PROCEEDING
The 2nd International Seminar on Chemical Education 2017
September, 12-13th 2017

Determination of Lead Metal (Pb) in Indonesian Kangkung (*Ipomoea Aquatica*) by Atomic Absorption Spectrophotometer (AAS)

Ragil Farhandimas Rizki[1,*], Tri Esti Purbaningtias[2], Muhaimin[3]

[1]Student Chemistry Analyst Department, Islamic University of Indonesia
Gedung Laboratorium Terpadu, Kampus Terpadu UII, Jl. Kaliurang Km 14, Sleman, Yogyakarta,
*email: Farhandimas49@yahoo.com
[2]Chemical Analyst Department, Islamic University of Indonesia
[3]Cemistry Education Department, Islamic University of Indonesia

Abstract

This study aimed to determine the effect of water condition towards Indonesian kangkung (*Ipomoea Aquatica*) quality. Indonesian Kangkung ((*Ipomoea Aquatica*), is a vegetable that is widely consumed by the public and this vegetable is a good source of vitamin A which is very good. The Pb content was analyzed in water and all part of Indonesian kangkung (*Ipomoea Aquatica*),. The sampling of Indonesisan kangkung (*Ipomoea Aquatica*), and water had been done with random sampling method. Determination of the content of Pb were analyzed using Atomic Absorption Spectrophotometer (AAS) and calibration method. Based on the results of research conducted, leaf 0.0039 mg/gram, root 0.000284 mg/gram, stem 0.00057 mg/gram and water 0.0198 mg/gram. Based on the result, it can be concluded that the Pb content in kangkung affected by water condition.

Keywords: Lead (Pb), Indonesian Kangkung (*Ipomoea Aquatica*), AAS

Introduction

Vegetables are source of food that contains many vitamins and minerals that are useful in public health, one of them is kangkung. Kangkung is a type of vegetables that are often consumed by the community and this vegetable is a good source of vitamin A. Kangkung is a vegetable that is easily grown in aquatic or near the river, and watered with river water. However, many vegetables circulating in the community are not guaranteed to be safe because they are suspected to have been contaminated by heavy metals such as lead metals, especially crops planted in areas polluted by factory waste or air pollution caused by vehicles. Lead Pb involves belonging to a toxic metal group, which is harmful to the life of a living being. The toxicity of Pb in children during childhood and ongoing causes neurotostics (nervous toxicity) and behavioral abnormalities (Katipana, 2015). High concentrations of heavy metals can also lead to the death of fish species in the tangled river (Palar, 2004). According to Darmono (2001),

states that the toxicity of metals in humans cause some negative effects, but the main thing is the emergence of detoxification and excretion tissue damage (liver and kidney) (Katipana, 2015). Some metals have carcinogenic properties (cancerous formation) as well as teratogenic (misformed organs). Along with the increasing activity in various development sectors, especially in the industrial sector, the problem of environmental pollution is increasingly becoming a very critical issue for developed countries and developing countries. One of the heavy metals that pollute is lead (Pb). Environmental contamination by factory waste containing Pb causes plants growing in the area to be contaminated with Pb waste. Apparently kangkung is a plant that easily absorbs heavy metals such as Pb, whereas kangkung is widely consumed and often found growing in empty lands. It turns out that kangkung plants grown or planted in polluted areas of Pb can absorb Pb and are brought to all parts of the plant.

Materials and Method

The material used in this research was kangkung which was obtained in Sleman, Yogyakarta. The chemicals used are 2.5 N Nitric Acid, Distilled water and Whatman 42 Filter Paper. The equipment used in this research was a set of glass tools, Atomic Absorption Spectrophotometer (AAS), furnace (Thermo Scientific Model No. FB1410M-33), Oven (UN 55), Hotplate (Thermo Scientific Model No. SP131320-33), vacum pump (Krsbow Model No. KW19-533), Analytical Balance (OHAUS item PA214).

Samples of water and kangkung were taken in Sleman, Yogyakarta by random sampling method that was taking water samples at some point randomly and inserted into 600 mL plastic bottle which aimed for metal in water not react with its container, kangkung sample was taken by picking the whole kangkung.

Analysis of Pb metal content in water was done by inserting water sample into beaker glass 50 mL 1.5 g then added HNO_3 2.5 N as much as 15 mL then heated to boiling and cooled. The sample solution was filtered using Whatman 42 filter paper with the help of a vacum pump. The filtrate was obtained, diluted as much as 50 mL with distilled water and analyzed using AAS.

Analysis of Pb metal content on stems, roots, and kangkung leaves were done by washing watercress then dried after it was cured at 80°C for 48 hours. The dried sample were mashed with a blender until it becomes a powder. The powder weight was 1.5 g and put into the furnace at 450 °C for 12 hours until it becomes ash. The sampled ash can be reduced by adding 15 mL of 2.5 N HNO_3 and heated to boiling. The cold sample was filtered using Whatman 42 filter paper with the help of vacum pump. The obtained filtrate was diluted until 50 mL with distilled water and analyzed using AAS with a method of curve of calibration with standard solution of 0; 0.5; 1; 2; 3; 5; and 10 ppm.

Result and Discussion

Result of research of heavy metal content (Pb) on kangkung plant (*Ipomoea Aquatica*). Parts of stems, leaves, roots and water in Sleman, Yogyakarta. Based on the result of the research, the result of heavy metal content of lead (Pb) in kangkung (*Ipomoea Aquatica*) and water can be seen in Table 1.

Table 1. The results of lead content (Pb) in Indonesian Kangkung (*Ipomoea Aquatica*) and their water

Sample	Mass* (g)	Absorbance	Lead (Pb)	
			mg/L	mg/Kg
Leaves	53.86	0.0378	4.2	3.9
Roots	96.81	0.0494	5.51	2.84
Stems	88.07	0.0093	1	0.57
Water	1.5	0.0057	0.59	19.8

*in fresh weight of sample

This result was obtained by interpreting absorbance of sample with the linier regression from calibration curve data from standard solution. The linierity obtained by linier regression equal to 0.9993, which means that linear derived (Figure 1).

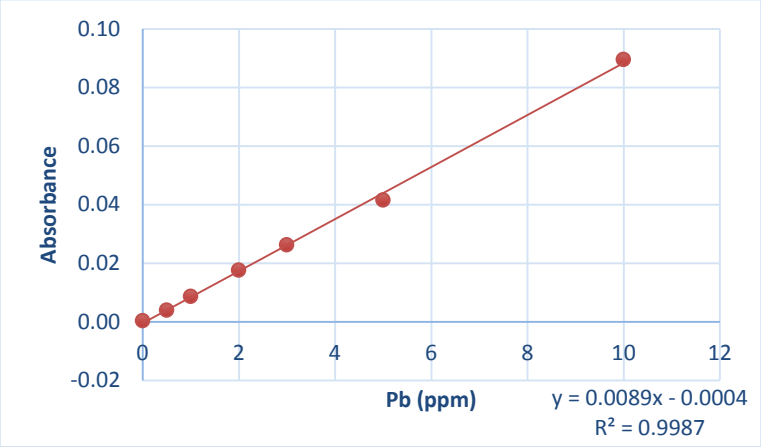

Fig. 1. Calibration Curve of Pb Standard Solution

From result of lead (Pb) heavy metal content on leaf, stem, roots and water in Sleman Yogyakarta, showed that heavy metal content of lead (Pb) found in water equal to 19.8 mg/Kg so it can be concluded that water which is source minerals of kangkung, contaminated by heavy metal lead (Pb) so that the plants around the waters can be polluted by heavy metal lead (Pb). Kangkung is a plant that easily absorbs heavy metals such as Pb and it turns out that kangkung plants grown or planted in polluted areas Pb can absorb Pb and brought to all parts of the plant (Kohar et al., 2004). This can be proved by the results of the research that has been done that there is a heavy metal content of lead (Pb) on the leaves of 3.9 mg/Kg, roots of 2.84 mg/Kg, stem by 0.57 mg/Kg.

Another possible mechanism by kangkung (*Ipomoeae Aquatica*) is tolerance. According to Fitter and Hay (1991), tolerance is a mechanism by which plants can develop metabolic systems that can function at potential toxic concentrations, possibly with enzyme molecules. Based on several studies, enzymes, cell walls, especially acid phosphatase, have been shown to be tolerant of toxic levels of much higher ions (Cu^{2+}, Zn^{2+}) in resistance than in normal plants. Root organs, stems and leaves are useful nutrients for the uptake, processing, transport and stockpiling of food substances (Katipana, 2015).

Plants are able to absorb the ions in the environment into the body through the cell membrane. The ions absorbed by the plant are essential ions and mineral salts needed to support their growth. In addition, plants can also absorb other ions in

their environment which are toxic to plants, as well as heavy metals. Pb ability of plants to absorb essential ions and mineral salts is explained by Fitter and Hay (1991) that soil nutrients move upwards from the roots in over the soil in tracheid elements (i.e. tracheids or vessel components) xylem.

In this research, heavy metal content of lead (Pb) in kangkung is in leaf part, it is caused by leaf sealain function for leaf photosynthesis process can also be a storage place for food. Therefore, heavy metal lead (Pb) which is absorbed by plants kangkung accumulated on the leaf.

In this study the roots contain heavy metal lead (Pb) of 2.84 mg/Kg becaused root has a very important function for the survival of a plant that has the task to strengthen the establishment of plants, absorb water and food substances to places in the body of plants in need, the absorption function is what causes the root is the organ that most accumulates heavy metals (Tjitrosoepomo, 2003).

In addition to the roots and leaves, the stem of the kangkung also contained heavy metal lead (Pb) of 0.57 mg/Kg it is because the stem is the road transporting water and food substances from the bottom up and road transporting assimilation results from top to bottom (Tjitrosoepomo, 2003). Thus, after absorption of ions which are first performed by the roots, the stem becomes the second organ passed by the ions to go to leaf. The ions are reduced in stems and leaves as some of these elements as well as Cu elements are needed by plants for metabolism.

Based on SNI 01-7387-2009 (Table 2), the maximum limit of heavy metal content (Pb) in food is 1.0 mg /Kg, then kangkung (*Ipomoea Aquatica*) in Sleman, Yogyakarta has exceeded the maximum limit. The content of Pb in water also exceeds the limits of government regulations stating that the limit of Pb in clean water is 0.05 mg/L (Permenkes 416/Menkes/Per/IX/1990 in Depkes, 2009), so it is necessary to verify the method to see the accuracy of the analysis results. The presence of heavy metal content (Pb) in water was caused by the presence of household waste and vehicle waste which can increase the heavy metal content of lead (Pb) in kangkung (*Ipomoea Aquatica*). To reduce heavy metal contamination of lead (Pb) on by way of reducing consumption of raw vegetables. Vegetables should be prepared by blanching process. In the process of blanching vegetables

Table 2. Maximum Limit of Lead contamination (Pb) In Food According to SNI No. 7387: 2009 (Badan Standarisasi Nasional, 2009)

No. Food Category	Food Category	Limit
08.0	Meat and meat products, including poultry meat and bushmeat	200.0 mg/Kg
13.0	Meat and bushmeat	152 mg/Kg
14.0	Food products for special nutritional purposes	150.0 mg/Kg
01.0	Beverages in cans	0.02 mg/Kg
02.0	Dairy products	0.1 mg/Kg
04.0	Fats, oils and oil emulsions	0.5 mg/Kg
05.0	Fruit and vegetables and their processed product	1.0 mg/Kg
06.0	Cotton candy/candy and chocolate	1.0 mg/Kg
07.0	Wheat flour	0.5 mg/Kg
08.0	Bacterial products	1.0 mg/Kg
09.0	Meat and their derived products	0.3 mg/Kg
11.0	Fish and their derived products	2.0 mg/Kg

given preliminary heating in boiling temperature which aimed to reduce heavy metal contamination attached to the surface of vegetables. The habit of consuming raw vegetables had a risk for health problems because of the possibility of metal contained in vegetables has not been reduced. In addition to filtering, washing in running water then steaming or boiling vegetables is another safe way to consume healthy vegetables (Munarso et al., 2005). Prevention of heavy metal accumulation can also be done by consuming lots of fiber.

Conclusion

Based on the results of research that has been done can be concluded that the Kangkung (*Ipomoea Aquatica*) and water in Sleman, Yogyakarta is reflected with heavy metals (Pb) with yield on the leaves, roots, stems and water respectively 3.9; 2.84; 0.57; and 19.8 mg/Kg.

References

Badan Standarisasi Nasional. (2009). Standar Nasional Indonesia (SNI). SNI 7387:2009. Batas maksimum cemaran logam berat dalam pangan. Dewan Standarisasi Indonesia: Jakarta.

Darmono. (2001). Lingkungan Hidup dan Pencemaran: Hubungan dengan Toksikologi Senyawa Logam Penerbit Universitas Islam Indonesia, Jakarta

Depkes. (1990). Peraturan Menteri Kesehatan RI No 416/Menkes/Per/IX/1990, Tentang Syarat-Syarat dan Pengawasan Kualitas Air. Departemen Kesehatan RI: Jakarta.

Fitter A.H. and Hay, R.K.M. (1991), Fisiologi Lingkungan Tanaman. Universitas Gajah Mada, Yogyakarta.

Katipana, D. D. (2015). Uji Kandungan Logam Berat Timbal (Pb) Pada Kangkung Air *(Ipomea aquatic F)* Di Kampus UNPATI Poka. Alumni Program Studi Pendidikan Biologi. UNPATI. Vol. 1 No.2.

Kohar I, Hardjo P.H, Jonatan M, and Agustanti O, (2014). Studi Kandungan Logam Pb Dalam Batang dan Daun Kangkung *(Ipomoea Reptans)* Yang Di Rebus Dengan Penambahan NaCl dan Asam Asetat. Fakultas Farmasi, Universitas Surabaya, Surabaya. Vol. 3 No. 8.

Munarso, J., Suismono, Murtiningsih, Misgyarta, R. Nurdjannah, Widaningrum, M. Hadipernata, L. Sukarno, Danuarsa, Wahyudiono. (2005). Identifikasi Kontaminan dan Perbaikan Mutu Sayuran. *Laporan Akhir Balai Besar Penelitian dan Pengembangan Pascapanen Pertanian*. Badan Penelitian dan Pengembangan Pertanian. Departemen Pertanian.

Tjitrosoepomo, G. (2003). Morfologi Tumbuhan. Gadja Mada University Press: Yogyakarta