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# PROCEEDING

# The 2nd International Conference of Medical and Health Sciences (ICMHS) and The 2nd Life Sciences Conference (LSC) 2016

*"Towards a Better Quality of Life through Interdisciplinary Research"*

Yogyakarta, 9th-10th December 2016
The Alana Hotel and Convention Center

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*"Role of Agriculture in Poverty Alleviation of Rural Areas"*

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Universitas Muhammadiyah Yogyakarta, Indonesia
*"Continuing Professional Development of Practicing Nurses in Indonesia"*

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*"Diabetic Neuropathy - A Chance Towards A Better Treatment"*

**Mohammad Khalid Ashfaq**
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*"Natural Products –Use or Misuse"*

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American University of Ras Al Khaimah, United Arab Emirates
*"Emerging Biotechnologies and Genomic Medicines in Human Health and Well-Being"*

**Muhammad Sasmito Djati**
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*"Herbal Medicine a Holistic Approach: in case of food supplement formulation of Sauropusandrogynus and Elephantopusscaberto modulate immune and hormonal system in pregnant Salmonella typhi infected mice"*

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# SPEAKER OF INTERNATIONAL CONFERENCE

ICMHS-O-2-22

# Air Pollution Effect to Human Health in Palembang City

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**Abstract**

Adverse effects of ambient air pollution in the environment, climate and public health has been recognized. Air pollution has an effect both acute and chronic human health, affecting a number of different systems and organs. This paper is to explain the effects of air pollution on human health and the mechanism of action briefly. The method used is a reviews of research papers and reports on air pollution and the effects on human health. Air pollution in the city of Palembang as big city comes from motor vehicles, especially of particulates matter. Particulate air pollution is important to attention as it affects the human respiratory system.

Keywords: air pollution, particulate matter, human health effect, Palembang city

## INTRODUCTION

Air pollution is the result of the process effluent generated from human activities to meet their needs, from the production sector and the transport sector. Increasing the number of human caused increase discharges that pollute the air, thereby increasing the contaminant and the correlated increase the number of people suffering from disorders and diseases caused by air pollution.[1,2,3]

More than 80% of people living in urban areas are exposed to air pollution levels monitored air quality has exceeded the limits of WHO. While all regions of the world affected population in low-income cities are the most affected. According to the database of the latest urban air quality, 98% of the cities in the countries of low and middle income with more than 100,000 inhabitants do not qualify from the WHO air quality guidelines. However, in high-income countries, the percentage dropped to 56%. In the last two years, the database now covers 3,000 cities in 103 countries, by measuring the levels of urban air pollution and recognize the impact of health-related, the numbers almost doubled.[4] Due to a decrease in urban air quality, then the risk increases for people who live in it such as stroke,[5] heart disease,[6] lung cancer,[7,8] and acute and chronic respiratory diseases, including asthma.[4]

Air pollution has an effect in the form of acute and chronic human health, affecting a number of different systems in the organs. Starting from such a mild irritation of the upper respiratory (ARI), chronic respiratory and heart disease, up to lung cancer, including acute respiratory infections in children and chronic bronchitis in adults. Diseases of the heart and lungs that already exist will be burdensome disease, or asthma attacks. In addition, exposure to pollutants in the short term and the long term has also been associated with premature death and reduced life expectancy.[1,2]

There is a quantitative relationship between exposure to a high concentration of small particulate matter ($PM_{2.5}$ and $PM_{10}$) and increasing numbers of sick or dying, both daily and from time to time. Fine particle air pollution is a risk factor for cardiovascular disease mortality through mechanisms specific causes such as pneumonia and systemic inflammation, accelerated atherosclerosis, and change the cardiac autonomic function.[9,10] Long-term exposure to $PM_{2.5}$ air pollution is associated with an increased risk of death from cardiovascular disease.[11] Conversely, when the concentration of small particulate matter and fine particulate matter is reduced, the mortality rate associated will also fall by assuming other factors remain the same.[4]

Palembang city as the capital of South Sumatra Province has become one of the cities with the progress of construction is high, so there is a negative effect on the quality of the environment, including air quality, particularly from the transportation industry sector. With the development of transport infrastructure in the city of Palembang will increase their emissions and particulate matter from the exhaust of vehicles increases, it decreases the quality of the air in the city of Palembang. These circumstances have a

negative impact, both short term and long term in an increasing of cases of the disease in later life. Therefore, it is necessary to monitor the air quality, the air pollutant standard index used.

## MATERIALS AND METHODS

This study is a review of the literature in the form of scientific articles and reports related agencies and from the environment laboratory of environmental protection agency of South Sumatra province. Air Pollutant Index Data of Palembang city taken from the measurement tools that are in the office environment laboratory, environmental protection agency of South Sumatra province.

Index of air quality standards are used officially in Indonesia is the air pollutant index (ISPU), in accordance with the Decree of the Minister of Environment No. 45 of 1997 on air pollution index.[12] Air pollution index is a number that does not have a unit that describes the condition of the ambient air quality in a specific location and time based on the impact on human health, aesthetic value and other living things, to more clearly seen in Table 1. The air pollution index set how to change the levels of air pollutants are measured into a number dimensionless. Range of air pollution index can be seen in Table 2.

Air pollution index data obtained from the operation of Ambient Air Quality Monitoring Stations Automatically. While the air pollution index parameters include: a. Particulate matter ($PM_{10}$), b. Carbon Monoxide (CO), c. Sulfur Dioxide ($SO_2$), d. Nitrogen Dioxide ($NO_2$), e. Ozone ($O_3$).[12]

Calculation and reporting as well as air pollution index information based on the decision of the Head of Environmental Impact Management Agency No. 107 of 1997, including the load-parameters basic parameters for air pollutant index (ISPU) and period of time measurement.[13]

**Table 1. The air pollutant index (ug / m3) at 25$^0$C and 760 mmHg.**

| API | CO (8 Hours) | $NO_2$ (1 Hour) | $SO_2$ (24 Hour) | $O_3$ (1 Hour) | $PM_{10}$ (24 Hours) |
|---|---|---|---|---|---|
| 50 | 5 | * | 80 | 120 | 50 |
| 100 | 10 | * | 365 | 235 | 150 |
| 200 | 17 | 1.130 | 800 | 400 | 350 |
| 300 | 34 | 2.260 | 1.600 | 800 | 420 |
| 400 | 46 | 3.000 | 2.100 | 1.000 | 500 |
| 500 | 57,5 | 3.750 | 2.620 | 1.200 | 600 |

Source: The head of the Environmental Control Agency (13)

*=Not Available

**Table 2. Range of air pollutant index**

| Category | Range | Explanation |
|---|---|---|
| Good | 0 – 50 | Does not give effect to the health of humans or animals and have no effect on plants, buildings or aesthetic value. |
| Moderate | 51 – 100 | Does not give effect to the health of humans or animals, and has no effect on plants, buildings or aesthetic value. |
| Unhealthy | 101 – 199 | Adverse human or animal groups that are sensitive or could cause damage to plants or aesthetic value. |
| Very Unhealthy | 200 – 299 | Adverse health in a number of segments of exposed populations. |
| Dangerous | >= 300 | Dangerous generally, can seriously harm the health of the population. |

Source: The head of the Environmental Control Agency.[13]

## RESULTS

Palembang is the capital of South Sumatra province. Palembang is the second largest city in Sumatra after Medan. Palembang city has an area of 358.55 km$^2$ inhabited by 1.8 million people with a population density of 4,800 per km$^2$. Predicted in 2030 the city will be inhabited by 2.5 million people. Construction of LRT (train overpass) and development plans the GP motor circuit in Jakabaring and the F1 circuit in Tajung Api-api area, is the latest development project Palembang.

Palembang history that was once the capital of the kingdom of Buddha maritime Southeast Asia's largest at the time, the kingdom of Srivijaya, which dominates the archipelago and the Malay peninsula in the 9th century also made this city known as "Bumi Sriwijaya". Based on the inscriptions found in the Bukit Kedukan Siguntang Hill west of Palembang who declared the formation of a wanua interpreted as a town on June 16, 688 BC to make the city of Palembang as the oldest city in Indonesia. In the Western world, the city of Palembang is also nicknamed the Venice of the East (the "Venice of the East").

Location of Air Quality Station in Palembang City at Environmental Protection Agency, South Sumatera Province, and location map presented in Figure 1. Results of Measurement of Air Pollutant Index are presented in Table 3.


Source: Google maps.

**Figure 1. Location Map of Station Air Quality in Palembang City**

**Table 3. Air Pollutant Index in 2016 at Palembang City**

| Month | Date | $O_3$ | $NO_2$ | $SO_2$ | CO | $PM_{10}$ |
|---|---|---|---|---|---|---|
| January | 16 | 15 | 4 | 15 | 10 | **22** |
| | 22 | 13 | 5 | **29** | 10 | 26 |
| | 29 | 17 | **56** | 15 | 10 | 22 |
| February | 05 | 14 | 2 | **16** | 10 | 6 |
| | 12 | 16 | 4 | 17 | 10 | **23** |
| | 19 | 14 | 3 | 7 | 10 | **33** |
| | 26 | 15 | 8 | 9 | 10 | **29** |
| March | 04 | 9 | 8 | 11 | 10 | **22** |
| | 11 | 8 | 6 | 9 | 10 | **20** |
| | 18 | 10 | 2 | 16 | 10 | **22** |
| | 25 | 15 | 7 | 16 | 10 | **32** |
| April | 08 | 15 | 7 | **24** | 10 | 23 |
| | 15 | 10 | 7 | 12 | 10 | **15** |
| | 22 | 15 | 7 | 12 | 0 | **28** |
| | 29 | **24** | 7 | **24** | 10 | 2 |

| Month | Date | $O_3$ | $NO_2$ | $SO_2$ | CO | $PM_{10}$ |
|---|---|---|---|---|---|---|
| May | 06 | 15 | 7 | 24 | 10 | 23 |
| | 13 | 26 | 7 | 25 | 10 | 30 |
| | 20 | 22 | 7 | 23 | 10 | 21 |
| | 27 | 21 | 7 | 24 | 10 | 22 |
| June | 03 | 26 | 7 | 35 | 10 | 24 |
| | 10 | 25 | 8 | 23 | 10 | 37 |
| | 17 | 23 | 5 | 20 | 10 | 30 |
| | 24 | 23 | 7 | 21 | 10 | 34 |
| July | 01 | 18 | 8 | 35 | 10 | 30 |
| | 15 | 17 | 7 | 40 | 10 | 25 |
| | 22 | 18 | 8 | 35 | 10 | 27 |
| | 29 | 27 | 8 | 32 | 20 | 35 |
| August | 05 | 27 | 7 | 28 | 20 | 27 |
| | 12 | 23 | 6 | 31 | 20 | 24 |
| | 19 | 19 | 4 | 19 | 10 | 10 |
| | 30 | 23 | 5 | 23 | 10 | 36 |
| September | 02 | 23 | 9 | 22 | 10 | 47 |
| | 16 | 27 | 8 | 26 | 10 | 47 |
| | 23 | 23 | 8 | 34 | 10 | 42 |
| | 27 | 32 | 13 | 48 | 30 | 49 |
| October | 04 | 26 | 5 | 27 | 10 | 42 |
| | 11 | 23 | 6 | 21 | 10 | 28 |
| | 21 | 27 | 35 | 31 | 10 | 48 |
| | 28 | 19 | 5 | 30 | 10 | 33 |

**Source: Enviromental Lab, Environmental Agency of of South Sumatra Province**

The measurement results obtained from January 2016 until October 2016 known that air quality index of Palembang city included in all category, where the results of the calculation are under 50. Air Pollutant Index value used is the highest value of the components of the index of air pollutants. On the 29th of January of 2016, the index value of $NO_2$ is 56 and in the category of medium (51 -100). While pollutants $PM_{10}$ and $SO_2$ are two types that have the highest value. In February, March, September and October, the highest index value of $PM_{10}$, $SO_2$ whereas in May, July and August.

## DISCUSSION

The air quality in Indonesia, especially in big cities and metropolitan, heavily influenced by transport activity.[12] Air pollution in major cities in Indonesia have a major impact on the decline in air quality nationwide. Reports 2008 Environmental Performance Index compiled by Yale University showed air quality Indonesia was one hundred and two (102) with a score of 66.2 out of one hundred and forty-nine (149) state. Switzerland is a country that has the most excellent air quality with a score of 95.5, while Nigeria is a country that has the worst air quality with a score of 39.1.[14]

The measurement results AQI in Palembang known that the air pollutant standard index is quite good. Measurement parameters of the standard five, namely $PM_{10}$, $SO_2$, $NO_2$, CO and $O_3$, it is known that the pollutants which have the highest index value was $PM_{10}$ and the second highest was $SO_2$.

Air Quality Index in India is based on eight parameters ($PM_{10}$, $PM_{2.5}$, $NO_2$, $SO_2$, CO, $O_3$, $NH_3$, and Pb) have a short-term standard for near real-time dissemination of AQI. Proposed for air quality stations working continuously, AQI is reported in real-time for as many parameters as possible. For manual station, the daily AQI reported with a one week lag to ensure user data is studied and available for AQI. A web-based dissemination AQI system developed for fast, simple and elegant look for a response to a request AQI. Other features of the website include the reporting of pollutants responsible for the index, pollutants exceeding the standards and health effects.[15] AQI in China was first used in 1996 with the standard index of air pollutants as much as 7 parameters, namely $SO_2$, NOx, $NO_2$, CO, $O_3$, $PM_{10}$ and TSP.[16]

The importance of air quality monitoring by measuring air pollutant standard index in order to obtain air quality information to be used as input in environmental management policy makers, in particular air quality.

**Particulate $PM_{10}$.** Particulates are solids or liquid in the air in the form of smoke, dust and vapors whose diameter is very small (ranging from <1 micron to 500 microns), which can stay in the atmosphere for a long time. Besides disturbing aesthetics, small-sized particles in the air can be inhaled into the respiratory system and cause respiratory diseases and lung damage.[1,2,4,17] The particles are inhaled into the respiratory system will be set aside depending on the diameter. Large-sized particles are retained in the upper respiratory tract, whereas small particles that can be inhaled (inhalable) will get into the lungs and stay in the body for a long time. Inhalable particles are particles with a diameter below 10 μm ($PM_{10}$). $PM_{10}$ is known to increase the number of deaths caused by heart and respiratory disease, at a concentration of 140 ug/m3 can reduce lung function in children, while at a concentration of 350 ug/m3 may aggravate the condition of patients with bronchitis. The toxicity of inhalable particles depends on the composition.[4,11,17]

Inhalable particles can also be a secondary particulates are particles formed in the atmosphere of gases combustion products undergo physical-chemical reactions in the atmosphere, such as sulfate and nitrate particles formed from $SO_2$ and NOx gases. Generally, secondary particles measuring 2.5 microns or less. The main proportion of $PM_{2.5}$ is ammonium nitrate, ammonium sulfate, sodium nitrate and secondary organic carbon. These particles are formed in the atmosphere by the slow reaction, so often found as contaminants transboundary air displaced by the movement of the wind over long distances from the source. Secondary particles $PM_{2.5}$ can cause more harmful effects on health because of their size allows it to be sucked and go deeper into the respiratory system.[2,7,18]

Sulfate and nitrate particles and acidic inhalable will react directly in the respiratory system, result in a more harmful than small particles that are not acidic. Heavy metal particles and the carbon-containing compound may have a carcinogenic effect, or be a carrier of toxic pollutants other gaseous or semigas because it sticks to the surface.[7] Included in the inhalable particles are particles of Pb emitted from the exhaust gases of motor vehicles that use fuel containing Pb. Lead is a pollutant emitted from motor vehicles in the form of fine particles smaller than 10 μm and 2.5 μm.[1] Particulate is also a major source of smog (haze) which lowers visibility.[18,19]

The need for attention to $PM_{2.5}$ in addition to $PM_{10}$, for $PM_{2.5}$ has the ability to go up into the bloodstream when inhaled into the respiratory process. Some countries have established as one of the parameters $PM_{2.5,}$ such as India, China, USA, Britain.

**Sulfur Dioxide (SO2).** Air pollution by sulfur oxides (SOx) is mainly caused by two components of sulfur oxide gas that is colorless, namely sulfur dioxide ($SO_2$) and sulfur trioxide ($SO_3$). $SO_2$ has the characteristic pungent smell and is not flammable in air, while $SO_3$ is a gas that is not reactive. $SO_2$ is a major contributor to acid rain. Once in the atmosphere, $SO_2$ undergo conversion to $SO_3$ which then becomes $H_2SO_4$. At night or during rainy or humid conditions, $SO_2$ in the air is absorbed by water droplets and forming alkaline sulphate in the droplet.[20,21]

Burning fossil fuels such as oil and coal and other materials containing sulfur will produce two forms of sulfur dioxide, $SO_2$ always produced in large quantities, while $SO_3$ is formed varies from 1 to 10% of total Sox.[2,7,20,21]

$SO_2$ is generally the result of combustion, including motor vehicles. Therefore, it is necessary mitigation through the use of fuel that is environmentally friendly, as well as restrictions on the age of vehicles on the highway.

**Effects of Air Pollution on Human Health.** Increased burning of fossil fuels in the past century are responsible for progressive change in the composition of the atmosphere. Air pollutants, such as carbon monoxide (CO), sulfur dioxide ($SO_2$), nitrogen oxides (NOx), volatile organic compounds (VOCs), ozone ($O_3$), heavy metals,

and respirable particles ($PM_{2.5}$ and $PM_{10}$), differ in its chemical composition, the nature of the reaction, emissions, and the disintegration time in a long or short time.[1,2,4,19]

Sign in and contact with air pollutants to humans primarily through inhalation and ingestion, skin contact while a minor route of exposure. Air pollution contributes to a great extent on the contamination of food and water, the consumption in some cases the main intake of these pollutants. Through the gastrointestinal and respiratory tracts, the absorption of pollutants may occur, while a number of toxic substances can be found in the general circulation and saved to a different network. Elimination occurs at a certain level by a process of excretion.[1,2,17]

There is a quantitative relationship between exposure to a high concentration of small particulate matter ($PM_{2.5}$ and $PM_{10}$) and increasing numbers of sick or dying, both daily and from time to time.[18] Fine particle air pollution is a risk factor for cardiovascular disease mortality through mechanisms specific causes such as pneumonia and systemic inflammation, accelerated atherosclerosis, and change the cardiac autonomic function.[9,10] Long-term exposure to $PM_{2.5}$ air pollution is associated with an increased risk of death from cardiovascular disease.[11,22,23,24] Conversely, when the concentration of small particulate matter and fine particulate matter is reduced, the mortality rate associated will also fall by assuming other factors remain the same.[4] WHO air quality guidelines of 2005 provide global guidance thresholds and limit air pollution as a factor that pose health risks. The WHO guidelines indicate that by reducing particulate pollution ($PM_{10}$) 20-70 ug/m3 (micrograms per cubic meter), can reduce deaths from air pollution by about 15%.[4,25]

Pollutant gases contributing to most of the variation in atmospheric composition and mainly due to the burning of fossil fuels.[1,2] Nitrogen oxides are emitted as NOx that rapidly reacts with ozone or radicals in the form of $NO_2$. Ozone in the lower atmosphere is formed by a series of reactions involving $NO_2$ and volatile organic compounds, the process is initiated by sunlight. Carbon monoxide (CO), on the other hand is a product of incomplete combustion. Another major source is road transport. While the results of anthropogenic $SO_2$ from the combustion of fossil fuels containing sulfur (mainly coal and oil) and the smelting ores containing sulfur, while volcanoes and oceans are the main source of natural.[2,21]

SOx pollution causes respiratory system irritation and eye irritation, as well as harmful to the health of elderly and patients with chronic cardiovascular diseases respiratory system. Besides an effect on human health, SOx pollution is also harmful to the health of animals and can damage plants.[2,21]

## CONCLUSION

AQI data show that the air quality in Palembang is good. Pollutants the highest in the city of Palembang is particulate $PM_{10}$ and the second highest is $SO_2$. Therefore, monitoring and reduction of particulate pollutants $PM_{10}$ and $SO_2$ should be a concern for policy makers. The decrease of pollutants can be done with attention to the condition of vehicles and vehicle age restrictions are there on the highway.

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