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**The Effectiveness of a Simple Filtration Tool Made from Bananas in
Reducing PM_{2.5} at Fish Smoking House in Ternate City**

Susan Arba¹, Mustafa²

1 Environmental Health Department of Politeknik Kemenkes Ternate

2 Environmental Health Department of Politeknik Kemenkes

Corresponding author: restynsun@gmail.com

ABSTRACT

Particulate Matter (PM) is a type of hazardous pollutant of various sizes, which can cause high mortality due to exposure to air pollution. Particulate Matter <2.5µm (PM_{2.5}) or so-called fine Particle particles is one type of particulate that is very small in size and can cause various types of disease. If inhaled into the body can penetrate the lower respiratory tract and can through the bloodstream. The smoke produced by burning coconut shells in a fish-smoking environment is a problem that exists in the smoking room of fish. This study aims to analyze The Effectiveness of a Simple Filtration Tool in Reducing PM_{2.5} in Fish Smoking Houses In Ternate City. The research design used is pre-experimental with the method one group pre-post test design. The research was carried out in a fish-smoking house, Ternate City, Maluku Province North. The population in this study was all fish-smoking houses in the City of Ternate. Data that collected and then processed using a statistical program. The results showed that the p-value PM_{2.5} is 0.048 which is less than the critical research limit (<0.05), meaning that there is a difference. There is a significant difference between PM measurements_{2.5} before and after which means a simple filtration tool made from banana midrib is effective in reducing PM_{2.5}. Conclusion Filtering system made from banana midrib is effective in reducing PM concentration_{2.5} at the fish-smoking house.

Keywords: PM_{2.5}, banana midrib, smoking fish

BACKGROUND

Potential to spur economic growth and equal distribution of business fields. On the other hand, it can hurt the environment if not handled properly. Negative impacts that can endanger human health include air pollution both indoors and outdoors.

Air pollution is the entry or inclusion of substances, energy, and/or other components into ambient air by human activities, thereby exceeding the air quality standards that have been set (Permen LH, 2010). Air pollution can cause lung inflammation and if it continues it can lead to a decrease in lung function, which in turn increases lung function abnormalities. Air pollutants that cause abnormalities in the respiratory tract are if pollutants from ambient air are inhaled, including SO₂, O₃, and NO₂ particles including PM_{2.5} and PM₁₀ (Mukono, 2008)

Dust harmful particles are often referred to as *suspended particulate matter* with a size of 1 micron to 500 microns. In the case of air pollution both inside and outside the building, dust is often used as an indicator of pollution used to indicate the level of danger (Pudjiastuti, 2002). Air pollution by dust particles measuring 0.1 to 100 µm can cause respiratory diseases

(Suhariyono, 2006). A work environment filled with dust can interfere with the vital capacity of the lungs. The harmful effects of dust depend on the presence of particle characteristics, namely, size distribution, form factor, and elemental composition (Mukono, 2010). According to Agusnar (2008), the size of dust or particles that enter the lungs will determine the location of attachment or deposition.

According to *Environmental Protection Agency* (2014) *particulate matter* (PM) is particles that float in the air for a long time or particles found in the air, including dust, dirt, soot, and smoke. Particles that are less than 10 micrometers (PM₁₀) can cause health problems because they can be inhaled and accumulate in the respiratory system. Particles that are less than 2.5 micrometers (PM_{2.5}) are referred to as *fine particles* and are believed to pose the greatest health risk because of their small size (about 1/30 the width of an average human hair) so that they can enter the lungs. *The Environmental Protection Agency* (EPA) groups dust particles based on their size into 2 categories, namely dust particles = 10 micrometers and dust particles = 2.5 micrometers (EPA, 2014). If inhaled into the body it can penetrate the lower respiratory tract and can pass through the bloodstream (Irniza *et. al.*, Cheng *et. al.*, 2012). In the body, particulates can settle into the respiratory tract through several physical mechanisms such as sedimentation, impaction, diffusion, interception, and electronic precipitation (Hastiti, 2013). Particulates with a size of PM_{2.5} can be inhaled and deposited in the respiratory organs. On long-term exposure, PM_{2.5} can cause acute respiratory infections.

The Government of Indonesia based on Government Regulation Number 41 of 1999 concerning the threshold value issued a threshold value of PM_{2.5} in ambient air which was 65 g/m³ (average per 24 hours). Based on research in China, exposure to PM_{2.5} and PM₁₀ in a short time has an impact on increasing the risk of the cardiovascular system and some physiological disorders in the respiratory system, such as decreased lung function, as well as disrupting the respiratory cavity of someone who has a history of asthma (Pui *et. al.*, 2014). According to WHO (2010), PM_{2.5} can also cause respiratory tract infections (ARI), lung cancer, cardiovascular disease, premature death, and chronic obstructive pulmonary disease.

Based on research conducted by Marpaung (2012) related to the effect of PM_{2.5} intake_{2.5} and the incidence of pulmonary function disorders of traders at the Depok city integrated terminal, it shows that there is a significant relationship between the value of OR = 6.5 (*p-value* = 0.004). A similar study was also conducted by Komariah (2016) which showed that there was a significant relationship between impaired lung function and PM_{2.5} with the proportion of the sample of 50% experiencing restrictive and 10.9% experiencing obstructive.

Smoking fish is one of the livelihoods of the Indonesian population in coastal areas other than fishermen. Fish smoking is one of the traditional fish preservation processing processes and the antimicrobial compounds contained in the smoke from burning fuel such as aldehydes, alcohols, and ketones can inhibit the growth of spoilage bacteria and the occurrence of protein coagulation in fish so that fish can survive from spoilage bacteria (Harahap, 2010). 2011). Coconut shell fuel is included in the category of hardwood species consisting of lignin, cellulose, hemicellulose, and ash with a moisture content of 6%-9% (Harahap, 2011). The smoke produced by burning coconut shells in the fish-smoking environment is a problem that exists in the fish-smoking room. The smoke from burning coconut shells can produce pollutants consisting of CO₂, HC, NO₂, and particulates (Hidayat *et al.*, 2012). According to the EPA (2014), biomass burning can produce smoke, while the fine particles in the smoke are PM_{2.5} and PM₁₀.

Ternate City is a coastal area where most of the people are fishermen. The catch of fish is processed as smoked fish, and the smoking area in Ternate City is not equipped with a chimney, so it has the potential for indoor and outdoor pollution. Therefore, this research was conducted to minimize the occurrence of air pollution.

RESEARCH METHODS

Research design *pre-experimental* with the *one group pre-post test design* which aims to analyze the causal relationship by involving one group of subjects (Nursalam, 2015), so this study analyzes the effectiveness of a simple filtering system using banana stem material. For PM_{2.5}. The sample size is 10 fish smoking houses which were taken using *a simple random sampling technique*. This analysis uses *Paired T-Test*.

RESULTS AND DISCUSSION

Table 1. Paired Sample T-Test Effectiveness of Simple Filtration Equipment Made from Bananas in Reducing PM_{2.5} in

Variable	Mean	Significance/ p-Value
Pre-test PM _{2.5}	3175,70	0,048
Post-test PM _{2.5}	605,97	

Source: Primary Data, 2021

Based on table 1 shows that the calculation uses the *Paired Samples T Test*, the p-value is 0.048 which is less than the critical research limit (< 0.05), so it can be concluded that the hypothesis is to accept H1. This means that there is a significant difference between PM_{2.5} before and after which means that a simple filtration device made from banana midrib is effective in reducing PM_{2.5} in fish smoking houses in Ternate City.

This study uses a filtration device as an appropriate technology tool (TTG) which is tested on air pollution in the form of PM_{2.5} and PM₁₀ in fish smoking areas. Air filtration is air filtration used in air health studies to minimize air pollution caused by industrial and transportation activities. So in seeing this, the researchers conducted research related to air pollution caused by the burning of smoked fish using local ingredients, namely banana midrib. The purpose of this study was to see the effectiveness of the banana midrib filtering system on PM_{2.5}. Analysis of the results of PM_{2.5} using *Paired Samples T Test*, then the p-value of 0.048 which is less than the critical research limit (< 0.05), so it can be concluded that the hypothesis is accepted H1. This means that there is a significant difference between PM_{2.5} before and after which means that a simple filtration device made from banana midrib is effective in reducing PM_{2.5} in fish smoking houses in Ternate City.

This is due to the content of banana stems which generally have high biomass. The results of the study by Fahrurozi et al (2010), stated that in plants that have high biomass, the oxygen supply is high so it decreases.

The results of this study are supported by Meitri (2014) that banana midribs and leaf stalks are used to filter dirty air full of carbon monoxide. From the results of this study, the dried and processed fronds were made into a carbonation filter, when mounted on a motor, it could filter carbon monoxide up to 76%, and when a mask was made, the filtration effect was 94% (Meitri Widya 2014). The research of St. Mu'tamirah and Baharuddin Sunu (2019) also stated that the results of the CO measurement at point 1 carried out at the *traffic light fly-over* before filtering was 60 ppm and decreased by 40 ppm after passing through the banana midrib and *zeolite* so that it became 20 ppm. . This shows that the banana midrib alone can

filter gas parameters, especially *particulate matter* produced by combustion. This is also in line with research by Arba et al (2021) which stated that the concentration of PM_{2.5} after being filtered using a filter made from banana midrib decreased compared to before being filtered, meaning that the banana midrib filter was effective in filtering PM_{2.5}, there was a decrease in PM_{2.5} on the motor. Kawasaki and Yamaha use banana midrib filters, and there are differences in PM_{2.5} on Kawasaki and Yamaha motorcycles. The banana midrib is the same as coconut fiber which has the potential as a biomass filter, an absorbent, and bioaccumulation of heavy metals. This is because it has a high percentage of cell wall material as a source of metal binding and also biomass. And also has a high content of cellulose in the form of fibrous compounds and has high tensile stress so it is possible to use it as a biomass filter capable of absorbing PM_{2.5} and PM₁₀. In addition, banana fronds are available in abundance, are cheap, and have less economic value.

The results of previous studies stated that banana fronds or stems can be used as filter media because they have cellulose content and high hygroscopic ability. The high cellulose content in banana stems allows it to be used as an absorbent medium (Prabawati & Wijaya, 2008). Hygroscopic properties are useful for absorbing harmful inorganic chemicals (Edahwati, 2012). The vascular bundle system in banana stems consists of *xylem* and *phloem* arranged scattered (Intiro, 2013).

Banana fronds have the potential to reduce particulate matter, whereas the use of banana stems as filter media can reduce PM_{2.5} in the smoking process of fish. This is due to the influence of biological processes from banana stems and the high percentage of organic matter and biomass in banana stems. The use of banana stem filter media directly (continuously) for a long time can provide an alternative to air sanitation technology using filter media from natural materials or organic materials that are easy and inexpensive. It is hoped that the use of banana stems will be able to neutralize particulate matter in the results of smoking fish. The results of this study are an appropriate technological tool from banana stems that can help the community in minimizing health problems due to smoke exposure. According to RE Hester *et al*, (2016) that smoke exposure is one of the causes of health problems such as ARI in children, chronic obstructive pulmonary disease, asthma, and lung cancer. The source of smoke comes from human activities which can be in the form of biomass burning (household wood burning, forest fires, and others) and also includes cigarette smoke.

CONCLUSION AND RECOMMENDATION

Based on the results obtained from this study, it can be concluded that there is a significant effect between air filtration made from banana midrib in reducing the concentration of PM_{2.5} with a significance value (p-value) = 0.05 (p < 0.05).

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