SURABAYA INTERNATIONAL HEALTH CONFERENCE
"Empowering Community For Health Status Improvement"
Novotel Samator East Surabaya Hotel, July, 13-14 2019

Determination of Lead Level (Pb) in Garage Worker's Hair Using Atomic Absorption Spectroscopy (AAS)

D.D. Wulandari [1], A.M. Putri [2], Handayani [3]

[1] Health Faculty, Nahdlatul Ulama Surabaya University, Jl. Jemursari 51-57 Surabaya
[2] Medicine Faculty, Nahdlatul Ulama Surabaya University, Jl. Jemursari 51-57 Surabaya

Abstract: Pb is a heavy metal produced from the combustion of fuels that does not decompose or burn completely. Heavy metals in the human body usually accumulate in several organs such as kidneys, liver, nails, adipose tissue, and hair. This study aims to determine the level of lead and find out the use of masks in workshop workers in the Sidoarjo area. This research was conducted on garage workers in the Sidoarjo region with the number of respondents 27 people using hair samples and measuring Pb levels using the Atomic Absorption Spectrophotometer (AAS) method with supporting data in the form of questionnaires. Based on the results of research obtained on garage workers who did not use masks, the average yield of lead (Pb) of 46.9 µg / g and the garage workers using masks obtained a mean lead level (Pb) of 34.3 µg / g. Based on statistical analysis, the results showed that there were no significant differences in Pb levels between respondents who used masks and respondents who did not use masks. The conclusion obtained from the results of this study is that there were no statistically significant differences in Pb levels between respondents who used masks and respondents who did not use masks in garage workers in the Sidoarjo region.

1. Introduction

Lead (Pb) included in group IVA heavy metals in the Periodic System of Chemical Elements, has an atomic number 82 with atomic weight of 207,2, in solid form at room temperature, melting point 327.4 °C and has a specific gravity of 11.4 /l. Pb atom rarely found in nature but in form compounds with other molecules, for example in the form of PbBr2 and PbCl2 (Gusnita, 2012). Lead (Pb) is a heavy metal can find in two forms, namely inorganic and organic. Organic Pb compounds such as Pb-tetraethyl and tetramethyl Pb are widely used as additives in gasoline fuel. Pb is generally known as lead, commonly used as a mixture of gasoline fuel. Its function, in addition to increasing lubrication power, also increases combustion efficiency. So that the performance of motorized vehicles increases. This chemical with gasoline is burned in the engine. The remaining ± 70% comes out with exhaust emissions from combustion results and lead which is wasted through the exhaust is one of the air pollutants (Witjahjo., Putri 2010).

Motorized vehicles as products technology in its operations requires fuel oil. Black or tin lead, also known as name Plumbum (Pb) is one of the pollutants main generated by burning activity of vehicle fuel oil motorized. The effects of lead (Pb) damage various human organs, especially the nervous system, blood, kidney, system formation system heart, and reproductive system. Lead also can cause high blood pressure and anemia. Negative impact from lead is that of lead contamination in the air according to research is potential cause for improvement accumulation of inner lead content blood. Accumulation of lead in blood relatively high will cause digestive tract syndrome, consciousness, anemia, kidney damage, hypertension, neuromuscular, and consequences pathophysiological and central nerve damage and behavior change (Ardillah, 2016).

Heavy metals in the human body usually accumulate in several organs such as kidneys, liver, nails, adipose tissue, and hair. Analysis of heavy metals in blood or urine is not accurate. Heavy metals that are in the blood or urine cannot last long and can be released immediately through the body's metabolic cycle while analysis of heavy metals through hair is more accurate. This is because heavy metals last longer in the hair. The amount of metal in the hair correlates with the amount of metal absorbed by the body. Therefore, hair can be used as a material biopsy (Gusnita, 2010).

2. Methode

a) Research Instruments

The research instrument is a tool used to collect useful data or information to answer research problems. Instrument as a tool at the time of research using a method. Instrumentation used in this research is Atomic Absorption Spectrophotometer (SSA), analytical scales, porcelain plate, desiccator, oven, measuring cup, volume pipette, komagome pipette, goblet, erlenmeyer, electric timer, funnel, spatula, stirring rod, glass bottle closed, mortar and pestle.

b) Sample Preparation

a. Sample preparation cut hair segments ± 5 to 10 mm long and weigh 10 mg. Weigh the hair sample and wash it with deionized water then add 20 ml nitric acid and then heat it to white steam. Then add in
b. 100 ml volumetric flask and add distilled water until the boundary mark is filtered if there is a sediment. After that homogeneous and ready to be read on SSA
c. Preparation of Calibration Curves Manufacture of 1000 ppm Pb mains. Considering very carefully Pb(NO_3) then diluted with HNO31 M in a 1 L volumetric flask to the boundary mark. Then the multilevel dilution is done so that the standard is obtained with a concentration of 0, 0.2, 0.4, 0.6, 0.8, 1 ppm.

c) Determination of Pb

This analysis uses SSA with Pb cathode lamp and wavelength of 283.3 nm. Then set the tool using a blank solution. Measure absorbance of Pb standard solutions from low to high concentrations. Callibration curves are made by plotting concentration as absis and absorbance as ordinat.

3. Result

The results of determination heavy metal lead (Pb) in hair samples of garage workers in the Sidoarjo area, East Java are as follows:

No	Sample Code	Lead level (mg/kg) before treatment	Lead level (mg/kg) after treatment
1	1A	96.92	95.48
2	2A	≤0.023	≤0.023
3	3A	50.38	23.67
4	4A	27.18	≤0.023
5	5A	46.85	10.96
6	6A	64.62	≤0.023
7	7A	29.30	54.95
8	8A	60.17	98.75
9	9A	46.38	25.27
	Average	46.9	34.3

Based on statistical analysis, the significant value of 0.789 results obtained <0.05 so that it can be concluded that the data has no significantly different on lead levels (Pb).

4. Discussion

Lead (Pb) is one of the air pollutants sourced from motor vehicle exhaust. This metal is the remnants of combustion that occurs between the fuel and the vehicle engine. Through vehicle gasoline exhaust, Pb is released into the air and some of it will form particulates in free air with other elements.

Exposure to lead (Pb) can come from food, drinks, air, the general environment, and the polluted work environment Pb. Non occupational exposure is usually through ingestion of food and beverages contaminated with Pb. Exposure through the respiratory tract and channel of refining mainly by Pb carbonate and Pb sulfate. Black lead and its compounds enter the human body through the respiratory tract and digestive tract, while absorption through the skin is so small that it can be ignored. The danger caused by air depends on the size of the particles. Particles smaller than 10 mg can be held in

the lungs, and larger particles settle in the upper respiratory tract (Hartini, 2010). One type of pollutant that can endanger human health is heavy metal, which will accumulate in certain body parts, such as kidneys, liver, nails, fatty tissue and hair.

The trace element is a chemical compound that the body needs for growth and development of the body in a small concentration and as an important mineral the body needs specifically in the amount of <1 mg / day (Santoso and Advisor 2009). In humans, trace elements can accumulate in the hair. The amount of trace elements in the hair correlates with the amount of trace elements absorbed by the body. Hair is a body part of living things that contain many structural proteins composed of amino cystine acids containing disulfide (-SS-) and cysteine bonds containing sulfihidril groups (-SH) which are capable of binding trace elements into the body (saeni 1997). Certain trace elements are also needed in the life process. For example in the process of metabolism for the growth and development of body cells. For example Co is needed for the formation of vitamin B12, Fe is needed for making hemoglobin and Zn functions in hydrogenase enzymes.

The sulfhidryl (-SH) and disulfide (-S-S-) groups in the hair are able to bind trace elements that enter the body and are bound inside the hair. Sulfide compounds are easily bound by trace elements, so if the trace element enters the body, the trace element will be bound by sulfide compounds in the hair (Pettrucci 1982).

Hair strands consist of horn substances containing keratin protein. This substance can also be on nails, fur, and horns of mammals. The function of the hair is to protect the influence of heat and cold. In hot areas, soft and thin feathers protect sunburn, while in cold areas thick fur can withstand body heat. The amount of trace elements in the hair correlates with the amount of trace elements absorbed by the body. Therefore hair can be used as a biopsy material. The study of methylmercury compounds shows that the amount of these compounds in hair is related to methylmercury in the area around the hair that grows (Saeni, 1997).

As explained earlier, exposure to pollutants produced by motorized vehicles includes benzene, carbon monoxide, nitrogen, sulfur and lead. Each pollutant has an effect on the health of workers exposed to one of them to the blood profile, namely hemoglobin. Some pollutants have an effect on the bone marrow where the bone marrow is a place for blood synthesis (World Health Organization, 2016).

About 90% of lead absorbed by blood binds to red blood cells (Palar, 2008). According to WHO the limits of blood lead levels below 10 µg / dL (ppm) are categorized as low, and above 25µg / dL are categorized as high (Marianti, 2013). Lead which is absorbed by the body binds to the active group of the ALAD enzyme (Amino Levulinic Acid dehydrase), where this enzyme functions in the synthesis of red blood cells.

Lead (Pb) can enter the human body through the digestive system (digestion) or through the respiratory system (inhalation). The process of entering Pb metal ions into the body can be through various ways and will accumulate in the organs of the body. Although the human body can excrete lead, it is not proportional to its absorption so that it can cause negative effects both acute and chronic. Pb metal ions in the blood are bound by erythrocytes that are sent to soft tissues (bone marrow, nervous system, kidneys, liver) and to hard tissues (bones, nails, hair, teeth). Air Pb in the respiratory tract ± 40% and in the digestive tract ± 5-10%, then Pb is distributed to the blood ± 95% and bound to red blood cells, the rest is bound by plasma. Some Pb are stored in soft tissue and excretory bones (bones, nails, hair, teeth) especially through the kidneys and digestive tract (Palar, 2012).

The level of lead pollution in hair samples is categorized by reference to the limits of blood lead levels issued by WHO. This categorization is done by referring to several research results which state a significant correlation between lead levels in blood and hair. The results of the study by Sanna et al (2007) which state that the levels of lead in blood and hair in children in the Italian Sardina region that were sampled statistically showed a significant correlation. This opinion is also supported by the results of research from Bergomi et al (1989) in Sassuolo (North Central Italy), Chlopicka et al (1898) in the provinces of Katowicw Silesia, and Esteban et al (1999) in Saratov Russian City.

Based on Table 5.2, the results of testing lead levels (Pb) in hair samples of workshop workers without using masks in the Sidoarjo Region, East Java have the highest lead (Pb) levels of 96.92 µg / g indicated that there are Pb in hair samples not all workers indicated lead (Pb). The lowest results in housewives as controls obtained results <0.023 µg / g which means that these workers have very little

Pb levels that can be read by atomic absorption spectrophotometers. The results of testing lead levels (Pb) in workshop workers using masks in the Sidoarjo area, East Java have the highest lead levels of 98.75 μg / g of workers indicated Pb in hair samples, in workshop workers who use masks many workers get normal results namely < 0.023 μg / g is not indicated by lead levels (Pb). This is due to the influence of years of work, personal protective equipment (PPE) and smoking habits on lead levels in respondents' hair samples.

In this study using wet destruction because in general wet destruction can be used to determine elements with low concentration. After the destruction process is expected, only metals are left in the form of ions. The solvents used in this method include nitric acid (HNO3). Cut hair segments ± 5 to 10 mm long and weigh 10 mg. Weigh the hair sample and wash it with deionized water then add 20ml nitric acid and then heat it to white steam. Then add in a 100ml volumetric flask and add distilled water until the boundary mark is filtered if there is a sediment. After that, it is homogeneous and ready to be read on the SSA.

Workshop workers in the Sidoarjo area showed lead levels in hair samples of <0.023-96.92 μg / g very high lead levels and indicated Pb, based on the results of this study found that there was the highest lead level in workshop workers without using a mask of 96.92 μg / g and the lowest is <0.023 μg / g. This can be caused by the influence of working period, personal protective equipment (PPE) and smoking habits on lead levels in respondents hair samples. From the normal value for lead levels in human hair at ≤ 12μg / g if more than the normal value determined can harm someone because at this level there is a possible negative effect on health in the form of hypertension, impaired kidney function, other effects that can occur in pregnant women causes a miscarriage in the fetus.

Lead levels in workshop workers without using masks in the Sidoarjo area, East Java are higher than workshop workers using masks from the average that have been obtained. The difference between the two Pb lead levels in the human hair sample is because workshop workers without using masks are more likely to breathe free air entering the body than with workshop workers using masks which are less likely to absorb Pb because they use personal protective equipment (PPE) in the form of masks so that their respiratory system will be slightly protected.

Furthermore, the ANOVA One Way test was carried out by performing normality tests first with abnormal results, and a homogeneity test which the results were obtained was not homogeneous. From the results of normality and homogenity, ANOVA One Way Test cannot be carried out, because the ANOVA Test data must be normal and homogeneous. Then the Kruskal-Wallis Test test was carried out. P = 0.789, which means that there is no effect of lead (Pb) on the sample of human hair.

Based on research that has been done with hair bioindicators that with a significant test and linear regression there is a positive correlation between the length of work with lead content in the hair of workers, especially gas station workers (Subagiada, 2011). The results of statistical tests that have been done with the kruskal wallis test on workshop workers without using masks with workshop workers using masks have a significant value of p = 0.789 which means there is no influence on lead levels (Pb) whereas according to the descriptive analysis there is influence between workshop workers without masks with workshop workers who use masks based on the results of figure 5.1 bar diagrams lead levels show the average results of workshop workers without using masks with a yield of 46.9 μg / g while in workshop workers using masks obtained an average of 34.3 μg / g.

REFERENCE

[1] Anwar, R, W. 2012. *Studi Pengaruh Suhu Dan Jenis Bahan Pangan Terhadap Stabilitas Minyak KelapaSelama Proses Penggorengan*. *Skripsi*, SI Undergraduate, Universitas Hasanuddin.

[2] Asri S, Indri S, Anda I,J. 2014, *Analisa Pengaruh Penggunaan Alat Pelindung Diri (APD) Terhadap Allowance Proses Kerja Pemotongan Kayu*,J@TI Undip, Vol IX, No3.

[3] Betty N. 2010, *Analisis Kadar Timbal (Pb) Pada Makanan Jajanan Berdasarkan Lama Waktu Pajanan Yang Dijual Di Pinggir Jalan Pasar I Padang Bulan Medan Tahun 2009*, Skripsi, Fakultas Kesehatan Masyarakat, Universitas Sumatera Utara, Medan

[4] Cotsarelis G. 2008, Botchkarev V. *Biology of hair follicles*. In: Wolff K, Goldsmith LA, Katz SI, Gilchrest BA, Paller AS, Leffell DJ, editors. Fitzpatrick's

[5] Cheremisinoff, N.P. 2002. *Handbook of Water and Wastewater Treatment Technologies.*USA: Butterworth-Heinemann.
[6] Darmono. 2001. *Lingkungan Hidup dan Pencemaran Hubungannya dengan Toksikologi Senyawa Logam*. UI Press, Jakarta.
[7] Dessy G. 2010. *Pencemaran Logam Berat Timbal (Pb) di Udara dan Upaya Penghapusan Bensin Tertimbal*, Peneliti Bidang Komposisi Atmosfer, LAPAN, Bandung.
[8] Dewi. 2011. *Analisis Cemaran Logam Timbal (Pb), Tembaga (Cu), dan Kadmium (Cd) Dalam Tepung Gandum Secara Spektrofotometri Serapan Atom.* Skripsi. Jakarta: FMIPA Program Studi Farmasi Universitas Indonesia
[9] Devi N,S. 2001. *Digitized by USU digital library.*
[10] Effendi H. 2003. *Telaah Kualitas Air Bagi Pengelolaan Sumberdaya dan Lingkungan Perairan. Kanisius,* Yogyakarta. Funjaya Y. 2004. Fisiologi Ikan. Jakarta : Rineka Cipta.
[11] Ghalib M. 2002. Pengaruh Logam Berat Timbal (Pb) Terhadap Konsumsi Oksigen Juvenil Ikan Bandeng. *Jurnal Science and TechnologyVol 3 No 3 Desember 2002.*
[12] Hutagalung, H.P, Razak H. 1989. Pengamatan Kadar Pb dan Cd dalam Air dan Biota di Estuaria Muara Angke. *Majalah Oseanologi di Indonesia. Volume 15: 1-10. Lembaga Oseanologi Indonesia. LIPI. Jakarta*.
[13] Ilham N. 2013, Faktor-faktor yang berhubungan dengan perilaku pekerja dalam penggunaan Alat Pelindung Diri (APD) Pada Industri Pengelasan Informal Di Tangerang. 2013. *Skripsi*, Univeristas Islam Negeri.
[14] Jonarson, S. 2004. Analisa Kadar Asam Lemak Minyak Goreng Yang Digunakan Penjual Makanan Jajanan Gorengan Di Padang Bulan Medan Tahun 2004. *Skripsi* SI Undergraduate, Universitas Sumatera Utara.
[15] Kementrian Dinas Kesehatan. 2011. *Keamanan Makanan Jajanan*, Pustekkom Kemdiknas.
[16] Khopkar, S.M. 1990. *Konsep Dasar Kimia Analitik*. Jakarta : UI Press
[17] RB Bambang W., Minartika P. 2010. Effect Of Lead (Pb) at Highway's Air On Lung's Microscopic Appearance And Lead (Pb) Blood Level Of Male Balb/C Mice. *Skripsi*, Semarang.
[18] Morais, S., e Costa, F. G., de Lourdes Pereira, M. 2012. *Heavy Metals And Human Health*. INTECH Open Access Publisher.
[19] Palmer RF, *Blanchard S, Stein Z. – Environmental Mercury Release, Special Education rates,and autism disorder: an ecological study of Texas. Health Place.*2006;12:203-209
[20] Priskilla. 2012. Definisi Rambut Manusia, *Serviens In Lumine Veritatis*.
[21] Skoog, D.A. 2000. *Principles of Instrumental Analysis.* USA : CSB College Publishing
[22] Schlake T. 2007. *Determination of hair structure and shape*. Semin Cell Develop Biology ; 18: 267–273.
[23] Vogt A, McElwee KJ, 2008. Blume-Peytavi U. *Biology of the hair follicle*. In: Blume Peytavi U, Tosti A, Whiting DA, Trueb R, editors. *Hair growth and disorders*. Berlin: Springer; p. 1–19.
[24] Widowati, W., Sastiono. A., Jusuf. R. 2008. *Efek Toksik Logam Pencegahan dan Penanggulangan Pencemaran.*Yogyakarta: Penerbit Andi
[25] Widaningrum, M.S. 2007. Bahaya Kontaminasi Logam Berat dalam Sayuran dan Alternatif Pencegahan Cemarannya. Balai Besar Penelitian dan Pengembangan Pascapanen Pertanian. Buletin Teknologi Pascapanen Pertanian, 3: hal. 16–27.