

Increased of SOD Enzyme Activity in Serum Workers At Home Industry Petis Burning Wood Smoke Exposure in Sekardangan Village Sidoarjo Regency

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Abstract- Nitrogen dioxide and formaldehyde gases are the chemical substance of wood burning product affect to respiratory disorders. The chronic exposure it are gases effected cellular influence enzymes activity serum SOD. The aim of this study was to analyze the effect of exposure to nitrogen dioxide and formaldehyde gases against serum SOD of worker in home industry petis. The design of this study was observational analytic with prospective longitudinal study. The study sites of home industry petis and government Sekardangan office. The population of this study was 2 population that were the workers of home industry petis and the workers of government Sekardangan office with some inclusive criteria that worked at male, not getting sickness asma and willing to participate in this study. Sample size was 12 workers that was taken by simple random sampling.

The analysis result showed that nitrogen dioxide and formaldehyde gases in air effected of enzymes serum Δ SOD and Δ GPx decide exposure group and not exposed (independen t test, $p < 0,05$). The effect of nitrogen dioxide and formaldehyde gases in air effected enzymes activity serum Δ SOD (linier regression, $p < 0,05$), but health complaints was effected by nitrogen dioxide and formaldehyde gases (logistic regression, $p < 0,05$). It is concluded that was exposure of nitrogen dioxide and formaldehyde gases effect increasing of enzymes activity serum SOD of worker at home industry petis. Otherwise, there is effect of exposure of nitrogen dioxide and formaldehyde gases to health complaints. It is suggested that need work rotation for workers have period of more than 5 years, workers should eating vegetables and fruits that contain vitamin C and E.

Keywords: - nitrogen dioxide and formaldehyde gases, wood burning smoke, serum SOD and GPx, health complaints.

1. INTRODUCTION

The growth of small and medium scale industry develops coloring regional economy. Ranging from the food industry, crafts, furniture, until convection or textiles, existence has become one of the solutions to overcome the unemployment rate at the same time move the wheels of the economy of the area. Industrial construction activity is one of the economic sectors of activity aiming to improve the welfare of the community. Therefore, the development of industrial sector often gets top priority in the National Development Plan for most developing countries. The industrial sector is regarded as a pioneer of economic development because this sector is generally much growing faster than the agricultural sector, as can be seen from the industrial sector's contribution to the gross national product increasing (Law No.25, 2004).

Increased industrial activity has begun to increasingly rapid impact on the environment, including the impact of physical, chemical, economic and cultural. Lately, industrial activity began to public attention due to the effects caused, among others, use of raw materials that could damage the ecosystem, using fuel that can endanger the health of workers and disposing of waste that can pollute the environment (Ginting, 2007).

Estimated percentage of the main components of air pollution, especially industrial activities that use fuel wood as follows, formaldehyde (CH₂O) 60%, carbon monoxide (CO) 10.53%, sulfur oxides (SO_x) 0.9%, nitrogen oxides (NO_x) 8.9%, amounting to 1.33% particulate matter, hydrocarbons (HC) 18.34% and greenhouse gases (CH₄, CO₂ and N₂O) spread in percentage value primary source (Susanto, 2004).

All the above parameters may cause a negative impact on health when exposed repeatedly and occurred imbalance of the body's biological response. Some pollutants that can cause health problems include formaldehyde and nitrogen dioxide gas. In the process of combustion in industrial activity will occur reaction process that produces nitrogen dioxide and formaldehyde (Susanto, 2004).

Various studies have been conducted to determine the relationship of nitrogen dioxide and formaldehyde to health problems. As research conducted by Clark (2010) suggests that the increased incidence of asthma occurred along with increased initial exposure by gas NO, NO₂, and formaldehyde. Asthma is caused by the inhalation of formaldehyde can be classified as asthma irritation caused by brief exposure to high concentrations of formaldehyde and identified causes

of asthma symptoms suddenly occurred known as "Reactive airways dysfunction syndrome" (RADS) (Brooks et al., 1998 : Vandenplas et al., 2004). Exposure to formaldehyde causes increasingly severe respiratory work during respiration due to irritation of the respiratory tract (Vandenplas et al., 2004).

Some home industry in the District Sidoarjo paste in the production process using fuel wood with long processing time between + 8 hours in a day, while working workers use masks and ventilation in the room occurred production is inadequate for good air circulation. Based on subjective complaints obtained from preliminary observations using a questionnaire of 15 workers is known that workers who have complaints to sneeze as many as 10 people (67%), cough as many as 12 people (80%), pain in the throat as many as 9 people (60%), and experiencing shortness of breath as many as six people (40%). Based on the NIOSH (2005) states that the use of firewood during the combustion of which will produce nitrogen dioxide and formaldehyde gas. The production process is not controlled properly will cause health problems for workers who every day are exposed to nitrogen dioxide gas. Based ACGIH NO₂ gas concentrations in the air are permitted expose humans continuously for 8 hours each day (TLV-TWA) of 3 ppm and exposure occur continuously in a short time (15 minutes), is allowed no more than 4 times the exposure, with at least a break of 60 minutes each period of exposure (TLV- STEL) of 5 ppm. Formaldehyde concentrations allowed by ACGIH short exposure permitted (TLV-STEEL) with a concentration of 0.3 ppm, while by NIOSH brief exposure allowed by a concentration of 1 ppm (ACGIH, 2007).

Nitrogen dioxide gases and formaldehyde is a group of free radicals and can affect an increase in the activity of serum superoxide dismutase enzyme (SOD) as well as being oxidative stress. Oxidative stress is an imbalance between the production of reactive oxygen to the body's biological system's ability to detoxify reactive compounds or repair cell damage (Otero, 2009)

This situation causes excess free radicals, which will react with fat, protein, cellular nucleic acid, so will be happen local damage and specific organ dysfunction. If oxidative stress is prolonged, will cause damage to cells or tissue, which in turn is causing malignancy, inflammation, atherosclerosis, aging, and ischemia (Arief, 2009).

2. RESEARCH METHODS

This type of research is observational analytic and study design prospective longitudinal study, because the observation and measurement of the variables in the sample group and the control is carried out cross-week measurement before and after the work within 40 hours (Monday morning and Friday afternoon) ,

This research was conducted in three home industry engaged in the finished material, by producing a paste as the main commodity. During the stirring process the home industry uses wood fuel to the duration of exposure for 8 hours of work and workers do not use masks and the lack of ventilation which serves as the air exchange. The research location was in Jl. Sekardangan Sidoarjo district. The research was conducted during February-May 2015.

Population in this research is in the home industry workers exposed petis formaldehyde and nitrogen dioxide gas as well as the community (village employees Sekardangan) is not exposed to formaldehyde and nitrogen dioxide gas.

Interviews were conducted on workers at home industry and society in the region petis sekardangan to know the age, years of service, diet, habits using a mask, smoking habits, nutritional status, and respiratory complaints which aims to analyze the influence of these factors to the increase in SOD activity in serum , Observations carried out aiming to determine the condition of ventilation in home industry paste production space and work space in the region sekardangan community, as well as the use of masks at home industry workers in paste. In this research activity measurements conducted to determine exposure to formaldehyde and nitrogen dioxide gas in the space industry paste production at home and work space communities in the sekardangan aims to determine the concentration of formaldehyde gas and nitrogen dioxide in the air at the workplace. Measurement o formaldehyde and nitrogen dioxide gas using a midget impinger. Measurements of height and weight carried on working at home industry petis as exposed group and society in the region sekardangan as a group not exposed. Examination increase serum SOD activity is aimed at analyzing the increased activity of SOD enzyme serum, using the ELISA method.

3. RESULTS AND DISCUSSION

Based on the results of research regarding the increase in SOD Enzyme Activity in Serum Workers At Home Industry Petis Burning Wood Smoke Exposure Sekardangan In the village of Sidoarjo regency is as follows:

Table 1. Statistics on Improvement Research SOD Enzyme Activity in Serum Workers At Home Industry Petis Burning Wood Smoke Exposure Sekardangan In the village of Sidoarjo Regency

No	Independent Variable	Means _± SE	Unit
1	Nitrogen dioksida	0,1454+0,107	ppm
2	Formaldehid	0,0291+0,0263	ppm
3	Age	41,00 ±13,38	Years
4	Work Period	3,08 ±0,90	Years
5	Smooking Habits	426,67+231,09	rod

6	SOD	14,52±3,58	U/ml
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Characteristics of respondents in this study include: age, years of smoking habit. In accordance with the results of the study the average age in the exposed group is 41.6 years, while in the group not exposed to 30.7 years. Meydani (2000) states that the older age cause organ function decline and decrease in cell regeneration ability to repair themselves, or replace and maintain the structure of its normal function.

The average tenure in the exposed group is 3.08 years and the unexposed group is 7 years. Long working period determines the exposure a person exposed to the smoke of burning wood that can lead to impaired function of the lungs and affect the activity of antioxidant enzymes. The longer the exposure (tenure) the more likely someone get such risks. Suma'mur (2009) states that one of the potential variables that may interfere with the function of the organ is the length of a person is exposed.

Smoking habits were measured by an index that is the result of multiplying Brikman between smoking duration (in years) the number of cigarettes smoked in a day. Criteria include light smokers smoking habits 0-200 = IB, IB = moderate smokers and heavy smokers IB 201-600 > 600. Based on the average results of the study of cigarettes smoked each day at 426.67 rods are exposed group whereas in the group not exposed to 111, 58 rods Smoking is a factor of the potential concomitant pulmonary function impairment. Smoking habits not only will reduce the level of exchange of oxygen in the blood, but also will be a potential factor of several lung diseases, including lung carcinoma. Habit of smoking can aggravate the incidence of pulmonary function impairment (Epler, 2000).

Effect of exposure to nitrogen dioxide and formaldehyde against SOD activity was analyzed using linear regression. Analysis of the effect of exposure to nitrogen dioxide and formaldehyde to ΔSOD enzyme activity can be seen in Table 5:

Table 2. Analysis of Effects of Smoke Exposure Enzyme Activity against Wood Burning ΔSOD at Home Industry Petis Workers in 2015

Variable	ΔSOD Enzyme Activity	
	β	p
NO ₂	24,929	,014*
Formaldehid	93,594	,038*
Age	,094	,173
Work Period	-4,335	,000**
Smoking Habits	1,638	,017*

* p < 0,05 (significant)

** p < 0,00 (Very significant)

Table 2. On the effect of exposure to nitrogen dioxide and formaldehyde to ΔSOD enzyme activity at home industry workers in paste. The influence of exposure to nitrogen dioxide and formaldehyde gas, tenure and smoking habits of the enzyme activity ΔSOD with significance p < 0.05.

Gas adsorption nitrogen dioxide and formaldehyde repeatedly and continually accumulate mainly in the conductive channel and respiratory airways (pulmonary acinus) and cause changes in lung morphology (WHO, 1997).

Nitrogen dioxide and formaldehyde which enters the body through the circulatory system to be metabolized or undergo biotransformation into metabolites assisted activation and inactivation by the enzyme cytochrome P-450. Nitrogen metabolites can be inactivated form of the compound nitric acid and nitric whereas inactivation formaldehyde compounds such as formic acid can be excreted through the urine, and can also be metabolites activation of reactive nitrogen species that is becoming and can also bind to hemoglobin to form methemoglobin (ATSDR, 2006).

Biological response of the body in warding exposure to nitrogen dioxide and formaldehyde, namely by presenting monocytes to memfagositosis RNS / ROS in cells, the process requires quite a lot of oxygen to metabolize the RNS / ROS into metabolites inactivation into asthma denitrat and nitrite. Too many RNS / ROS cause an imbalance in the body's biological response of the body by activating the enzyme antioksidan (dismutase dismutase, catalase, and glutathione peroxidase and glutathion transferase) in fagocyt called oxidative stress (Arief, 2009).

Superoxide dismutase (SOD) is an enzyme that activates dismutasi reaction of superoxide anions to form hydrogen peroxide. Instead of catalase would protect cells directly, through the decomposition of hydrogen peroxide to water. Presence of glutathione cycle also dismissed the hydrogen peroxide into water with the aid of the enzyme glutathione peroxidase (GPx). SOD, catalase and GPx are very important endogenous antioxidant in the human body and animals (Harris, 1992). Countermeasures that exposure to free radicals do not cause health problems, we have to do is fix a more healthy diet, not smoking, eating foods that are not berpengawet, colorings, flavorings that contain many harmful chemicals, regular exercise and eating fruits or vegetables that contain lots of antioxidants (Prawirohardjono et al., 2000).

Countermeasures that exposure to free radicals do not cause health problems, we have to do is fix a more healthy diet, not smoking, eating foods that are not preservative, colorings, flavorings that contain many harmful chemicals, regular exercise and eating fruits or vegetables that contain lots of antioxidants (Prawirohardjono et al., 2000).

Some types of vitamins has been shown to have anti-oxidant activity is quite high. Examples of vitamins that many compounds act as anti-oxidants in the body are vitamin C and vitamin E (Alstucl et al., 1995). Vitamin E plays a role in maintaining the health of various tissues in the body, ranging from skin tissue, eye, red liver till blood cells. In addition, this vitamin can also protect the human lung from air pollution. The health value associated with the work of vitamin E in the body as natural anti oxidant compound. Vitamin E many found to fish, chicken, egg yolks, yeast, and oil plants. Although it is only needed in small amounts, vitamin E deficiency can lead to fatal health problems for the body, such as infertility in both men and women. Furthermore nerve and muscle function will be impaired prolonged (Hidgon, 2002). Non-enzymatic antioxidants can be obtained from the nutritional components of vegetables, fruits and spices. Components that are antioxidants in vegetables, fruit and herbs include vitamin C, vitamin E, β -carotene, flavonoids, isoflavones, flavones, anthocyanins, catechins and isokatekin (Kahkonen et al., 1999).

Oxidants in cigarette having sufficient quantities to play a major role in the occurrence of damage to the airways. It is known that tobacco smoke oxidants spend intracellular antioxidant in the lung cells (in vivo) through a mechanism that is linked to oxidant stress. It is estimated that each puff of a cigarette having oxidant ingredient in a very large number, including aldehydes, epoxida, peroxide and other free radicals which may be quite long-lived and survived to cause damage to the alveoli. Other materials such as nitric oxide, peroxy radicals, and carbon-containing radicals exist in the gas phase. Also contains other relatively stable radical nature of tar phase. Radical in tar phase include moieties semiquinone produced from a variety of quinone and hydroquinone. Repeated minor bleeding is very possible cause of desposisi iron in the lung tissue of smokers. Iron in the form led to the formation of hydroxyl radicals from hydrogen peroxide deadly. Also found that smokers had increased neutrophils in the lower respiratory tract that has contribute to a further increase concentration of free radicals (Hidgon, 2002).

4. CONCLUSION

Based on the research that has been done, can be summed up as follows:

1. Exposure to nitrogen dioxide and formaldehyde in the home industry petis increase SOD activity in serum in a large group with significant exposure at $p < 0.05$.
2. Exposure to nitrogen dioxide and formaldehyde in the home industry petis increase GPx enzyme activity in serum in a large group with significant exposure at $p < 0.05$.

3. Exposure to nitrogen dioxide and formaldehyde in the home industry petis improve respiratory symptoms in the exposed group with a significant at $p < 0.05$.
4. There are differences in the activity of enzymes SOD and GPx pre-post on the exposed and unexposed groups with a significantly large at $p < 0.05$.

Advice can be given that the processing of paste does not cause further health problems, which is necessary for the job rotation of workers who have a life of over 5 years, workers eat vegetables and fruits that contain vitamin C and E.

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