OVERVIEW OF BLOOD LEAD LEVELS

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OVERVIEW OF BLOOD LEAD LEVELS IN TRAFFIC OFFICERS ON JL. IR. H. JUANDA EAST BEKASI USING THE ICP-MS METHOD

Abstract

Introduction: The contribution of air pollution to vehicles that use fuel oil shows a contribution of 49% worldwide. About 70% of the lead contained in fuel by burning gasoline will be released into the air. This has an impact on increasingcarbon emissions and waste production that will pollute the city of Bekasi. Alkyl lead is used as a gasoline fuel mixture. Alkyl lead also functions as an anti-knock additive in fuel, namely to reduce the impact of engine work so as to reduce noise when combustion occurs in motorized vehicle engines. This source currently accounts for the most lead levels in the air. Lead can cause air pollution in two forms, namely gases and particulates. Lead is one of the main pollutants released when burning fuel oil in vehicles. Lead that enters the human body even in small amounts can be dangerous, because it accumulates in the body and eventually causes toxic effects on various organ functions. One of the people whocan experience lead poisoning from vehicle emissions on the highway is a traffic officer. Lead compounds can enter the human body through digestion, respiration, and skin. The mouth and respiratory tract are themost common routes by which lead enters the human body. The purpose of this study was to measure and determine blood lead levels in traffic officers using the ICP-MS method.

Method: The method used in this study is to use a blood sample of EDTA which is then injected into the ICP-MS device.

Results: The results obtained are < 2.28 μg /L or equivalent to < 22.8 g/dL.

Conclusion: Based on the research that has been done, it can be concluded that the blood lead levels of 10 respondents showed no detectable lead in the blood, namely < 2.28 μg /L.

Key words : Blood, lead, ICP-MS, purposive sampling, traffic officers.

INTRODUCTION

Air pollution results from increased vehicle emissions and traffic congestion. This pollution usually occurs in big cities. The contribution of air pollution to vehicles that use fuel oil shows a contribution of 49% worldwide. Indonesia itself is still dominated by the use of lead-type fuel. About 70% of the lead contained in fuel by burning gasoline will be released into the air. The city of Bekasi is one of the buffers for the metropolitan city of Jakarta. This causes the population and mobility of residents in this city to continue to increase.The population in Bekasi City reaches 2,402,465 people. The large population is also directly proportional to energy needs, reduced vegetation cover and increased daily waste. This has an impact on increasing carbon emissions and production waste that will pollute the city of Bekasi. Air pollution is still the biggest problem in big cities where the pollutants in the air are harmful to human health and the environment. Based on the estimated quality index data (AQI) in 2022, the air pollution level in the city of Bekasi is 152 AQI US. This indicates an unhealthy level of pollution. The ingredients in air pollution include PM2.5 28.7 g/m^3, PM10 42.4 g/m^3, O_3 3.9 g/m^3, NO_2 21.5 g/m^3 (Apriani & Wibowo, 2019).

Alkil lead (TEL and TML) is used as a gasoline fuel mixture. Alkyl lead serves to increase lubrication and increase combustion efficiency. Alkyl lead also functions as an anti-knock additive in fuel, which is to reduce the impact of the engine working so that it can reduce noise when combustion occurs in a motorized vehicle engine. This source currently contributes the most lead levels in the air (Gusnita, 2012). Lead can cause air pollution in two forms, namely gas and particulate matter. Lead gas that comes from the use of fuel from burning vehicle gasoline is usually in the form of TEL or TML. Commonly used additives in vehicle fuels typically include a combination of 62% tetraethyl lead, 18% ethylene dichloride, 18% ethylene dibromide, and nearly 2% other compounds (Koh, 2021). Lead is one of the main pollutants released when burning fuel oil in vehicles. Vehicles are the main cause of air pollution. Air pollution is caused by exhaust fumes such as gasoline. Dust particles containing heavy metals such as CO as a by- product, hydrocarbons (HC) and lead. Lead that enters the human body even in small amounts can be

dangerous, because it accumulates in the body and eventually causes toxic effects on various organ functions. The first effect of chronic lead poisoning before reaching the target organs in humans is a disturbance in hemoglobin biosynthesis (Ardillah, 2016).

One of the people who can experience lead poisoning from vehicle emissions on the highway is one of thetraffic officers. A traffic officer is someone who regulates traffic rules on the highway. Traffic officershave an important role, namely making traffic engineering to minimize congestion that occurs on thehighway. Staff at work always wear masks. These tools are used to protect themselves from dust contamination that is inhaled while on the road. The use of personal protective equipment can reduce the risk of disease associated with lead exposure, and is expected to pose little risk associated with their work. Lead compounds can enter the human body through digestion, respiration, and skin. The mouth and respiratory tract are the most common routes by which lead enters the human body. Many human activities are caused by residues of lead-containing products that are burned and inhaled directly, such as transportation (Maskinah, 2017). In the body, as much as 95% of blood lead binds to erythrocytes and can inhibit aminolevulinic acid dehydratase (ALAD), thereby inhibiting hemoglobin synthesis. Lead isexcreted in several organs of the human body, especially in the kidneys and in the digestive tract. Leadexcretion through urine is 75% - 80%, 15% in feces and the rest is excreted through bile, sweat, hair andnails (Rosita& Lidiawidiarti, 2018).

METHOD

A. Tools and Materias

1. Tools :

   The tools used in this study were the ICP-MS Agilent series 7800, measuring flask, micropipette,vacutainer tube (EDTA), waterbath, handscoon, syringe, tourniquet, alcohol swab, cooler, water bath and fume hood.

2. Material:

   The material used are whoole blood, HNO_3 (Merck), Aqua milli (Millipore), and H_2O_2 (Merck).

B. Procedure

1. Blood Specimen Collection

   The specimen used was 3 ml of blood taken using an EDTA tube. The blood specimen taken is venous blood. The venous blood sampling is done by preparing tools and materials before sampling. Selection of veins by palpating the patient's arm at the median cubital location after insertion of a 3- finger tourniquet above the puncture site. Clean the puncture site with 70% alcohol and allow the alcohol to dry. Next, the vein is punctured with a needle and withdraw the syringe suction until the syringe is completely filled. Then remove the tourniquet, pull the needle and the site of the puncture mark is covered with tape. The blood in the syringe is transferred into the EDTA vacutainer tube and then inverted 8-10 times (Gandasoebrata, 2016).

2. Blood Sample Preparation

   0.5 ml of blood is pipetted and put into a test tube. Blood was added with 1 ml of concentrated HNO_3. The mixture was heated in a water bath with a temperature of 90°C . The mixture was added with 0.5 ml of H_2O_2. The solution was reheated in a water bath at 90°C for 2 hours. Chill. Add 10 ml of Aqua milli, then filtered. The sample is injected into the ICP-MS Agilent series 7800.

3. Preparation of lead main liquor 1000 ppm

   $Pb(NO_3)_2$ weighed as much as 1.59897 gram then added concentrated HNO_3 solution to the mark of the 1000 mL volumetric flask (Fajriah, 2017).

4. Preparation of lead standard solution

   - Preparation of standard solution of Pb 100 ppm

     5 ml of 1000 ppm pb main liquor was pipetted, then 5 ml of HNO_3 was added. The solution homogenized until evenly distributed. Add aqua milli to the limit of the 50 ml volumetric flask (Fajriah, 2017).

RESULTS

A. Respondents overview

Respondents in this study were traffic officers. This traffic officer serves as a traffic controller on the highway. Traffic officers aged 23-45 years with a total of 3 women and 7 men who meet the inclusion criteria who have worked 1-25 years. Traffic officers work 1-8 hours a day. During work, trafic officers always wear masks as personal protective equipment. The subjects of this study were traffic officers on Jl. Ir. H. Juanda, East Bekasi. The sample was taken by purposive sampling technique, the number of samples obtained was 10 respondents with data collection techniques carried out by filling out questionnaires. The results obtained were < 2.28 g/L or equivalent to < 22.8 g/dL. These results are still within the normal limits for lead levels in the blood based on the Decree of the Minister of Health of the Republic of Indonesia Number 1406/MENKES/IX/2002, which is 10-25 g/dL (Theory, 2002).

B. Sample preparation

Sample preparation is the process of eliminating components other than the analyte that will interfere with the analysis process. Preparation in this study using the method of destruction. The purpose of destruction is to separate organic compounds and metals contained in the sample so that only lead metal is present in the sample(Asmorowati et al., 2020). Sample preparation was carried out using the wet digestion method, because in the process the sample was able to decompose organic matter in the sample with the help of concentrated oxidizing acid and heat(Kristianingrum, 2012).

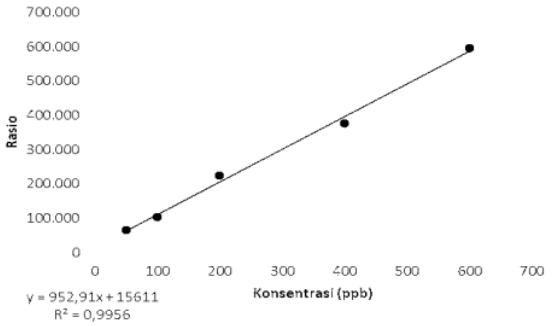
Lead standard solution calibration curve

Consentration (ppb)	Standard volume created (μl)	Standard solution (ppm)
50	25	100
100	50	100
200	100	100
400	200	100
600	300	100

Lead calibration curve data

No	Solution	Consentration (ppb)	Ratio
1.	Standart 1	50	6.4991
2.	Standart 2	100	10.2883
3.	Standart 3	200	22.3713
4.	Standart 4	400	37.7018
5.	Standart 5	600	59.5883

The measurement of the intensity ratio of the lead standard solution after measuring the absorbance of the lead standard series solution, and data from each solution were then included in the calibration curve. The regression equation obtained for the standard blood lead is y= 952.91x + 15611 with the relation coefficient (R2) is 0.9956.



Picture 1. Lead standard solution curve

The lead standard solution curve was made by making standard concentrations of 50, 100, 200, 400, 600 ppb from 100 ppm stock solution. Based on the line equation data obtained from the standard solution curve of lead, namely y = 952.91x + 15611 with a relation coefficient (R2) so that the lead concentration is obtained as a reference in determining the lead content in the sample. The curve above shows a linear relationship between concentration and absorbance, the relation coefficient (R2) of lead is 0.9956 r> 0.95, which means this value shows a high correlation with the relationship between concentration and ratio (Lusiana, 2012).

Table 1. The results of lead levels in the blood of traffic officers

No	Code sample	The results µg/L	The ressults µg/dL	Description
1.	1	< 2,28 µg/L	< 22,8 µg/dL	Not detected
2.	2	< 2,28 µg/L	< 22,8 µg/dL	Not detected
3.	3	< 2,28 µg/L	< 22,8 µg/dL	Not detected
4.	4	< 2,28 µg/L	< 22,8 µg/dL	Not detected
5.	5	< 2,28 µg/L	< 22,8 µg/dL	Not detected
6.	6	< 2,28 µg/L	< 22,8 µg/dL	Not detected
7.	7	< 2,28 µg/L	< 22,8 µg/dL	Not detected
8.	8	< 2,28 µg/L	< 22,8 µg/dL	Not detected
9.	9	< 2,28 µg/L	< 22,8 µg/dL	Not detected
10.	10	< 2,28 µg/L	< 22,8 µg/dL	Not detected

Information :
In accordance with Threshold Limit Value For Chemical Substance And Physical Agents And Biological Exposure Indices 2017.

DISCUSSION

In the study of W A Saud & Purwati (2020) the description of blood lead levels in gas station operatorsat the Kliwon market in Surakarta showed that 10 respondents from gas station operators obtained normal lead levels according to the CDC standard, which is < 10 g/dL. In general, the older a person is exposed to lead will damage the liver and kidneys, therefore it is necessary to encourage workers who are at risk of being exposed to lead to pay more attention to work safety by using personal protective equipment that canreduce lead exposure. Lead is also found in motor vehicle exhaust. The operation of motorized vehicles willrelease air pollutants that have a negative impact, both on the environment and human health. Lead emissionsas exhaust from motor vehicle fumes enter the air in the form of gas. Lead emission is a side effect of combustion that occurs in vehicle engines from TEL and TML compounds added to fuel (Purnama, 2015).

Lead that enters the human body even in small amounts can be dangerous, because it accumulates in the body and eventually causes toxic effects on various organ functions. The first effect of chronic lead poisoning before reaching the target organ is a disturbance in hemoglobin biosynthesis (Ardillah, 2016). If this is not immediately addressed, the toxic effects of lead metal will continue, including the human organs,especially the nervous system, the human blood formation system, the kidneys, and the heart system. Lead can also cause high blood pressure and anemia. The relatively high accumulation of lead in the blood will cause digestive tract syndromes, consciousness, and central nervous system damage and behavioral changes(Palar, 2008).

If the body is exposed to lead every day with a long enough working period, it can cause lead to enterthe body, then it will stick to red blood cells and dissolve red blood cells before the regeneration stage. Thenature of lead damage depends on the intensity of exposure and the time it takes red blood cells to regenerate,but continued exposure to lead will cause blood to circulate in the body and then continue into the bloodstream to the bone marrow(Maskinah, 2017). In old age the level of sensitivity is higher than the average adult, usually because the activity of the biotransformase enzyme decreases with age and the resistance of certain organs to the effects of lead decreases. The older a person is, the higher the concentrationof lead that accumulates in body tissues(Mahendra & Ardiani, 2015)

CONCLUSION

Based on the research that has been done, it can be concluded that the blood lead levels of 10 respondents showed no detectable lead in the blood, namely < 2.28 g/L. Based on the results of the research that has been done, it is recommended that further research be more varied in determining the criteria for selecting respondents, research locations and examinations related to lead, namely hemoglobin.

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