

Effectiveness of Lime Juice (*Citrus aurantifoliaswingle*) to Decrease Hg, Cd and Pb Levels in Shells Meat and White Shrimp

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Abstract

Citric acid contained in lime is 7 - 7,6%. The decrease of Pb levels caused by acid solution can damage the complex bond of metal protein, besides Pb is a type of fat soluble metal so that by dissolving the fat indirectly also decrease the levels of Pb and Cd in shells meat and Shrimp. The purpose of this research was to know the effectiveness of lime juice (*Citrus aurantifolia swingle*) in decreasing levels of Heavy Metal Mercury (Hg), Cadmium (Cd), and Lead (Pb) on Shells Meat and White Shrimp. The type of this research was experimental quantitative research that was treatment with immersion of lime juice (*Citrus aurantifolia swingle*) with concentration of 15% and 30% in 30 minutes and 60 minutes immersion variation to decrease the levels of Hg, Cd and Pb on shells meat and White shrimp. The results of the study showed that the decrease of mercury weight (Hg), Cadmium (Cd), and Lead (Pb) on Shellfish and White Shrimp after 15% of lime juice was immersed in 30 minutes of soaking time effectively decreased Hg levels in *Marcia himalina* amounted to 97.95%. In soaking lime juice 15% in 60 minutes immersion time is most effective to decrease Hg levels in *Marcia hiantina* shells by 98.17%. In 30% of the 30% of 30% lime juice in 30 minutes of immersion is most effective in reducing Hg levels in *Marcia hiantina* shells by 93.33%. As well as on soaking water of lime juice 30% in 60 minutes soaking time most effectively reduce the level of Hg on *Marcia hiantina* shells by 97.6%.

Meat shells and white shrimp soaked with lime juice decreased heavy metal levels. The longer the shell in soak with lime juice then the heavy metal levels decreases. This decrease was due to the long immersion time the metal contact with the acid is also longer, so acid has a long chance to bind the metal.

Keywords: Lime juice (*Citrus Aurantifoliaswingle*), Hg, Cd, Pb, Shellfish and White Shrimp

I. INTRODUCTION

Indonesia is the world's largest archipelagic country with 17,581 islands, with coastlines of 81,000 km and an area of approximately 5.8 million square kilometers, or about three-quarters of the total area of Indonesia. The coastal region of Indonesia has enormous development potential. The development potentials of coastal and marine areas largely comprise three groups: renewable resources, un-renewable resources and environmental services (Environmental service). The oceans are the disposal of foreign objects and the deposition of waste products produced by humans. The oceans also receive materials carried by water from agricultural areas and household wastes, garbage and exhaust from ships, oil spills from tankers and offshore oil drilling, and much more waste is wasted into the oceans, thus polluting the sea later Affect the biota in it (Darmono, 2010).

In recent years environmental pollution has been widespread and pollution loads in the environment are heavier as more industries are discharging waste in the waters, this can lead to problems that need to be specifically addressed, especially heavy metal waste (Palar, 2008). The presence of heavy metals can also kill directly at very high concentrations, these heavy metals can also be accumulated by aquatic organisms even in low concentrations in the water column. The level of toxicity of heavy metals to aquatic animals, ranging from the most toxic are Hg, Cd, Zn, Pb, Cr, Ni. Meanwhile, the toxicity levels of humans from the most toxic are Hg, Cd, Ag, Ni, Pb, As, Cr, Sn, Zn (Widowati, et al. 2008).

As a densely populated urban area, the waters located west of Makassar city are estimated to contain considerable pollutants. The complexity of industrial activities, tourism and vehicle density in Losari and surrounding beaches can lead to the entry of heavy metal pollutants such as Mercury (Hg), Cadmium (Cd) and Lead (Pb). To see the effect of human activities on the entry of heavy metal pollutants Hg, Cd and Pb in the waters can be known by looking at the concentration accumulated in the organs of organisms that live around these waters. Shellfish (bivalves) contained in the Losari Coast waters is in addition to easy diteMukan is also an animal whose life is settled and associated in the coastal area so that this marine biota accumulates substances contained in aquatic bodies including Hg, Cd and Pb.

Based on research that has been done by Rahmini (2003) heavy metal Pb which was successfully detected at Blood clams (*Andara granosa*) in Losari Beach ranges from 0.6485-3.8059 ppm. Similarly, the results of research conducted by Windi (2010) concentration of Pb on *Marcia hiantina* shells on average in the morning 3,5333 ppm while in the afternoon that is 2,8519 ppm (Windi, 2010).

National Standardization Agency of Indonesia regarding the maximum limit of contamination Heavy metal in food states that the permissible heavy metal levels in the body of shellfish which can be consumed by humans for Hg and Cd is not more than 1.0 mg / kg Pb not more than 1.5 mg / kg. For that we need efforts to reduce the heavy metal levels on the shell so safe when consumed by humans. One of these efforts is to use metal binder or called chelating agent such as citric acid and acetic acid (Agustini, 2008).

According to Armanda (2009), metal binding process is a process of balance the formation of metal complex ions with sequestrants (chelating compounds). Potential sequences that are widely found in nature are Starfruit “Wuluh” and Tamarind. In the research that has been done by Jhauharotul and Sudarminto with 3 levels of concentration of Javanese acid and Starfruit “Wuluh” (5%, 10%, 15%) which is different from Shells meat research obtained the higher the concentration of acid given to Shells meat, The lower Pb. In addition to tamarind and starfruit “wuluh”, lime juice (*Citrus aurantifolia* swingle) also has the ability as a chelator (metal binder). Citric acid contained in lime is 7 - 7,6%. The decrease of Pb levels caused by acid solution can damage the complex bond of metal protein, besides Pb is a type of fat soluble metal so that with indirect fat dissolve also decrease the levels of Pb and Cd in shrimp and shrimp meat (Setiawan, et al., 2012). Research conducted by Armanda (2009), after soaking tiger prawns with lime solution for 30 minutes there was a decrease in Pb level of 48.40% while immersion for 60 minutes decreased Pb level by 64.46%. Thus, the immersion of shrimp in lime solution effective to decrease Pb metal levels in tiger shrimp (*Penaeus monodon*) derived from Belawan sea waters.

Based on the above background description, the authors want to do the same research that lowers Heavy Metal Hg, Cd and Pb by using lime juice on shellfish meat and white shrimp which is a marine biota is accumulating higher pollutant than other marine biota. Lime juice in this study with concentrations of 15% and 30% in the immersion time of 30 minutes and 60 minutes.

II. METHODS

The summary of the methods were:

- a. The type of research: experimental study
- b. The treatment: soaking lime juice (*Citrus aurantifolia* swingle) with 15% and 30% concentration in 30 minutes and 60 minutes immersion variation to decrease the levels of Hg, Cd and Pb on shells meat and white shrimp. This research was done by 3 times repetition (replication) sample examination.
- c. Location: The shrimp and white shrimp were collected from the sellers in Losari Beach Kota Makassar. Examination of shells meat and white shrimp samples conducted at Central Health Laboratory Makassar.
- d. Time: 1) Preparation: January to March 2016, 2) Implementation: April 2016 to September 2016
- e. Variable: 1) Independent variables: Lime juice Water 15% and 30% with soaking time 30 minutes and 60 minutes, 2) Dependent variable: the heavy metal levels of Hg, Cd and Pb on shells meat and shrimp.
- f. Population: all shells meat and white shrimp were sold in Losari Beach of Makassar City.
- g. Sample: Marcia hiantina shrimp and white shrimp (*Litopenaeus vannamei*) Conducted treatment by taking shell meat and white shrimp, each of 10 gr and done soaking lime juice with concentration of 15% and 30% with soaking time 30 Minutes and 60 minutes.

III. RESULTS

A. Result of decrease of mercury weight (Hg), Cadmium (Cd), and Lead (Pb) on Shrimp Meat and White Shrimp after 15% of lime juice in 30 minutes immersion time

Table 1. Hg levels of Shellfish and Shrimp Meat After Immersion Lime juice with 15% Concentration for 30 Minutes

Immersion lime 15% 30 Minutes	Start (mg/kg)	Treatment (mg/kg)			Average (mg/kg)	Decrease	
		I	II	III		mg/kg	%
Control MH	0.075				0.005	0.07	93.33
Marcia hiantina	0.075	0.0029	0	0.0017	0.0015	0.0734	97.95
Control WS	0.038				0.013	0.025	65.78
White Shrimp	0.038	0.0018	0	0.0007	0.00083	0.0371	97.80

The Hg levels of Marcia Hiantina Shells was 0.075 mg / kg. After soaking with aquadest (control) for 30 minutes, obtained the average Hg levels of 0.005 mg / kg and decreased by 0.07 mg / kg or by 93.33%. After the soaking of lime juice with 15% concentration for 30 minutes obtained the average Hg level of 0.0015 mg / kg and decreased by 0.0734 mg / kg or 97.95%. Hg levels in white Shrimp was 0.038 mg / kg. After soaking with aquadest (control) for 30 minutes, the average Hg levels of 0.013 mg / kg and decreased by 0.025 mg / kg or 65.78%. After

the soaking of lime juice with 15% concentration for 30 minutes, the average Hg levels of 0.00083 mg / kg and decreased 0.0371 mg / kg or 97.80%.

Table 2. Cd levels of Shrimp and Shrimp Meat After Soaking Lime juice with 15% Concentration For 30 Minutes

Immersion lime 15% 30 Minutes	Start (mg/kg)	Treatment (mg/kg)			Average (mg/kg)	Decrease	
		I	II	III		mg/kg	%
Control MH	0	0	0	0	0	0	0
Marcia hiantina	0	0	0	0	0	0	0
Control WS	0	0	0	0	0	0	0
White Shrimp	0	0	0	0	0	0	0

Cd levels on Marcia Hiantina Shells and White Shrimp at 0 mg / Kg.

Table 3. Pb levels on Shrimp and Shrimp Meat After Soaking immersing Lime juice with 15% Concentration For 30 Minutes

Immersing lime 15% 30 Minutes	Start (mg/kg)	Treatment (mg/kg)			Average (mg/kg)	Decrease	
		I	II	III		mg/kg	%
Control MH	0.92				0.5	0.42	45.65
Marcia hiantina	0.92	0.43	0.41	0.27	0.37	0.55	59.78
Control UP	0.5				0.09	0.41	82
White shrimp	0.5	0.26	0	0	0.086	0.413	82.66

Pb levels on Marcia hiantina Shells of 0.92 mg / kg. After soaking with aquadest (control) for 30 minutes, obtained the average Pb level of 0.5 mg / kg and decreased by 0.42 mg / kg or by 45.65%. After the soaking of lime juice with concentration of 15% for 30 minutes obtained the average Pb level of 0.37 mg / kg and decreased by 0.55 mg / kg or 59.78%. Pb level in white Shrimp is 0.5 mg / kg. After soaking with aquadest (control) for 30 minutes, obtained average Pb level of 0.09 mg / kg and decreased by 0.41 mg / kg or by 82%. After soaking water Lime with concentration of 15% for 30 minutes obtained average Pb level of 0.086 mg / kg and decreased by 0.413 mg / kg or by 82.66% .2. Result of decrease of mercury weight (Hg), Cadmium (Cd), and Lead (Pb) on Shellfish and White Shrimp after 15% of lime juice in 60 minutes immersion time.

Table 4. Hg levels on Shellfish and Shrimp Meat After Soaking Lime juice 15% Concentration For 60 Minutes

Immersion lime 15% 60 Minutes	Start (mg/kg)	Treatment (mg/kg)			Average (mg/kg)	Decrease	
		I	II	III		mg/kg	%
Control MH	0.075				0.008	0.067	89.33
Marcia hiantina	0.075	0	0.0017	0.0024	0.00136	0.0736	98.17
Control WS	0.038				0.019	0.019	50
White Shrimp	0.038	0.0002	0	0.0086	0.00293	0.0350	92.28

The levels of Hg on Marcia hiantina Shells was 0.075 mg / kg. After soaking with aquadest (control) for 60 minutes, the average Hg levels of 0.008 mg / kg and decreased by 0.067 mg / kg or 89.33%. After soaking lemon juice with concentration of 15% for 60 minutes obtained average Hg levels of 0.00136 mg / kg and decreased by 0.0736 mg / kg or 98.17%. Hg levels in white Shrimp is 0,038 mg / kg. After soaking with aquadest (control) for 60 minutes, obtained the average Hg level of 0.019 mg / kg and decreased by 0.019 mg / kg or by 50%. After the soaking of lime juice with 15% concentration for 60 minutes obtained the average Hg level of 0.00293 mg / kg and decreased by 0.0350 mg / kg or 92.28%.

Table 5. Cd levels on Shellfish And Shrimps After Immersion Lime Juice with 15% Concentration For 60 Minutes

Immersion Lime 15% 60 Minutes	Start (mg/kg)	Treatment (mg/kg)			Average (mg/kg)	Decrease	
		I	II	III		mg/kg	%
Control MH	0	0	0	0	0	0	0
Marcia hiantina	0	0	0	0	0	0	0
Control WS	0	0	0	0	0	0	0
White Shrimp	0	0	0	0	0	0	0

Cd levels on Marcia Hiantina Shells and White Shrimp at 0 mg / kg.

Table 6. Pb levels of Shrimp and Shrimp Meat After Soaking Lime juice with 15% Concentration For 60 Minutes

Immersion lime 15% 60 Minutes	Start (mg/kg)	Treatment (mg/kg)			Average (mg/kg)	Decrease	
		I	II	III		mg/kg	%
Control MH	0.92				0.5	0.42	45.65
Marcia hiantina	0.92	0.23	0.08	0	0.103	0.816	88.76
Control WS	0.5				0.11	0.39	78
White Shrimp	0.5	0.34	0	0	0.113	0.386	77.33

The Pb levels of Marcia Hiantina Shells was 0.92 mg / kg. After soaking with aquadest (control) for 60 minutes, obtained average Pb level of 0.5 mg / kg and decreased by 0.42 mg / kg or by 45.65%. After soaking lemon juice with concentration of 15% for 60 minutes obtained average Pb level of 0.103 mg / kg and decreased by 0.816 mg / kg or equal to 88.76%. Pb level in white Shrimp is 0.5 mg / kg. After immersion with aquadest (control) for 60 minutes, obtained average Pb level of 0.11 mg / kg and decreased by 0.39 mg / kg or by 78%. After the soaking of lime juice with concentration of 15% for 60 minutes obtained average Pb level of 0.113 mg / kg and decreased by 0.386 mg / kg or equal to 77.33%.

B. Result of decrease of mercury metals (Hg), Cadmium (Cd), and Lead (Pb) on Shellfish and White Shrimp after 30% of lime juice immersion in 30 minutes immersion time.

Table 7. Hg levels on Shellfish And Shrimps After Immersion Lime Juice with 30% Concentration 30 Minutes

Immersion lime 30% 30 Minutes	Start (mg/kg)	Treatment (mg/kg)			Average (mg/kg)	Decrease	
		I	II	III		mg/kg	%
Control MH	0.075				0.005	0.07	93.33
Marcia hiantina	0.075	0	0.0024	0.0069	0.0031	0.0719	95.86
Control WS	0.038				0.013	0.025	65.78
White Shrimp	0.038	0.0005	0.0079	0.0067	0.005033	0.0329	86.75

The Hg levels of Marcia Hiantina Shellfish was 0.075 mg / kg. After soaking with aquadest (control) for 30 minutes, obtained the average Hg level of 0.005 mg / kg and decreased by 0.07 mg / kg or by 93.33%. After the soaking of lime juice with 30% concentration for 30 minutes, the average Hg levels of 0.0031 mg / kg and decreased by 0.0719 mg / kg or 93.33%. Hg levels in white Shrimp was 0.038 mg / kg. After soaking with aquadest (control) for 30 minutes, the average Hg levels of 0.013 mg / kg and decreased by 0.025 mg / kg or 65.78%. After the soaking of lime juice water with 30% concentration for 30 minutes obtained the average Hg level of 0.0050 mg / kg and decreased by 0.0329 mg / kg or equal to 86.75%.

Table 8. Cd levels on Shellfish And Shrimps After Immersion Lime Lime Water with 30% Concentration For 30 Minutes

Immersion Lime 30% 30 Minutes	Start (mg/kg)	Treatment (mg/kg)			Average (mg/kg)	Decrease	
		I	II	III		mg/kg	%
Control MH	0	0	0	0	0	0	0
Marcia hiantina	0	0	0	0	0	0	0
Control WS	0	0	0	0	0	0	0
White Shrimp	0	0	0	0	0	0	0

Cd levels on Marcia Hiantina Shells and White Shrimp at 0 mg / kg.

Table 9. Pb levels on Shrimp and Shrimp Meat After Soaking Lime juice with 30% Concentration 30 Minutes

Immersion lime 30% 30 Minutes	Start (mg/kg)	Treatment (mg/kg)			Average (mg/kg)	Decrease	
		I	II	III		mg/kg	%
Control MH	0.92				0.5	0.42	45.65
Marcia hiantina	0.92	0.08	0.33	0.48	0.296	0.623	67.75
Control WS	0.5				0.09	0.41	82
White Shrimp	0.5	0.02	0.25	0.34	0.203	0.296	59.33

The Pb levels of Marcia Hiantina Shells was 0.92 mg / kg. After soaking with aquadest (control) for 30 minutes, obtained the average Pb level of 0.5 mg / kg and decreased by 0.42 mg / kg or by 45.65%. After the soaking of

lime juice with 30% concentration for 30 minutes obtained the average Pb level of 0.296 mg / kg and decreased by 0.623 mg / kg or 67.75%. Pb level in white Shrimp was 0.5 mg / kg. After soaking with aquadest (control) for 30 minutes, obtained average Pb level of 0.09 mg / kg and decreased by 0.41 mg / kg or by 82%. After the soaking of lime juice with 30% concentration for 30 minutes obtained average Pb level of 0.0203 mg / kg and decreased by 0.296 mg / kg or 59.33% .

C. Result of decrease of mercury weight (Hg), Cadmium (Cd), and Lead (Pb) on Shellfish and White Shrimp after 30% of lime juice immersion in 60 minutes immersion time.

Table 10. Hg levels on Shellfish and Shrimp Meat After Immersion Lime juice with 30% Concentrate 60 Minutes

Immersing Lime 30% 60 Minutes	start (mg/kg)	Treatment (mg/kg)			Average (mg/kg)	Decrease	
		I	II	III		mg/kg	%
Control MH	0.075				0.008	0.067	89.33
Marcia hiantina	0.075	0.0025	0.0008	0.0021	0.0018	0.0732	97.6
Control WS	0.038				0.019	0.019	50
White Shrimp	0.038	0.0052	0.0014	0.0036	0.0034	0.0346	91.05

The Hg levels of Marcia Hiantina Shellfish was 0.075 mg / kg. After soaking with aquadest (control) for 60 minutes, the average Hg levels of 0.008 mg / kg and decreased by 0.067 mg / kg or 89.33%. After the soaking of lime juice with 30% concentration for 60 minutes, the average Hg levels of 0.0018 mg / kg and decreased by 0.0732 mg / kg or 97.6%. Hg levels in white Shrimp is 0,038 mg / kg. After soaking with aquadest (control) for 60 minutes, obtained the average Hg level of 0.019 mg / kg and decreased by 0.019 mg / kg or by 50%. After soaking the water of lime juice with concentration of 30% for 60 minutes obtained the average Hg level of 0.0034 mg / kg and decreased by 0,0346 mg / kg or equal to 91,05%.

Table 11. Cd levels on Shellfish And Shrimps After Immersion Lime Juice with 30% Concentration For 60 Minutes

Immersing Lime 30% 60 Minutes	Start (mg/kg)	Treatment (mg/kg)			Average (mg/kg)	Decrease	
		I	II	III		mg/kg	%
Control MH	0	0	0	0	0	0	0
Marcia hiantina	0	0	0	0	0	0	0
Control WS	0	0	0	0	0	0	0
White Shrimp	0	0	0	0	0	0	0

Cd levels on Marcia Hiantina Shells and White Shrimp at 0 mg / kg.

Table 12. Levels of Pb on shellfish and shrimp Meat After Immersion of Lime juice with Concentration 30% For 60 Minutes

Immersing Lime 30% 60 Minutes	Start (mg/kg)	Treatment(mg/kg)			Mean (mg/kg)	Decrease	
		I	II	III		mg/kg	%
Control MH	0.92				0.5	0.42	45.65
Marcia hiantina	0.92	0.19	0	0	0.0633	0.856	93.11
Control UP	0.5				0.11	0.39	78
White shrimp	0.5	0.2	0.02	0.18	0.1333	0.366	73.33

The Pb levels of the Marcia Shellfish was 0.92 mg / kg. After soaking with aquadest (control) for 60 minutes, obtained average Pb level of 0.5 mg / kg and decreased by 0.42 mg / kg or by 45.65%. After the soaking of lime juice with concentration of 30% for 60 minutes obtained average Pb level of 0.0633 mg / kg and decreased by 0.856 mg / kg or by 93.11%. Pb level in white Shrimp was 0.5 mg / kg. After immersion with aquadest (control) for 60 minutes, obtained average Pb level of 0.11 mg / kg and decreased by 0.39 mg / kg or by 78%. After the soaking of lime juice with concentration of 30% for 60 minutes obtained average Pb rate of 0.1333 mg / kg and decreased by 0.366 mg / kg or by 73.33%. Data of Mercury Heavy Metals (Hg), Cadmium (Cd), and Lead (Pb) on shellfish Meat and White Shrimps after Immersion of lime juice with time variation, were analyzed using Independent sample t-test statistic test to determine the difference of metal levels Weight based on the difference concentration of lime and soaking time.

Table 13. Differential Test Result of Hg Level Based on Lime Concentration Difference

		Paired Differences					T	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Levels of Hg shrimp 30 minute 15% - Levels of Hg shrimp 30 minute 30%	-4.20000000E-3	.00485695	.00280416	-.01626534	.00786534	1.498	2	.273
Pair 2	Levels of Hg Shrimp 60 menit 15% - Levels of Hg Shrimp 60 minutes 30%	-4.66666667E-4	.00506491	.00292423	-.01304861	.01211527	-.160	2	.888
Pair 3	Levels of Hg shellfish 30 minutes 15% - Levels of Hg shellfish 30 minutes 30%	-1.56666667E-3	.00411380	.00237510	-.01178591	.00865257	-.660	2	.577
Pair 4	Hg shells 60 minutes 15% - Hg shells 60 minutes 30%	1.66666667E-4	.00260256	.00150259	-.00629846	.00663179	.111	2	.922

Table 13 shows that the value of significance was respectively 0.273; 0.888; 0.577; And 0.922 greater than 0.05 then there was no difference From the value of the decrease can be seen that between treatments with concentrations of 15% and 30% almost no difference or only slight difference.

Table 14. Results of Differences Test Hg Based on the Long Time Immersion

Paired Samples Test

		Paired Differences					T	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Levels of Hg Shrimp 30 minutes 15% - Levels of Hg shrimp 60 minutes 15%	2.10000000E-3	.00508626	.00293655	-.01473496	.01053496	.715	2	.549
Pair 2	Levels of Hg shrimp 30 minutes 30% - levels of Hg shrimp 60 minutes 30%	1.63333333E-3	.00574224	.00331528	-.01263118	.01589785	.493	2	.671
Pair 3	Levels of Hg shell 30 minutes 15% - levels of Hg shellfish 60 minutes 15%	2.83333333E-3	.00704651	.00406831	-.02033784	.01467117	.696	2	.558
Pair 4	Levels of Hg shellfish 30 minutes 30% - levels of Hg shells 60 minutest 30%	1.10000000E-3	.00533948	.00308275	-.01436399	.01216399	.357	2	.755

Table 14 indicates that the value of significance was 0.549; 0.671; 0.558; And 0.755 greater than 0.05 then there was no difference From the value of the decrease can be seen that between treatment with soaking time 30 minutes and 60 minutes almost no difference or only slight difference.

Table 15. Test Result of Different Pb Based on Differences Concentration of Lime juice

Paired Samples Test

		Paired Differences					t	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pb Shrimp 30 minutes 15% - Pb shrimp 30 minutes 30%	-.11667	.31214	.18022	-.89207	.65874	-.647	2	.584
Pair 2	Pb Shrimp 60 minutes 15% - Pb Shrimp 60 minutes 30%	-.02000	.16000	.09238	-.41746	.37746	-.217	2	.849
Pair 3	Pb Shells 30 minutes 15% - Pb Shells 30 minutes 30%	.07333	.28006	.16169	-.62237	.76904	.454	2	.695
Pair 4	Pb Shells 60 minutes 15% - Pb Shells 60 minutes 30%	.04000	.04000	.02309	-.05937	.13937	1.732	2	.225

Table 15 indicates that the value of their significance successively -raw by 0.273; 0.888; 0.577; and 0.922 greater than 0.05 then there was no difference From the value of the decrease can be seen that between treatments with concentrations of 15% and 30% almost no difference or just a slight difference.

Table 16. Differences Test Results Pb Based on the Long Time Immersion

Paired Samples Test

		Paired Differences					T	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pb Shrimp 30 minutes 15% - Pb Shrimp 60 minutes 15%	-.02667	.04619	.02667	-.14140	.08807	1.000	2	.423
Pair 2	Pb Shrimp 30 minutes 30% - Pb Shrimp 60 minutes 30%	.07000	.21932	.12662	-.47481	.61481	.553	2	.636

Pair 3	Pb Shells 30 minutes 15% - Pb Shells 60 minutes 15%	.26667	.06506	.03756	.10504	.42829	7.099	2	.019
Pair 4	Pb shells 30 minutes 30% - Pb Shells 60 minutes 30%	.23333	.30665	.17704	-.52842	.99509	1.318	2	.318
Pair 5	Pb shrimp control 30 minutes – Pb shrimp control 60 minutes	.01667	.06351	.03667	-.14110	.17443	.455	2	.694

Table 16. indicates that the value of significance was 0.423; 0.636; 0.019; 0.318; And 0.694 was greater than 0.05 then there is no difference. From the value of the decrease can be seen that between treatment with soaking time 30 minutes and 60 minutes almost no difference or only slight difference.

IV. DISCUSSION

Shells meat and white shrimp soaked with lime juice decreased heavy metal levels. The longer the shell in soak with lime juice then the heavy metal levels decreases. This decrease is due to the long immersion time the metal contact with the acid is also longer, so acid has a long chance to bind the metal. According to Christine Abadiana et al (2013) the longer time immersion the more contact between metal with acid so that the acid chance to bind the metal is getting bigger. This statement is also confirmed by research conducted by AM Alpatih et al (2010) who said that there is the influence of long interaction immersion of lemon acid to decrease levels of heavy metal Lead (Pb) on shellfish. The longer the immersion time, the heavy metal levels of Pb on the mussel meat decreases.

Marcia hiantina shrimp dipping, white shrimp (*Litopenaeus vannamei*) and blood clams (*Anadara granosa*) with Aquadest can decrease heavy metal levels. Aquadest does not have the ability to bind metals as well as to lime juice. Aquadest is only capable of dissolving and precipitating heavy metal levels on the surface of clam meat or in direct contact with the aquadest. The decrease in heavy metal levels after soaking with aquades is also caused because water can damage the complex bonds of protein metals, although not as effective as citric acid (Afsyah, 2011).

Lime juice contains elements of chemical compounds such as citric acid, amino acids (tryptophan, lysine), carbonic acid, damar oil, glycosides, fat, calcium, phosphorus, iron, sulfur vitamins B1 and C. Citric acid contained in Lime for 7 - 7.6% (Hariana, 2006 in Armanda 2009). This citrate acid can dissolve both polar compounds such as inorganic salts and sugars as well as non-polar compounds such as oils and elements (including Lead (Pb) in it). This statement is supported by Teguh Satra Setiawan et al. (2012) that acidic solutions can damage the complex bonds of protein metals, otherwise Pb is a type of fat soluble metal so that by dissolving fat indirectly also decreases Pb levels in shell meat. Lime juice is able to bind the metal that is in the shellfish and shrimp so that the levels of heavy Metal decreased after soaking.

Citric acid is corrosive to many metals such as iron, magnesium, zinc, and cadmium, which form hydrogen gas and citrate salt salt (called citrate). The citrate metal may also be obtained with citric acid with a suitable base. Citric acid / citric acid is a hydrophilic protic solvent (polar), similar to water and ethanol. Citric acid can dissolve both polar compounds such as inorganic salts and sugars as well as non-polar compounds such as oils and elements (including Lead (Pb) in it). Citric acid mixes easily with other polar or non-polar solvents so that the solubility and ease of mixing of citric acid is used as a heavy metal solvent Lead in shells.

Metals in general can form bonds with natural organic materials as well as artificial organic materials. The formation process of such bonding may occur through the formation of organic salts with carboxylic groups such as citric acid, tartrate, and others. In addition, metals can bind to atoms that have free electrons in organic compounds to form complexes (Palar, 2008).

The toxic properties of heavy metals are bound in sulfhydryl (-SH) groups in enzymes such as carboxyl cysteine, histidyl, hydroxyl, and phosphatyl from proteins and purines. Toxicity and lethal properties of heavy metals in the body of water biota (shells) can be removed by the addition of citric acid solution. This is because heavy metals bind to atoms that have free ions, whereas citric acid has four free electrons in the carboxylate group to form a

complex bond (metal binder). The occurrence of a reaction between a metal binder and a metal ion through a coordinate bond causes the metal ion to lose its ionic properties and cause the heavy metal to lose most of its toxicity.

V. CONCLUSION AND SUGGESTIONS

A. Conclusion

1. Degradation of mercury weight (Hg), Cadmium (Cd), and Lead (Pb) on Shellfish and White Shrimp after 15% of lime juice in 30 minutes of immersion time is most effective in reducing Hg levels in Marcia himalina clams by 97.95%.
2. Degradation of mercury weight (Hg), Cadmium (Cd), and Lead (Pb) on Shellfish and White Shrimp after 15% of lime juice in 60 minutes of immersion time is most effective in lowering Hg levels in Marcia himalina clams by 98.17%.
3. Reduction of mercury (Hg), Cadmium (Cd), and Lead (Pb) on Shellfish and White Shrimp after 30% of lime juice in 30 minutes of immersion time is most effective at lowering Hg levels in Marcia hiantina Shells by 93.33%.
4. Degradation of mercury weight (Hg), Cadmium (Cd), and Lead (Pb) on Shellfish and White Shrimp after 30% of lime juice in 60 minutes immersion time is most effective at lowering Hg level on Marcia hiantina 97.6%

B. Suggestions

1. It is expected that the community will immerse the mussels with lime juice for 30 minutes to reduce the heavy metal levels on shell and shrimp before washing or cooking.
2. For further research is advisable to do further research to determine the difference in protein nutritional value on blood shells that are not soaked and that have been soaked with lime solution.

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