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Determination of Cadmium (Cd) Metal Content in Milkfish at Port of Tanjung Mas

Feni Nilasari and Yari Mukti Wibowo*

Department of Chemical Analyst, Faculty of Engineering, Universitas Setia Budi of Surakarta
Jl. Letjen. Sutoyo, Mojosongo Kota Surakarta, Jawa Tengah 57127, Indonesia

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ABSTRACT

The location of milkfish ponds around the Port of Tanjung Mas is adjacent to an industrial area. This can increase the possibilities of milkfish being contaminated by heavy metals, for example Cadmium (Cd) metal. Therefore it is necessary to determine the levels of Cadmium metal in milkfish that are cultivated in ponds around the Port of Tanjung Mas. The aims of this study is to find out the levels of Cadmium metal in milkfish samples at the Port of Tanjung Mas whether or nor it exceeds the threshold. The method commonly used for metal analysis is the Atomic Absorption Spectrophotometry (AAS) method, because this method is simple, selective and sensitive for analyzing metal content in a sample of animal origin, such as milkfish. In the initial treatment, milkfish samples were separated between meat and bones. The milkfish was then dried by heating at 150^{o}C for 1 hour and continuing with ashes up to 550^{o}C. The ash-shaped sample was dissolved in concentrated HNO_3 and diluted with aquabidest. The aqueous sample solution was analyzed using ASS at a wavelength of 228 nm to determine the metal content of Cd in the sample. The level of Cd metal in milkfish samples analyzed using ASS, showed that it was still in accordance with the quality standard, which was below the threshold set in SNI No. 7387: 2009. Samples of milkfish taken from several pond locations showed that the farther pond was from the industrial area, the less Cd metal pollution in milkfish in the pond area.

*Corresponding author:

Yari Mukti Wibowo
Department of Chemical Analyst, Faculty of Engineering, Universitas Setia Budi of Surakarta
Email: yarimukti@gmail.com

INTRODUCTION

Around Port of Tanjung Mas there are several large industries. It is possible for such large industries to have a negative impact on the surrounding environment, especially the surrounding milkfish ponds. Based on previous research, milkfish (Chanos chanos sp) cultivated around the Port of Tanjung Mas are contaminated with lead metal (Pb), although it is still below the threshold value (Nilasari and Wibowo, 2018). Therefore it is also necessary to examine whether the milkfish around Tanjung Mas Port is contaminated with cadmium (Cd) metal or not.

Cadmium metal (Cd) has an atomic number of 48, an atomic mass of 112.41 and is included in heavy metals. In waters usually cadmium metal is found as hydrated ions, chloride salts, complexed with inorganic ligands or complexed with organic ligands (Anggraini, 2016). If the cadmium metal enters the human body and accumulates, it can cause health problems such as poisoning in renal nephrons (nephrotoxicity), cardiovascular disorders, and osteomalasea or Itai-itai disease (Harminta, 2004).

The most commonly used analytical method to measure cadmium metal content in a sample is the Atomic Absorption Spectrophotometry (ASS) analysis method because this method is simple, has a high level of selectivity and sensitivity (Widayanti and Widwiastuti, 2018; Sasongko et al, 2017; Raziah et al, 2017 2017; Nuraini et al, 2015; Marwah et al, 2015; Emilia et al, 2013; Rasyid et al, 2013; Novianto et al, 2012, Happy et al, 2012; Rumahlatu, 2011; Broekart, 2002).

MATERIALS AND METHODS

Research Materials

Samples of milkfish from ponds around Port of Tanjung Mas, $Cd(NO_3)_2$ 1000 ppm stock solutions from Merck, HCl 5 N, concentrated HNO_3 and Aquabidest.

Research Tools

Atomic Absorption Spectrophotometer (AAS) Brands Shimadzu Type AA-7000, lamp hollow cathode (Hollow Cathode Lamp) cadmium (Cd), 50 mL and 100 ml volumetric flask, 1 mL, 5 mL, 10 mL, 20 mL and 50 mL volume pipette, 100 mL and 200 mL beaker glass, blender, analytical balance, oven, furnace, porcelain cup, hotplate, stirring rod, glass funnel, Whatmann filter paper No.41 ash free and desiccator.

Procedure

Sampling

Milkfish samples were obtained from several ponds in the Port of Tanjung Mas area. 5 (five) stations were chosen as a place for milk fish sampling. Milkfish samples taken at harvest time are milkfish that are 2 months old and milkfish samples have almost the same length. The following is a map of the sampling station (Figure 1).

Sample Preparation

The milk fish sample that has been separated from the bones is mashed using a blender. The fine milkfish meat sample is then weighed as much as 10 grams using a porcelain cup. The cup had previously been dried using an oven at 105^{o}C for 1 hour. Samples of milkfish are made using a hotplate, then the samples are smeared using a furnace at 550^{o}C for 8 hours or until they become perfect ash, which is white ash. Samples that have become ash are added with 2 mL of concentrated HNO_3 and 2 mL of aquabidest in the sample, then stirred until homogeneous. The solution is then put into a 50 mL volumetric flask and added with aquabidest to the boundary markings, then shaken until homogeneous. The solution was then filtered using Whatmann No.41 ash free filter paper. (SNI-19-2898-1992 / Rev.1998, SNI 2354.5: 2011).

Making Standard Solution

1000 ppm of $Cd(NO_3)_2$ stock solution taken as much as 1 mL; 5 mL; 10 mL; 20 mL; and 50 mL using a volume pipette, then each solution is put into a 100 mL measuring flask. each pumpkin was added with 20 mL HCl 5 N and then added with aquabidest to the boundary markers and homogenized.

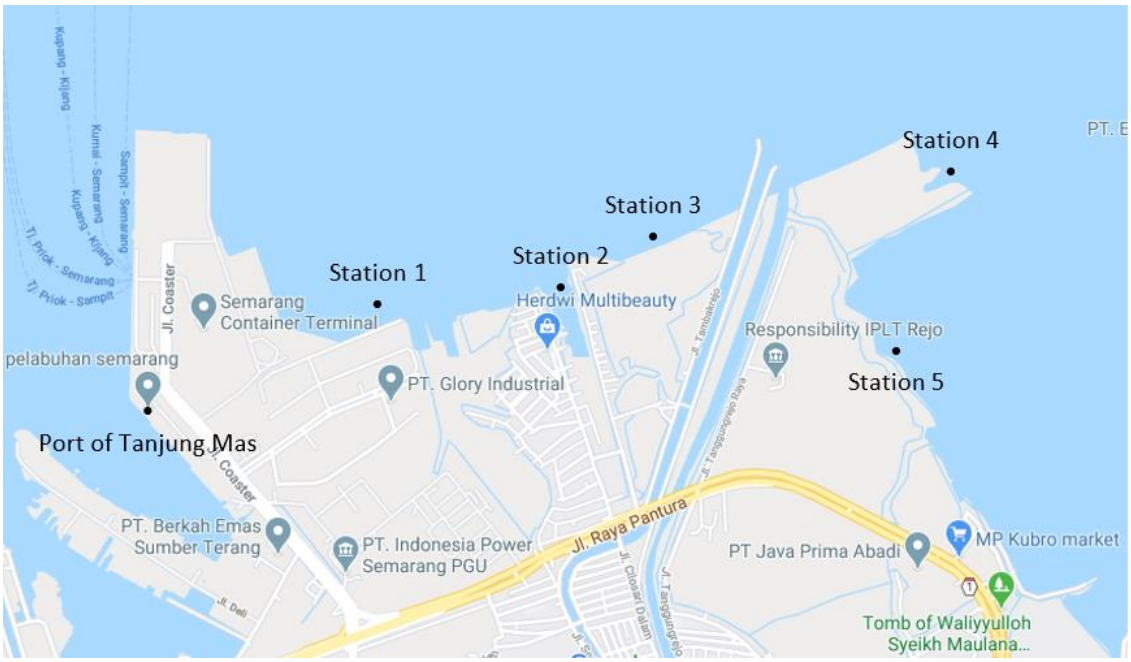

Figure 1. Map of Sampling Station

Making a Standard Solution Calibration Curve

Cd standard solution with a concentration of 0.1 ppm; 0.5 ppm; 1.0 ppm; 2.0 ppm and 5.0 ppm absorbance were measured using the Atomic Absorption Spectrophotometer (ASS) Brand Shimadzu Type AA-7000 at λ = 228 nm. From the absorbance obtained the relationship curve was made between the absorbance and the concentration of the standard solution (SNI-19-2898-1992 / Rev.1998; SNI 2354.5: 2011; Jeffery et al, 1989; Harvey, 2000). From the relationship curve, we can find the linear regression equation according to the following equation 1.

$$y = ax + b \quad \ldots\ldots\ldots (1)$$

Remarks: y = absorbance of standard solution
a = slope
x = concentration of standard solution
b = intercept

Determine Sample Solution Concentration

The sample solution is treated similar to a standard solution so that the absorbance of the sample solution is obtained. The absorbance of the sample solution is included in the linear regression equation of the standard solution calibration curve, so that the concentration of the sample solution is obtained in ppm

Comparing the Concentration of Sample Solutions

The concentration of the sample solution obtained from the linear regression equation is changed from ppm to mg/kg according to the following equation 2.

$$\text{concentration of sample solution } \left(\frac{\text{mg}}{\text{kg}}\right) = \frac{\text{concentration of sample solution (ppm)} \times \text{volume (L)}}{\text{mass of sample (kg)}} \quad \ldots\ldots\ldots (1)$$

The concentration of the sample solution obtained was compared with the existing quality standard in SNI No. 7387: 2009 related to the maximum limit of cadmium metal contamination in food.

RESULT AND DISCUSSION

This study is a continuation of previous studies, namely the determination of lead metal (Pb) content in milkfish around Port of Tanjung Mas. As with previous studies, this study also aims to determine the levels of cadmium metal (Cd) in milkfish samples at Port of Tanjung Mas whether or not it exceeds the threshold. This research uses atomic absorption spectrophotometry method to determine the concentration of Cd metal in milkfish samples. In addition, this study also compared the concentration of Cd metal in milkfish samples with the quality standards set in SNI-19-2898-1992 / Rev.1998, so it can be seen that the milkfish samples obtained around Port of Tanjung Mas are contaminated with Cd or not. The samples of milkfish used in this study were milkfish taken from 5 (five) stations and selected milkfish that were ready to be harvested were milkfish that were 2 (two) months old, and milkfish that were almost the same length. The milkfish samples are cleaned and then separated between meat and bones. This study uses meat from milk fish, because the part of milk fish that is most often consumed is meat.

After the milkfish meat sample is separated from the bone, the sample is ready to be destructed. Destruction of samples carried out is dry destruction or ashing, namely by heating using a furnace to a temperature of 550 ^{o}C for 8 hours. This sample destruction is carried out to separate the Cd metal from the sample matrix, especially the organic compounds present in the sample. After the graying process is complete the sample becomes white ash. Addition of concentrated HNO_3 to ash was carried out to remove metals present in the sample, especially Cd. The sample solution was put into a 50 mL volumetric flask and added with aquabidest to the boundary markers and homogenized. The solution obtained was then filtered using Whatmann No. filter paper. 41 ash free to obtain a solution that is free from impurities.

The standard solution used in this study is a standard Cd solution with a concentration of 0.1 ppm; 0.5 ppm; 1.0 ppm; 2.0 ppm and 5.0 ppm. The standard solution is made from 1000 ppm $Cd(NO_3)_2$ stock solutions. In making standard Cd solution 20 mL HCl 5 N is added so that the solution is acidic. This is done to prevent the formation of hydroxide from Cd metal when stored for a long time. Each Cd standard solution was analyzed using the Shimadzu Brand AA-7000 Atomic Absorption Spectrophotometer at λ = 228 nm. The analysis results obtained are in the form of absorbance of each solution. From the absorbance obtained, the relationship curve between absorbance and the concentration of the standard solution is made and the linear regression line equation is sought. The equation of the linear regression line from the calibration curve of the standard solution Cd is y = 0.0942x + 0.0143 with R^2 = 0.9998. The following is a graph of the Cd standard solution calibration curve (Figure 2).

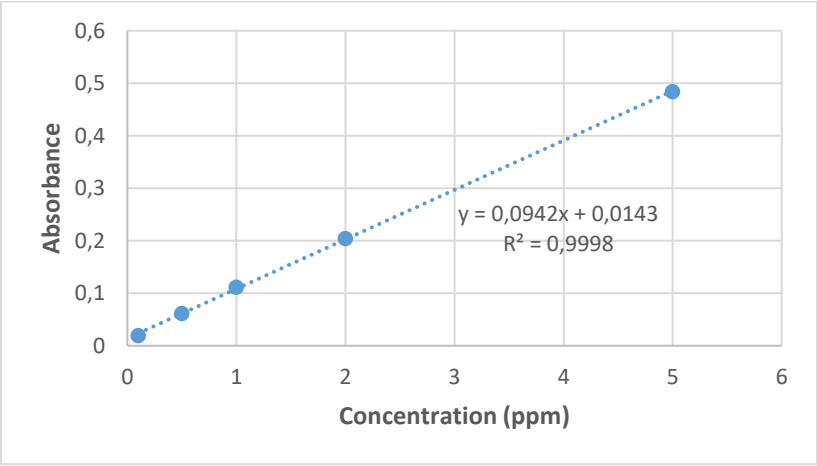

Figure 2. Cd Standard Solution Calibration Curve

The Cd standard solution calibration curve is used to calculate the concentration of Cd metal in the asphalt sample solution. The sample solution was also analyzed using the Shimadzu Brand AA-7000 Atomic Absorption Spectrophotometer at λ = 228 nm. Analysis of the sample solution is done in duplicate. The results of the analysis are absorbance of the sample solution. The absorbance is related to the linear regression equation to calculate the concentration of Cd in the sample solution. The absorbance of sample solution and the concentration of Cd in the calculated sample solution are shown in the Table 1.

In Table 1 we can see that the concentration of Cd metal at each sampling location is below the specified quality standards in SNI No 7387: 2009 which is equal to 0.1 mg / kg. In Table 1, we can also find out that the concentration of Cd from Station 1 to Station 5 is getting smaller. This shows that the farther the location of milkfish sampling stations from industrial areas, the smaller the level of Cd metal pollution to milkfish samples. Even though the level of Cd metal pollution is below SNI No. 7387: 2009, such pollution should remain a concern, because milkfish contaminated by Cd can be consumed by humans. In the human body, the Cd metal can accumulate over a long period of time, so that it can endanger human health.

Table 1. Absorbance and Concentration of Cd Metals in Sample Solutions

Sample Location	Absorbance of Samples Solution	Cd Metal Concentration (mg/Kg)	Average Cd Metal Concentration (mg/Kg)
Station 1	0,0150	0,0369	0,0423
	0,0152	0,0477	
Station 2	0,0148	0,0263	0,0236
	0,0147	0,0209	
Station 3	0,0145	0,0105	0,0080
	0,0144	0,0055	
Station 4	-0,0135	0,0000	0,0000
	-0,0131	0,0000	
Station 5	-0,0120	0,0000	0,0000
	-0,0127	0,0000	

CONCLUSION

Samples of milkfish obtained from ponds around the Port of Tanjung Mas are contaminated by Cd metal, although they are still below the quality standard stipulated by SNI No. 7387: 2009. The farther the milkfish pond station is from the industrial area, the smaller the level of Cd metal pollution to milkfish.

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