ANALYSIS OF LEVELS OF HEAVY METAL (Pb) IN HAIR OF EMPLOYEES OF PT. X ANGSANA TANAH BUMBU ATOM ABSORPTION SPECTROPHOTOMETER (AAS)

I Putu Indra Sagita[1*], Rahmadani[2], Faisal Rahman[3]

[1,2]Bachelor of Pharmacy Study Program, Faculty of Health
[3]English Undergraduate Study Programs, Faculty of Humanities, Sari Mulia University, Banjarmasin,
**E-mail: pgvariasi628@gmail.com*

Abstract

Background : Lead (Pb) or lubricant is a heavy metal that can cause toxicity in the human body. Lead pollution is caused by many factors, one of which is the use of fuel or exhaust gas from heavy equipment vehicles. The process of entering lead in the body can be through the air and penetrates the skin.
Objectives : To identify the element of lead in the employee's body and to determine the effect of different types of employees at PT. X Angsana Tanah Bumbu on lead levels in the body.
Methods : The research design used was observational analytic with a cross sectional design. Population and sample are employees of PT. X Angsana Tanah Bumbu, totaling 16 people, were taken using purposive sampling technique. Data were analyzed using Independent sample t-test with 95% confidence level.
Result : The minimum level of lead heavy metal is 17.954 mg/kg and the maximum lead content is 67.114 mg/kg. Based on the results of the analysis using the Independent sample t-test, it was obtained that the significance value = 0.022 (Ha <0.05) there was an effect of the type of employee on the lead (Pb) level in the hair of PT. X Angsana Tanah Bumbu.
Conclusion : Differences in lead levels in employees of PT. X Angsana Tanah Bumbu is caused by field employees being exposed to lead caused by exhaust gas from heavy equipment vehicles, while in offices they are not exposed to heavy equipment exhaust gases but from hair coloring.
Keywords : Hair, Field employees, Offices, Lead (Pb).

Introduction

The very rapid increase in mining in all fields can cause two impacts, namely positive impacts and negative impacts. The positive impact of mining from the economic sector is an increase in employment and infrastructure. While the negative impacts caused by the increase in coal mining are: environmental pollution. The pollution is in the form of water pollution, soil pollution and air pollution. This pollution can cause various diseases such as respiratory diseases, cancer and other diseases, and even cause death rates (Ismail, 2007).

Pollution is a condition that has changed from the original form to a worse state. Shifting the shape of the arrangement from the original condition to this poor condition can occur due to the entry of polluting materials or pollutants. Pollutants have toxic properties that can harm living organisms. Toxicity or the toxicity of pollutants is what then triggers the occurrence of pollution. Air pollution is caused by various activities originating from vehicles (transportation), factory exhaust gases, power plants, and cigarette smoke which are closely related to the activities of human life (Darmono, 2009).

The effects caused by lead (Pb) that are quickly seen after exposure are stinging in the eyes, burning sensation in the throat, coughing and blurred vision. The process of absorption of lead (Pb) in the body can be carried out in two ways, namely through the air (breathing) and through the entry of food and drinks that have been exposed to lead (Pb) through the mouth. Exposure to lead (Pb) that enters the body will be absorbed and some will be excreted. The absorbed lead will be transported by the blood throughout the body with a percentage of 95% absorbed bound by erythrocytes which will then be distributed throughout the body in soft and hard tissues. Lead is excreted through urine, faeces, and sweat. According to Palar (2012), one of the heavy metals that pollutes the air is lead (Pb) which is produced from exhaust gas emissions produced by various human activities.

Based on research conducted by Permatasari (2012) regarding the study of levels lead (Pb) is not normal. The data stated that public transport drivers aged 36-50 years showed the highest percentage of 40% of lead (Pb) levels in their urine. According to research by Samsuar dkk (2017), the results showed that there was lead contamination in the hair of workers (0.258 ppm to 4.813 ppm). On the gills of carp there are (0.11636 to 0.15878 ppm) while in the flesh (0.059 to 0.1160 ppm). According to WHO, the limit of lead levels in the body, which is below 10 g/dl (ppm) is categorized as low and above 25 g/dl is categorized as high. Based on a preliminary study conducted by I Putu Indra Sagita on November 30, 2020, the employees of PT. X Angsana Tanah Bumbu has a work schedule every day and the number of employees is 16 people, samples taken from the age of 30-40 years with 5-8 years of work. The element used to identify lead (Pb) in employees of PT. X Angsana ground spice is hair. Because as described above lead will be distributed into hard tissues such as bones, teeth and hair. Then the instrument,,, analysis, which can be used to identify lead in hair is an atomic absorption spectrophotometer (AAS) with several advantages, including the number of samples used is relatively small, easy and simple. its operation.

Based on the description of the preliminary study above, the researcher was compelled to investigate the heavy metals in hair with the proposal title "Analysis of Heavy Metal (Pb) Levels in Hair of Employees of PT. X Angsana Tanah Bumbu by Atomic Absorption Spectrophotometer (AAS)".

Materials and Methods

The tools used in this study were hair clippers, combs, plastic clips, label paper, filter paper, Erlenmeyer 100 ml, 250 ml beaker glass, test tubes, spatula, stir bar, dropper pipette, analytical balance, oven, hot plate and spectrophotometer. atomic absorption (AAS).

The materials used in this study were hair from 6 participants, acetone, acetone pro-analyse, nitric acid (HNO_3), sulfuric acid (H2SO4), percholic acid (HClO4), potassium iodide (KI), sodium hydroxide (NaOH) and hydrochloric acid. (HCl) .

Sampling technique

Hair segments are cut from the base of the hair (roots) with a length of 0.5-1 cm as much as 2 mg (Suharjo, 2015). The sample was then washed clean. The sample was dried and then put into a plastic clip.

Destruction

The samples were destroyed using wet digestion (Marties et al, 2018). The sample was weighed as much as 2 mg. The sample was put in a 250 ml glass beaker then added a solution of HClO4: HNO_3 in a ratio of 1:5. The hair sample was destroyed using a hotplate at a temperature of 100°C until a clear liquid was formed with the appearance of white smoke. The resulting sample was filtered using whatman paper number 42. The filtered sample was diluted in a 50 ml volumetric flask with distilled water to the limit mark.

Lead Qualitative Test

Prepare 6 test tubes that have been added to 1 ml of the destroyed sample. 6 test tubes containing 1 ml of sample were added 2-3 drops of KI reagent if the formation of a yellow precipitate indicated a positive sample containing lead (Pb). 6 test tubes containing 1 ml of sample were added 2-3 drops of NaOH reagent if the formation of white color indicates a positive sample containing lead (Pb). 6 test tubes containing 1 ml of sample were added 2-3 drops of HCl reagent if the formation of a white color indicates a positive sample containing lead (Pb). Observe the reaction that occurs in the sample.

Lead Level Test Using Atomic Absorption Spectrophotometer (AAS)

Hair preparations that had been weighed 2 mg were analyzed using AAS with a Pb cathode lamp at a wavelength of 283.3 nm. Because at that wavelength the maximum absorption process occurs so that the detected lead Pb levels are more perfect. Then set the tool to zero using a blank solution, measure the absorbance of the Pb standard solution from low concentration to high concentration. Pb metal content was obtained in the sample

Results

Table 1. Basic standard curve absorbantion

Concentration	Absorbantion
0,000	0,0000
0,0200	-0,0004
0,1000	0,0057
0,2500	0,0150
0,5000	0,0319
1,2500	0,0806

The results of measuring lead standard solutions with various concentrations will produce absorbance then the results of the absorbance will be used to create a calibration curve, as shown in the figure below:

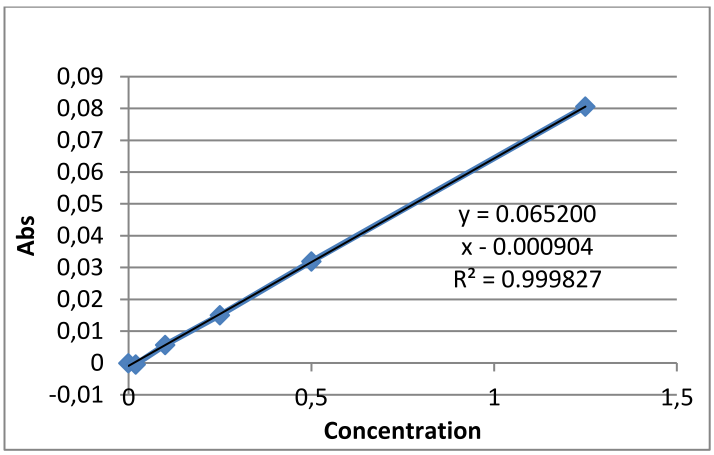

Figure 4.1 curve of concentration and absorbance standard solution of lead (Pb)

Based on the results of the calibration curve above, the value of r (correlation coefficient) is 0.9998 with a linear regression equation for a standard solution of lead, namely:

Y = 0.065200 X = - 0.00094

Where :

Y = Absorbance / absorption

X = Concentration

A = Slope

B = Intercept

Table 2. Results of Concentration (Pb) Test Using Atomic Absorption Spectrophotometer

No	Masa	Abs	Conc	Level Mg/kg	Average (Mg/l)
A1	0,0259	-0,0003	0,0407	17,953	SSA
A2	0,0170	-0,0002	0,0476	31,765	
A3	0,0226	-0,0002	0,0373	23,894	
B1	0,0142	-0,0001	0,3797	43,310	
B2.	0,0150	0,0001	0,3868	51,333	
B3	0,0149	0,0004	0,0300	67,114	

From the test results using six standard series solutions and listed in table 4.5 the linear regression equation is obtained as follows: y = 0.062500 x -0.00090412 So that the correlation coefficient (r) is 0.999827. While the value of a good correlation coefficient must be close to 1 with a sign of the formation of a straight line on the standard solution curve of lead (Pb). The value of r obtained has met the requirements set by the provision of the value of the correlation coefficient ($r > 0.98$) which indicates that the Atomic Absorption Spectrophotometer (AAS) is in good condition.

Discussion

The study entitled analysis of lead (Pb) heavy metal levels in the hair of PT. X Angsana Tanah Bumbu using atomic absorption spectrophotometer (AAS). The research was carried out through several research stages from the beginning such as sample selection, destruction, qualitative tests, making standard standard curves, to quantitative tests using atomic absorption spectrophotometers on hair of employees of PT. X Angsana Tanah Bumbu.

In this study, the sample (hair) used must be a solution so that the sample will be destroyed. The function of destruction is to break the bonds between organic compounds and the compounds to be analyzed (Palar, 2012). The digestion method used is the wet digestion method which is generally used for the identification of heavy metals that are not heat-resistant and have low concentrations (Marties dkk., 2018).

The solution used in the destruction process is a solution of nitric acid combined with percolic acid in a ratio of 1: 5 as a mixture of acids used for destruction.

Nitric acid is the main oxidizing agent used in the destruction process because of its strong acidic nature so that it can dissolve lead (Pb) heavy metal. During the oxidation process, a brown gas will be generated which indicates that the organic substances in the sample have been oxidized. This is in accordance with the statement of Wulandari and Sukesi (2013), namely the emergence of brownish smoke means that HNO3 has oxidized organic compounds. The addition of HC1O4 functions as an oxidizing agent which will help maximize the HNO3 decomposition of the organic matrix found in the hair. The following is a reaction that occurs when the oxidizing solution is added: 3Pb + 8HNO3→ 3Pb2++ 6NO3- + 2NO (↑) + 4H2O.

From the reaction results, inorganic minerals will be left behind and dissolved in strong acids. Minerals are in the form of metal cations and chemical bonds with organic compounds have been broken down (Dewi, 2012).

Qualitative Test

Based on the qualitative test conducted using 3 types of color reagents, namely KI, NaOH, and HCl. In the sample test using KI, the results are listed in table 4.2. In the table it can be seen that all samples showed positive results, but the sample test with NaOH and HCl reagents showed negative results, because the heavy metal lead (Pb) was small so that it showed negative results. Another possibility is that due to the destruction process, the lead heavy metal contained in the sample is not completely entangled, causing the lead content in the sample to not be identified using color reagents.

On the addition of the KI reagent in Table 4.2 a yellow precipitate was formed which indicated a positive sample containing lead (Pb) with the resulting reaction: Pb2+(aq) + 2KI → PbI2 (↓) + 2 K.

The qualitative test of lead heavy metal using NaOH which can be seen in table 4.4 forms a white precipitate if the positive sample contains heavy metal lead (Pb) with the reaction: Pb2+(aq) + 2OH-(aq)→ PbOH2 (↓).

Qualitative test of lead heavy metal using HCL which can be seen in table 4.3 a white precipitate is formed if the positive sample contains lead heavy metal (Pb) with the reaction: Pb2+(aq) + 2Cl-(aq) → PbCl2 (↓).

Based on the results obtained in table 4.4 for HCL and table 4.5 for NaOH, it can be seen that after adding reagents to the sample, no reaction changes such as the occurrence of a white precipitate were found. Based on research conducted by Marties et al (2018). Samples added using KI reagent will experience a positive reaction while samples added using HCl and NaOH reagents will experience a negative reaction. The factor causing negative reactions in all samples added with HCl and NaOH reagents was the lack of sensitivity of the solution to lead metal compared to the sensitivity of KI reagent to lead. The sensitivity is influenced by the nature of lead chloride which is slightly soluble in water so that lead does not settle completely when hydrochloric acid is added.

Quantitative Test

Analysis of lead (Pb) levels using a quantitative test, the first step is to make a standard standard curve. This step serves to determine the relationship between the concentration of the solution and its absorbance, so that the concentration of the sample can be known. From the test results using five standard series solutions and listed in table 4.5 the linear regression equation is obtained as follows: y = 0.062500 x -0.00090412 So that the correlation coefficient (r) is 0.999827. While the value of a good correlation coefficient must be close to 1 with a sign of the formation of a straight line on the standard solution curve of lead (Pb), in accordance with Lambert-Beet law, namely y = a + bx, where y is the absorbance, a slope (the point where the curve intersects the y-axis), x is the concentration and b is the intercept (slope of the linear curve). The value of r obtained has met the requirements set by the provision of the value of the correlation coefficient ($r > 0.98$) which indicates that the Atomic Absorption Spectrophotometer (AAS) is in good condition.

Quantitative test to measure the levels of lead (Pb) in hair that has been destroyed, hair samples were analyzed using Atomic Absorption Spectrophotometer (AAS) using a wavelength of 283.3 nm on 6 participants who were divided into 2 groups based on the type of employee. The results of the quantitative analysis showed the presence of heavy metal lead (Pb) in all samples in both occupational groups as shown in table 4.6.

In this study, the results of the analysis of heavy metal levels of lead (Pb) with the type of office employees showed that the levels of heavy metal lead (Pb) in their hair were higher than the levels of lead (Pb) found in field employees as shown in table 4.6. This happens because employees who work in the office section compared to field employees have a higher risk of being exposed to lead (Pb). This is because the types of office employees in sample B3 do hair coloring so that the amount of Pb levels is higher (Dewi, 2012). The use of gasoline fuel has a risk of lead pollutant because gasoline has a mixture of lead heavy metals, namely tetramethyl-Pb and tetraethyl-Pb which aims to increase lubrication and increase combustion efficiency. After combustion, lead will come out along with 70% exhaust emissions (Palar, 2012).

Research conducted by Linda et al. (2015) illustrates that the longer people work in an environment that is potentially polluted by heavy metal lead (Pb), the potential for $Pb2+$ ion levels in the blood, hair and other parts is also greater. In the group of office workers, the highest lead (Pb) levels were found in sample B3 of 67.114 mg/kg and the lowest levels of lead (Pb) were found in sample B1 with levels of 43.310 mg/kg. The difference in lead heavy metal levels in the employees was caused by several factors, where participant B3 had a place to live near the highway and before becoming an employee at PT X Angsana Tanah Bumbu, participant B3 worked as a hair salon handyman while sample B1 had a sufficient place to live. away from the highway. This is in accordance with studies that have been conducted on residents who live near major highways in California, showing the average blood PB level of about 22.7 g/100 ml in men and 16.7 g/100 ml in women. This number is greater than the population who live far from the highway.

The concentration of lead (Pb) in the blood of people living far from the highway is 16 g/100 ml in men and 9.5 g/100 ml in women (Palar, 2012). In the field employee group, the highest lead (Pb) levels were found in sample A2 of 31.765 mg/kg and the lowest levels of lead (Pb) were found in sample A1 with levels of 17.954 mg/kg. The results obtained average levels of lead (Pb) in the hair of employees in the first group (field) 24,537 mg/kg and for the second group with the type of employee (office) 53,919 mg/kg. There are several factors that cause a significant difference in these levels, one of the factors is in participant A2 before becoming a field employee at PT. X Angsana Tanah Bumbu, his previous job was a gasoline trader. The work is carried out on the side of the highway where the level of pollution on the highway can affect the level of lead levels, while in participant A1 the previous job was a rubber worker so that the level of lead exposure in his previous job was small.

Data analysis of lead levels in employee hair samples was processed using independent sample t-test to obtain a significance value. The results of the analysis obtained a value (*Sig 2-Tailed* = 0.022). Based on the hypothesis if the value of Ha <0.05, it can be concluded that there is an effect of different types of employees at PT. X Angsana Tanah Bumbu.

Conclusion

Based on the results of the analysis of heavy metal (Pb) levels in the hair of employees of PT. X Angsana Tanah Bumbu using Atomic Absorption Spectrophotometer (AAS) it can be concluded that from the 6 participants studied with different types of employees, the results of the presence of heavy metal elements of lead (Pb) in the hair of employees of PT. X Angsana Tanah Bumbu. Heavy metal levels of lead (Pb) in hair with two types of employees, namely field and office, obtained a minimum level of lead (Pb) 17.954 mg/kg and a maximum level of lead (Pb) 67.114 mg/kg.

The difference in lead (Pb) levels in the two types of employees of PT. X Angsana Tanah Bumbu, the type of employee group in the office has a higher lead content than the group of field employees. In this study, the SPSS analysis value was Sig (2-tailed) = 0.022. Based on the hypothesis if the value (Ha) <0.05, it means that there is an effect of different types of employees on lead levels in the hair of PT. X Angsana Tanah Bumbu this is due to the different sampling locations.

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