RESEARCH AND DEVELOPMENT CENTER
FOR MARINE AND FISHERIES
PRODUCT PROCESSING AND BIOTECHNOLOGY

Agency For Marine And Fisheries Research And Development

C.2.1

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Resmi Rumenta

Has succesfully as **Presenter** of

International Seminar

on Marine and Fisheries
Product processing and biotechnology

"Sustainable Marine and Fisheries Processing and Biotechnology Innovation to Meet International Demand"

August 26th 2015 in Jakarta, Indonesia

Dr. Agus Heri Purnomo
(Head of RDCMFPPB)

Gmail

TULIS

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International seminar marine and fisheries product processin

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ke feivevey, saya, romauli.napitu., Ajeng

Inggris Bask Terjemahkan pesan

Dear participants,
We are pleased to inform that your paper have been accepted to be prese

Best regards,
Sc.Research and development center for marine and fisheries product prc

---------- Pesan terusan ----------
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INTERNATIONAL SEMINAR
on marine and fisheries product processing and biotechnology
"Sustainable Marine and Fisheries Processing and Biotechnology Innovation to Meet International Demand"

AGENDA

Jakarta, August 26, 2015

Fisheries Product Processing

NO	CODE	NAME	TITLE
		Session 1 : 13.00 - 14.00	
1	PP02	Agnes Agustin	CHEMICAL EVALUATION OF TUNA FISH BONE DERIVED FROM WASTE OF TUNA LOIN PRODUCT AT BITUNG, NORTH SULAWESI
2	PP04	Bagus Sediadi	APPLICATION OF BETTER INSULATED FISH HOLDSON ARTISANAL TUNA FISHING VESSELS TO IMPROVE FISHING PERFORMANCE AND QUALITY OF FRESH TUNA
3	PP03	Dina fransiska	CRAB MEAT ANALOGUE MADE FROM SILVER BIDDY FISH (*Gerres Kapas Blkr*) ENRICHED WITH ALGINATE
4	PP01	Tikkyrino K	THE IMPACT FROM INCREASING IN INVESTATION FOR FISHERIES PRODUCT PROCESSING INDUSTRIES' DEVELOPMENT ON INDONESIA NATIONAL ECONOMY
		Session 2 : 14.00 - 14.45	
5	PP05	Ema Hastarini	UTILIZATION OF VANAME SHRIMP (*Litopenaeus vannamei*) HEAD FLOUR AND LINDUR FLOUR (*Bruguiera gymnorrhyza*) FOR SIMULATED CHIPS.
6	PP06	Diah Lestari Ayudiarti	THE CHARACTERISTIC OF FLAVOR POWDER FROM VANNAMEI SHRIMP HEAD (*Litopenaeus vannamei*) USING DIFFERENT RATIO OF CARRIER AGENT
7	PP07	Ema Hastarini	FORTIFICATION MANGROVE (*Bruguiera Gymnorrhiza*) AND SHRIMP SHELL FLOUR VANNAME ON PRODUCTS COOKIES
		Session 3 : 14.45 - 15.30	
8	PP08	Rodiah Nurbaya Sari	CHARACTERISTIC OF GLUCOSAMINE HYDROCHLORIDE FROM SHRIMP SHELL (*Penaeus vannamei*) CAUSED OF THE DIFFERENCE DRYING TECHNICAL
9	PP10	Sekar Mira	CONSUMER ACCEPTANCE LEVEL ON PROCESSED FRUIT JAM FROM *Eucheuma sp.*
10	PP09	Daisy M. Makapedua	FORMATION OF PHYTOSTEROL OXIDATION PRODUCTS DURING PROCESSING OF DRIED SEAWEED

INTERNATIONAL SEMINAR on marine and fisheries product processing and biotechnology

"Sustainable Marine and Fisheries Processing and Biotechnology Innovation to Meet International Demand"

AGENDA

Jakarta, August 26, 2015

Marine Biotechnology

NO	CODE	NAME	TITLE
Session 1 : 13.00 - 14.00			
1	B07	Ekowati chasanah	BIOPOTENCY OF INDONESIAN SEA CUCUMBER
2	B11	Jiang Li	ISOLATION AND CHARACTERIZATION OF NOVEL THERMOSTABLE K-CARRAGEENASE FROM HOTSPRING BACTERIUM, *Bacillus sp.*
3	B01	Ifah Munifah	CELLULOLYTIC BACTERIA FROM SOLID WASTES OF SEAWEED PROCESSING INDUSTRY (AGAR) MALANG
4	B02	Muhammad Nursid	INVESTIGATION ON ANTIOXIDANT COMPOUNDS FROM MARINE ALGAE COLLECTED FROM BINUANGEUN COAST, BANTEN-INDONESIA
Session 2 : 14.00 - 15.00			
5	B03	Nurrahmi Dewi Fajarningsih	THE DEVELOPMENT OF MARINE-BASED STANDARDIZED HERBAL MEDICINES IN INDONESIA
6	B04	Grace Sanger	ANTI-DIABETIC EFFECT OF EDIBLE MARINE ALGAE (*Halimenia durvilae*) COLLECTED FROM NORTH SULAWESI COASTAL AREA OF INDONESIA
7	B10	Sukoso	THE MARINE YEAST CONSORTIUM AS FERMENTATION STARTER IN PROTEIN HYDROLYZED OF EICHRONIA CRASSIPES
8	B06	Danar Praseptiangga	ALGAL LECTINS AND THEIR POTENTIAL USES
Session 2 : 15.00 - 15.45			
9	B08	Aris Nuryana	*Vibrio Harveyii* ANTIBACTERIAL ACTIVITY OF BRUGUIERA HAINESII LEAVES FROM TUNDA ISLAND
10	B09	Dedi Novendri	FABRICATION, CHARACTERIZATION AND APOPTOSIS- INDUCING EFFECT OF FUCOXANTHIN BEFORE AND AFTER MICROENCAPSULATION ON HUMAN LUNG CANCER (H1299) CELL LINE
11	B05	Muhamad Nasir	SYNTHESIS AND CHARACTERIZATION OF ELECTROSPUN MARINE GELATIN NANOFIBER FROM SKIN TUNA FISH BY ELECTROSPINNING

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PROCEEDING OF INTERNATIONAL SEMINAR ON MARINE AND FISHERIES PRODUCT PROCESSING AND BIOTECHNOLOGY 2015

"SUSTAINABLE MARINE AND FISHERIES PROCESSING AND BIOTECHNOLOGY INNOVATION TO MEET INTERNATIONAL DEMAND"

Research and Development Center for Marine and Fisheries Product Processing and Biotechnology
Jakarta, 2015

ISBN : 978-602-73685-0-7

PROCEEDING OF INTERNATIONAL SEMINAR ON MARINE AND FISHERIES PRODUCT PROCESSING AND BIOTECHNOLOGY 2015

RELATIONSHIP BETWEEN MERCURY ACCUMULATION IN TUNA (*Thunnus sp.*) WITH REGARDS TO FISH SIZE, SPECIES AND ENVIRONMENTS

Resmi Rumenta Siregar[*], Kinanti Larasati[**] and Asriani[**]

ABSTRACT

This study purpose to determine the relatioship between mercury accumulation in tuna with regard to fis size (30-80 kg), species (*yellowfin* tuna (*thunnus albacares*) and *bigeye* tuna (*thunnus obesus*), and environment (Indian Ocean and Banda Sea). Analysis of mercury content using Atomic Absorption Spectrophotometer (AAS). Data were analyzed using correlation test and T test. The results of correlation test for *yellowfin* tuna has r value = 0,943 > r table = 0,468, and *bigeye* tuna r value = 0,802 > r table = 0,468 that meaning of the correlation is positive. From the t test results on samples *yellowfin* and *bigeye* tuna fishing areas in the Indian Ocean t value (4,036) > t table (2,037), shown that significant differences. From the t test results on samples *yellowfin* and *bigeye* tuna in the Banda Sea have t values (3,939) > t table (2,037), shown that significant differences. Tthe results of the t test *yellowfin* tuna with the different fishing area of Indian Ocean and Banda has t value (3,108) > t table (2,037), also shown significant differences. The results of the t test *bigeye* tuna with the different fishing areas of Indian Ocean and Banda Sea has t value (2,819) > t table (2,037), shown the significant differences.

Keywords : mercury, yellowfin tuna, bigeye tuna, fishing ground

INTRODUCTION

Indonesia is the country with the highest potential of tuna in the world. Total tuna production in Indonesia is about 613.575 tonnes per year and the value is about 6.3 trillion dollars per year . Indonesia became important for the global tuna fisheries both in terms of resources , habitat and also trade because of Indonesia is supported by 2 wide ocean, Indian Ocean and the Pacific Ocean (KKP, 2014).

Based on data from the Food and Drug Administration (FDA) United States , in 2011 there were 89 cases of rejection of tuna exports from Indonesia to the United States, because of some hazards like histamin, salmonella and heavy metals (mercury/Hg, lead and cadmium/Cd). About 19.44 tonnes of tuna (US$ 128.71 million) was rejected (Bisnis.com , 2013).

Heavy metals such as mercury, lead, cadmium and nickel are harmfull for every organism eventhought in small concentrations. Metals are highly persistent substances that can accumulate in the food chain and cause accumulation effect in humans (Noble , 2005). Mercury has a high ability to participate in the process of bioaccumulation in marine organisms.

In many cases , mercury bioaccumulation is continuing to follow the food chain. Predator had higher concentrations of mercury in their flash than their prey (Mukhtasor , 2007). It is because of the predators eat small fish and organism that lived in lower levels of water which have been contaminated by mercury by food chain.

In case of Minamata, source of mercury contamination is from a plastic factory which used vinyklorida and acetaldehyde as raw materials. The factory dumped mercury into Minamata bay and entered into Minamata River. Analisys shown that, fish from Minamata River contains 27-102 ppm of mercury (Hg). During the years 1953-1960, 111 of fishermen was poison with mercury (Soemirat , 2003).

The purpose of this study was to determine the correlation between tuna weight (30-80 kg) toward the mercury content, comparing mercury content of tuna from same fishing ground with different species (Yellowfin and Bigeye) and comparing the mercury content of tuna with the same species from different fishing ground (Indian Ocean and Banda Sea).

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[**] Student at Sekolah Tinggi Perikanan

MATERIALS AND METHODE

Sample Handling

This study was conducted on Januari- May 2015, at the PT. Seafood Inspection Laboratory and PT. Balinusa Windumas, Benoa-Bali.

Yellowfin and bigeye tuna as samples of this study was from PT. Balinusa Windumas, with weight range of 30-32 kg, 33-35 kg, 36-38 kg, 39-41 kg, 42-44 kg, 45-47 kg, 48-50 kg, 51-53 kg, 54-56 kg, 57-59 kg, 60-62 kg, 63-65 kg, 66-68 kg, 69-71 kg, 72-74 kg, 75-77 kg and 78-80 kg. Fish was catch by longline from Indian Ocean (South) and Banda Sea (Northern) (Figure 1). Fish was directly transported to the laboratory at the same day in sterofoam with jelly ice.

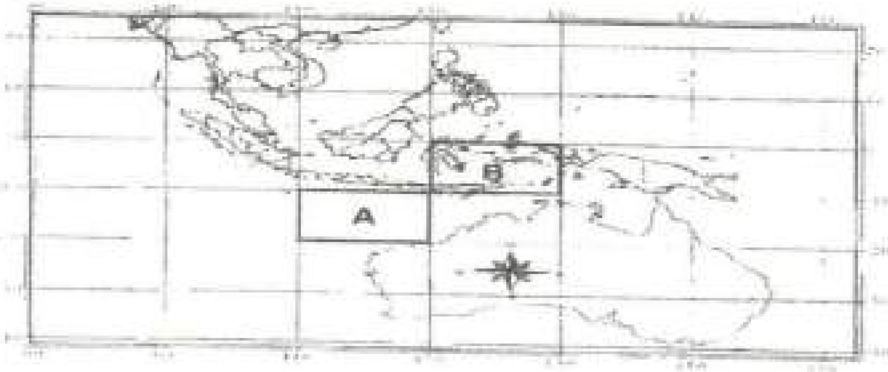


Figure 1. Fishing Ground (A is Indian Ocean, B is Banda Sea).

Material for mercury test are additive M, additive B, tissue, plastic, and aquadest The tools for mercury test are mercury analyzer (MA-2000), furnace, computer, digital scales 0.0001 g, chopping block, wood *roller*, tray, spatula, injection, plastic of glass, *stainless steel* washbasin, porselin cup, boat and small brush.

Extraction Process

Preparation of sample is done before the extract is injected into AAS. Extraction process consist of some step as figure 2 below.

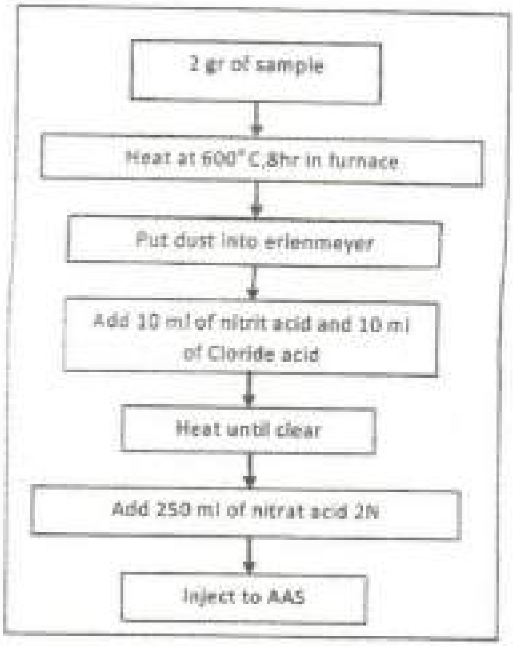


Figure 2. Extraction process of sample

Mercury Analysis

Atomic Absorption Spectrophotometer (AAS) was used of measuring total mercury in all samples. AAS Method refer to US EPA Method 7473 : Mercury in Solid and Solution by Thermal Decompositio, Amalgamation and Atomic Absorptions Spectrophotometry), CAS No. 7439-97-6.

Data Analysis

Microsoft Excel 97 was used for data processing, to calculate means and standard deviations for all multiple measurements and to generate graphs.

Pearson correlation was applied to determine relationship between weight of tuna and total of mercury in their flesh. Significant differences of total mercury to weight, species and fishing ground, were determined by Two Independent sample T-test.

Pearson Correlation

$$r = \frac{n\sum XY - \sum X \sum Y}{\sqrt{n\sum X^2 - (\sum X)^2}\sqrt{n\sum Y^2 - (\sum Y)^2}}$$

r = correlation n = number of samples

x = weight of tuna y = mercury content

Df = n – 1

Df = Degrees free

n = number of samples

r calculate < r table = not significant correlation

r calculate > r table = significant correlation

Two Independent Samples T Test

$$\text{Mean} = \frac{\sum_{i=1}^{n} x_i}{n}$$

$$S^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}$$

S2 = Variants

xi = variable results

x̄ = Average

n = number of samples

$$F = \frac{S_1^2}{S_2^2}$$

F = F determine

S_1^2 = biggest value of variant

S_2^2 = smallest value of variant

T test for equal variances (equal variance)

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

T test for different variances(unequal variance)

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

S_1 = standard deviation of sample 1

S_2 = standard deviation of sample 2

S_1^2 = sample variance 1

S_2^2 = sample variance 2

r = correlation between the two samples

n = number of samples

RESULT AND DISCUSSION

Correlation Between Size (Weight) of Tuna and Total Mercury

Mercury was analised in Yellowfin and Bigeye spesies for range of weight between 30-80 kg. The result of analisys shown that all sampel contain mercury. Bigeye tuna contain mercury higher than yellowfin in the same size. Data of mercury analisys of yellowfin dan bigeye spesies shown in table1.

Table1. Mercury in yellowfin and bigeye

No	Weight (kg)	Merkuri (ppm)		Max Standard (ppm)
		yellowfin	*bigeye*	
1.	30-32	0,378	0,388	1 (SNI 01-2693.1-2006)
2.	33-35	0,332	0,528	
3.	36-38	0,293	0,705	
4.	39-41	0,437	0,812	
5.	42-44	0,470	0,808	
6.	45-47	0,509	0,860	
7.	48-50	0,620	0,997	
8.	51-53	0,697	0,966	
9.	54-56	0,702	0,903	
10.	57-59	0,693	0,836	
11.	60-62	0,662	0,995	
12.	63-65	0,740	0,947	
13.	66-68	0,778	1,073	
14.	69-71	0,767	1,023	
15.	72-74	0,780	0,943	
16.	75-77	0,811	0,992	
17.	78-80	0,824	1,005	

Both yelowfin and bigeye, show that the greater weight of tuna, the higher the content of mercury. This is because of big tuna spent longer time at sea than the small one, so mercury was accumuklated in their flesh more than the fish and other organism, because mercury was accumuklated by food chain. Correlation Spearmen was used to analysis the data in table 1 to determine if the size of tuna effect the content of mercury. Graph of correlation between mercury accumulation in tuna (yellowfin and bigeye) with regards to size shown in Figure 3.

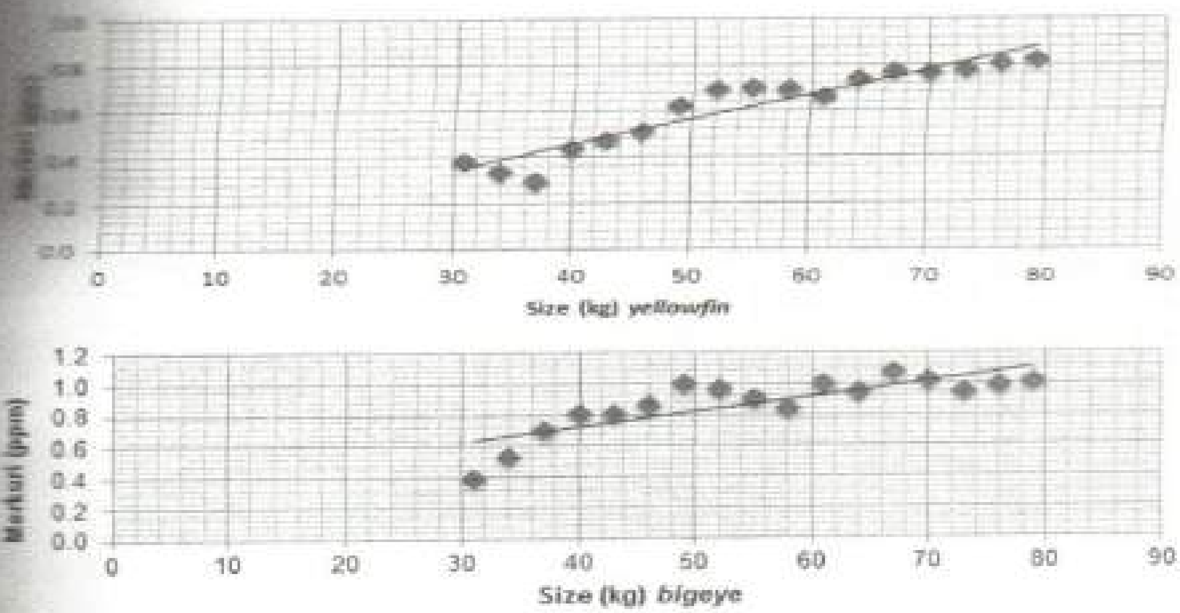


Figure 3. Correlation between mercury accumulation in tuna (yellowfin and bigeye) with regards to size.

This correlation test is to determine if the size of tuna effect the content of mercury. Correlation test shown that the yellowfin tuna species has a positive correlation with determined r value =0,943> r table = 0.468, and bigeye has also a positive correlation with determinate r value = 0.802> r table = 0.468.

Correlation value of bigeye is lower than yellowfin tuna. For both species can be concluded that there were positip relationship between the weight of tuna and mercury content. The greater weight of tuna, the greater the content of mercury. This is because tuna is top level predatory, so mercury was accumulated in their flesh more than the fish and other organism in below level of food chain.

The Mercury Content of Yellowfin and Bigeye Tuna from Indian Ocean and Banda Sea

Mercury at yellowfin and bigeye both from Indian Ocean and Banda Sea was analized. Total mercury of yellowfin and bigeye between weight 30 – 80 kg from Hindia Ocean, shown in table 2, and total mercury of yellowfin and bigeye between weight 30 – 80 kg from banda Sea, shown in table 3.

Table 2. Total mercury of yellowfin and bigeye from Hindia Ocean

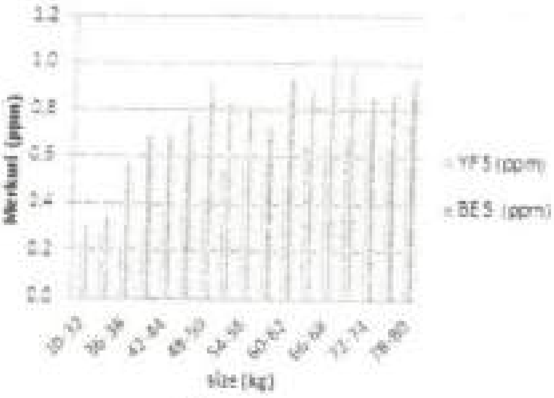
No	Weight (kg)	*yellowfin* (ppm)	*bigeye* (ppm)	Max Standard(ppm)
1	30-32	0,224	0,309	1 (SNI 01-2693.1-2006)
2	33-35	0,270	0,349	
3	36-38	0,241	0,686	
4	39-41	0,303	0,696	
5	42-44	0,376	0,702	
6	45-47	0,405	0,780	
7	48-50	0,429	0,924	
8	51-53	0,555	0,831	
9	54-56	0,584	0,820	
10	57-59	0,608	0,733	
11	60-62	0,535	0,937	
12	63-65	0,659	0,890	
13	66-68	0,656	1,036	
14	69-71	0,706	0,981	
15	72-74	0,749	0,855	
16	75-77	0,654	0,875	
17	78-80	0,747	0,940	

Table 3. Total mercury of yellowfin and bigeye from Banda Sea

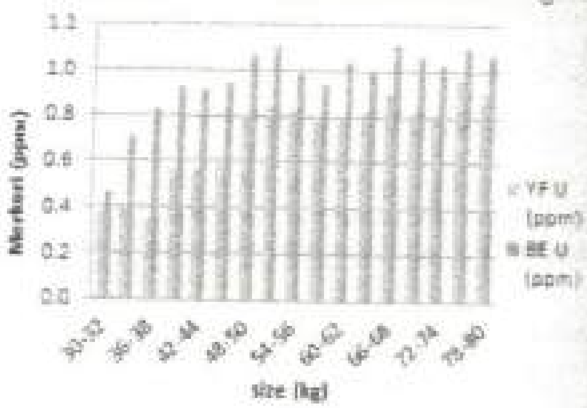
No	Weight (kg)	*Mercury* (ppm)		Max Standard (ppm)
		yellowfin	*bigeye*	
1	30-32	0,378	0,467	1 (SNI 01-2693.1-2006)
2	33-35	0,393	0,707	
3	36-38	0,345	0,824	
4	39-41	0,570	0,927	
5	42-44	0,564	0,913	
6	45-47	0,613	0,939	
7	48-50	0,811	1,069	
8	51-53	0,839	1,101	
9	54-56	0,820	0,986	
10	57-59	0,778	0,939	
11	60-62	0,788	1,053	
12	63-65	0,821	1,003	
13	66-68	0,899	1,110	
14	69-71	0,827	1,065	
15	72-74	0,810	1,030	
16	75-77	0,967	1,108	
17	78-80	0,901	1,070	

Table 2 and table 3 shown that bigeye both from Indian Ocean and Banda Sea contain mercury higher than yellowfin. All sample of yellowfin were comply with the standard (SNI 01-2693.1-2006), no sample contain more than 1 ppm of mercury) but in bigeye, we can see that almost all sample at size 66-80 contain mercury more than standard (1 ppm). This is because of the differences of behavior, temperature and depth of habitat between yellowfin and bigeye

Graph of total mercury of yellowfin and bigeye tuna from Indian Ocean and banda Sea shown in Figure 3



(a)



(b)

Figure 3. (a) Graph of total mercury of yellowfin and bigeye tuna from Indian Ocean, (b) Graph of total mercury of yellowfin and bigeye tuna from Banda Sea

T test performed on total mercury in yellowfin and bigeye from Indian Ocean, obtained stat t values (4.036)> t table (2.037). This shown that species of tuna, yellowfin and bigeye from same fishing ground have significant differences in mercury accumulation. From the results of the t test on yellowfin and bigeye tuna from Banda Sea, obtained the t stat value (3.939)> t table (2.037). This shows that tuna, yellowfin and bigeye species catched from the Banda Sea have significant differences in mercury accumulation.

This significant differences is cause by the differences of behavior, temperature and depth of habitat between yellowfin and bigeye, which is affect the total of mercury.

From the results of the t test on yellowfin tuna from Indian Ocean and yellowfin from Banda Sea, obtained t stat values (3.108)> t table (2.037). This shows that, same species of tuna from different fishing ground have significant differences in mercury accumulation

The Total Mercury of Yellowfin from Hindia Ocean and Banda Sea

Total mercury of yellowfin weight 30 – 80 kg from Hindia Ocean and Banda Sea, shown in Table 4, and total mercury of bigeye from Hindia Ocean and Banda Sea shown in Table 5.

Table 4. Total mercury of yellowfin from Hindia Ocean and Banda Sea

No	Weight (kg)	Merkuri Indian ocean (ppm)	Merkuri Banda Sea (ppm)	Max Standard (ppm)
1	30-32	0,224	0,378	1 (SNI 01-2693.1-2006)
2	33-35	0,270	0,393	
3	36-38	0,241	0,345	
4	39-41	0,303	0,570	
5	42-44	0,378	0,564	
6	45-47	0,405	0,613	
7	48-50	0,429	0,811	
8	51-53	0,565	0,839	
9	54-56	0,584	0,820	
10	57-59	0,608	0,778	
11	60-62	0,535	0,788	
12	63-65	0,659	0,821	
13	66-68	0,656	0,899	
14	69-71	0,706	0,827	
15	72-74	0,749	0,810	
16	75-77	0,654	0,967	
17	78-80	0,747	0,901	

Table 5. Total mercury of bigeye from Hindia Ocean and Banda Sea

No	Berat (kg)	Merkuri (ppm)		Max Standard (ppm)
		Hindia Ocean	Banda Sea	
1	30-32	0,309	0,467	1 (SNI 01-2693.1-2006)
2	33-35	0,349	0,707	
3	36-38	0,586	0,824	
4	39-41	0,696	0,927	
5	42-44	0,702	0,913	
6	45-47	0,780	0,939	
7	48-50	0,924	1,069	
8	51-53	0,831	1,101	
9	54-56	0,820	0,986	
10	57-59	0,733	0,939	
11	60-62	0,937	1,053	
12	63-65	0,890	1,003	
13	66-68	1,036	1,110	
14	69-71	0,981	1,065	
15	72-74	0,855	1,030	
16	75-77	0,875	1,108	
17	78-80	0,940	1,070	

Table 4 and table 5 shown that both in yelowfin and bigeye from Indian Ocean contain mercury lower than tuna from Banda Sea. On the table shown that , 46 kg of bigeye tuna from Banda Sea contain mercury more than 1 ppm (maximum standard according to SNI 01-2963.1-2006). Whereas from Indian ocean bigeye tuna contain mercury more than 1 ppm at 66 kg. Northern fishing area (Banda sea) which is surrounded by some islands that can causing mercury's pollution as consequence of disposal of sewage-waste into the sea from company or housing directly. Otherwise, Indian ocean is open ocean, only a few polution occur. Another factor such as temperature, meeting point of some flows at the ocean, and the depth of banda sea are likely give an effect for mercury contamination in some organism.

T-test used to compared the mercury contain of Tuna with the same species (yellowfin and bigeye) at different fishing area (Hindia ocean and Banda sea). Hindia ocean covering southern east Java, Bali to Nusa Tenggara, meanwhile, fishing area in northern sea is Banda sea.

T-test shown that yellowfin tuna from Hindia ocean and Banda Sea with the weight of sample is 30 – 80 kg which grouping each multiple of three obtained T value (3,108) > T table (2,037). The result shown that different fishing area with same species of tuna have significant differences on mercury contain.

T-test to compared the bigeye tuna from Hindia ocean and Banda sea obtained T-value (2,819) > T-table (2,037). The results shown that different fishing area with the same species of tuna have significant differences in mercury contain.

CONCLUSION

Conclusion

There are relationship between size of tuna and mercury contain. The bigger weight of tuna, the greater the levels of mercury. Mercury contain of yellowfin and bigeye tuna with the same fishing area have a significant defferences. Mercury contain of yellowfin tuna are smaller than bigeye tuna at the same fishing area. Mercury contain of different fishing area with the same species of tuna have a significant defferences. Mercury contain of yellowfin and bigeye tuna from Banda sea higher than mercury contain of yellowfin and bigeye tuna from Hindia ocean

Recomendation

Tuna fish processing company should care of weight, species, and fishing area for purchasing tuna as raw material.

ACKNOWLEDGEMENTS

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