptic test were analyzed using non-parametric of Friedman test according to Steel and Torrie (1993).

RESULTS AND DISCUSSION

The physical and chemical characteristics of smoked skipjack tuna obtained from different smoked fish producers in Kendari city are presented in Table 1. From the point of view of colour, it was found that there was no significant difference ($P > 0.05$) of smoked fish colour. The lightness (L*) values of samples were in the range of 40.40 to 45.38, a* value was 11.93 to 13.42 and b* value was 14.10 to 17.65.

Data in Table 1 showed there was no significant difference ($P > 0.05$) between samples obtained from different producers. Fuentes et al. (2010) and Røra et al. (2004) noted that thickness of fish slice, location or area where samples obtained as well as season during fish harvesting and smoking method used with smoked resources were some factors affecting end product's colour. Birkeland and Skåra (2008) reported that salmon fish fillet smoked with oak wood had an L* value 39.9; a* value 7.7 and b* value 18.1. The differences of L*, a* and b* values of samples used in some researches were

Table 2. Panelists score of smoked skipjack tuna produced in Kendari City.

Parameter	Producer			
	1	2	3	4
Colour	4.38±0.45 ^a	4.17±0.22 ^a	4.70±0.32 ^b	4.91±0.30 ^c
Taste	3.68±0.41 ^a	4.22±0.34 ^b	4.64±0.39 ^c	4.88±0.24 ^d
Texture	3.91±0.59 ^a	4.44±0.40 ^b	4.74±0.53 ^c	4.82±0.28 ^d
Aroma	4.43±0.55 ^a	4.73±0.15 ^a	4.79±0.07 ^a	5.10±0.06 ^b

Score ± standard deviations followed by same superscript at the same row were not significant different ($P > 0.05$).

possibly due to smoke composition, oxidation and polymerisation of smoke components and reaction between smoke components and fish protein in the different smoking methods.

The texture measurements of samples showed a range between 6.17 to 10.10 N and there were no significant differences ($P > 0.05$) between samples from different producers. Although Gómez-Guillén et al. (2009) found that the texture of different smoked fish (dolphinfish, blue whiting, fatty sardine, lean sardine) were in the range of 15 to 27 N at different storage time. Andersen et al. (1997) noted that the possible factor affecting the difference in texture measurement values was fat content, however Mørkøre et al. (2001) reported that smoked Atlantic salmon texture was not related to its fat content. Sigurgisladottir et al. (2000) stated that location and season where fish was harvested and processing steps, gave more significant effect on texture of end product.

While a_w value of samples were 0.93 to 0.95, moisture content was 63.46 to 68.47%, protein content 26.42 to 28.80%, fat content 3.70 to 4.30% and ash content 1.48 to 1.62%. However, only moisture content of samples was significantly different ($P < 0.05$). Results of this study were slightly different than the one reported by Fuentes et al. (2010) that is, smoked tuna in Spain had an a_w value of 0.922 to 0.958, moisture content 58.6 to 66.2%, protein content 15.4 to 31.5%, fat content 1.4 to 3.8% and ash content 6.1 to 7.5%. It is believed that the differences were due to quality of fresh fish as well as smoking method used. However, Cardinal et al. (2001) suggested moisture content of smoked fish should be less than 65%.

In this study, only smoked skipjack tuna from producers number 1 (65.00%) and number 2 (63.46%) were in the recommended moisture content. Ahmed et al. (2010) reported the relation of smoked fish protein, fat and ash content increased with decreased amount of moisture content during smoking process. In this study, ash content of samples was in the range of 1.48 to 1.62%, it could be classified as low ash content and this is due to the process where salt was not added and reduction of its moisture content.

The organoleptic characteristics of these samples were not significantly different ($P > 0.05$) between producers, where majority of panelists gave score of around 4, which

means either like nor dislike the products. However, panelists also showed their slightly dislike on texture and taste of smoked skipjack tuna from producer number 1, although from aroma point of view, panelists gave score 5 (slightly like) on aroma of samples from producers number 4 (Table 2).

According to Simko (2005), some factors such as physico-chemical quality of fresh fish, age, sex and season variation, and smoking process itself (smoke resources, smoke components, smoking temperature, humidity, time of smoking process and smoke density) could affect the organoleptic properties of end product while Guillén and Manzanos (2002) also noted that consumers food habit as well as traditional acceptance of food in each region also gave an effect on consumers preference.

Kjällstrand and Petersson (2001), Oduor-Odote et al. (2010), Jónsdóttir et al. (2008), Martinez et al. (2007) and Cardinal et al. (2006) reported that fenol and carbonyl compounds play an important role in taste of smoked fish, such as guaiacol and syringol as phenolic compounds gave a specific organoleptic characteristic. This components combined with different smoking technique also directly affected the organoleptic properties of smoked fish. Beside phenolic compounds, there was also possibility of interaction of carbonyl from smoke and protein which had an effect on the colour of smoked fish. It was also found that different variety of volatile compounds could give a variety of taste to end product as well.

Conclusion

Smoked skipjack tuna in Kendari city had similar physical, chemical and organoleptic characteristics due to similar smoke resources mainly coconut shell. However, as organoleptic test score showed that in overall, it was evaluated as average acceptability, therefore it is recommended to use different smoke resources to improve especially the organoleptic characteristics of end products.

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