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Overview of Air Microbiological Quality at The Microbiology Laboratory at Campus III Poltekkes Kemenkes Surakarta

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Abstract: *Indoor air quality is a problem that needs attention because it will affect human health. A laboratory is a place for a group of people who carry out various kinds of activities, both practicum, research, observation, training, and scientific testing. In the laboratory room where there is microbial contamination that can cause disease and can be transmitted through equipment, materials used, laboratory and research samples, and laboratory visitors. This research was conducted to know the description of the quality of air microbiology at the Microbiology Laboratory Campus III Poltekkes Kemenkes Surakarta. The study began with the isolation of air microbes in the Microbiology Laboratory of Campus III Poltekkes Kemenkes Surakarta with PCA (Plate Count Agar) media, continued with colony counting and macroscopic observations of the colony characteristics found. Microbes were found in the air at a predetermined air intake point. There were 4 colonies of air in the instructor's workroom, 19 colonies of air in the laboratory, 1 colony of air in the laboratory equipment and materials storage room, 16 colonies of air outside the laboratory, 13 colonies of air near the laboratory bathroom. At the five sampling points, the number of microbial colonies still met the standard. However, the presence of microbes in the air needs attention, because indoor air quality can affect human health.*

INTRODUCTION

Microorganisms can live everywhere, not only in open spaces but in closed spaces. The life of microorganisms in an enclosed space is easier to control than in an open space. If in a closed room, the life of microorganisms can be controlled, then the room can be categorized as a sterile room (Darmadi, 2009). Air as an important environmental component in life needs to be maintained and improved in quality so that it can provide support for living things to live optimally (Prihudoyo, 2019). Air can be grouped into outdoor air and indoor air. Indoor air quality greatly affects human health, because almost 90% of human life is indoors (Kim et al., 2021).

The causes of indoor air quality problems include the presence of microbes. Microorganisms

that are spread indoors are known as bioaerosols. Indoor bioaerosols can come from the outside environment and contamination from indoors (Kalwasińska et al., 2012). From the outside environment, it can be in the form of fungi originating from decaying organisms, dead plants, and animal carcasses, bacteria originating from soil-borne which penetrate the space, microbes near ponds or lakes entering the room through wind gusts, and microbes in the environment. Outdoor space that can penetrate closed buildings. Contamination that comes from inside the room, namely at humidity between 25-75%, fungal spores will increase and there will be an increase in fungal growth (Fitria et al., 2008).

Indoor air quality is a problem that needs attention because it will affect human health (Mukono, 2014). Indoor air quality is the air in a building that is inhabited or occupied for at least 1 hour by people with different health statuses (Arjani, 2011). Air quality levels that do not meet standards will cause symptoms such as sneezing, coughing, skin irritation, shortness of breath, respiratory tract, eye irritation, headaches (Corie, *et al*. 2005). These rooms can be used as offices, schools, transportation facilities, shopping centers, hospitals, residential homes, and laboratories.

The laboratory is a place to apply scientific theory, theoretical testing, experimental evidence, research, and so on by using tools that are completeness of facilities with adequate quantity and quality (Saleh, 2006). A laboratory is a place for a group of people who carry out various kinds of research activities, observations, training, and scientific testing as an approach between theory and practice from various disciplines. Physically, the laboratory can also refer to a closed room, room, or open space (Saleh, 2006).

In a laboratory room where microbial contamination can cause disease and can be transmitted through equipment, materials used, practicum and research samples, as well as laboratory visitors (Khan et al., 2017). Transmission of microorganisms to humans occurs by certain mechanisms, for example by blowing wind, water droplets or droplets, coughing or sneezing splashes, conversation, and contact with equipment surfaces (Kollef et al., 2021).

Microorganisms in the air are a very significant element of pollution as a cause of symptoms of various diseases (Susanto et al., 2019). Microorganisms can be in the air in various ways, especially from flying dust. The number of colonies of microorganisms in the air depends on the activity in the room and the amount of dust and other impurities. A dirty room will contain air that contains a lot of microorganisms than a clean room (Moerdjoko, 2004).

Microorganism contamination is the most influential parameter on indoor air pollutants. Infection can be caused by the microbiological quality of the room air because several ways of transmitting microorganisms that cause infection can be transmitted through the air (Susanto et al., 2019). Air in public spaces is unconsciously being shared by many people. Microorganisms bacteria and fungi that are spread in the air (bioaerosols) will be inhaled and cause infectious diseases if they are pathogenic. According to Yusup *et al*. (2014), Although not yet included in the pollutant criteria, bioaerosols are an important indoor air quality parameter because they pose a risk of contamination among humans.

Given that there are many microbes in the air we breathe, the microbes in the air are one of the determinants of air quality in terms of microbiology. One of the laboratories at Campus III Poltekkes Kemenkes Surakarta is a microbiology laboratory that is used as a support for learning and research on microbiology. However, so far the microbiological quality of the air in the environment around the laboratory has not been tested. Based on this background, research was conducted to test the Air Microbiological Quality at the Microbiology Laboratory at Campus III Poltekkes Kemenkes Surakarta.

METHOD

Research Materials and Tools. The materials used include air samples from the Microbiology Laboratory Campus III Poltekkes Kemenkes Surakarta, PCA (Plate Count Agar) media, spirit, 70% alcohol, equates, tissue. The equipment used includes a bunsen burner, incubator, autoclave, oven, hot plate, stirring rod, spray bottle, beaker, Erlenmeyer flask, analytical balance, petri dish, aluminum foil, sterile cotton.

Making of microbial growth media. The media used in this study is PCA (Plate Count Agar) media. Making the media is done by weighing the media according to a predetermined formula, then put into 1000 mL of distilled water. The solution was homogenized and boiled using a hot plate and a magnetic stirrer. Covered with aluminum foil. Sterilized by autoclaving at 121°C for ± 15 minutes at a pressure of 1.5 atm. Next, the media was poured into sterile Petri dishes and allowed to solidify.

Sampling. Sampling was carried out at a predetermined point. Air sampling was carried out using a petri dish containing PCA media which was placed separately at 5 predetermined points, with the lid of the cup open and left for 10 minutes. Then incubated at 37°C for 24 hours (Incubation was carried out in an inverted cup position). Colonies growing in each plate were counted and observed for colony characteristics, including colony shape, colony edge, colony color, surface rise, and number.

RESULT AND DISCUSSION

An overview of Air Microbiology Quality at the Microbiology Laboratory at Campus III Poltekkes Kemenkes Surakarta can be seen in Table 1. below.

Table 1. Overview of Airborne Microbial Colonies in the Microbiology Laboratory

Sampling Point	Source Location	Number of Colonies	Colony Features
1	The air inside the Instructor's Workspace	4	the shape of the colonies is circular, the color of the colonies is solid white, the increase in the flat surface is thin evenly.
2	Air in the main part of the laboratory	19	the shape of the colonies is circular, irregular, punctiform, filamentous, the color of the colonies is white and dense white, the increase in the flat surface is thin evenly and slightly raised.
3	Air in the laboratory equipment and materials storage room	1	the shape of the colonies is circular, the color of the colonies is solid white, the increase in the flat surface is thin evenly.
4	Laboratory outdoor air	16	the shape of the colonies is circular, irregular, amoeboid, the color of the colonies is white and dense white, the increase in the flat surface is thin evenly, convex, and slightly raised.
5	The air near the Laboratory bathroom	13	the shape of the colony is circular and irregular, the color of the colony is white and solid white.

Sampling Point	Source Location	Number of Colonies	Colony Features
			flat surface rise, thin evenly, convex, and slightly raised.

This research was conducted to know the Air Microbiological Quality at the Microbiology Laboratory at Campus III Poltekkes Kemenkes Surakarta. Air samples were obtained from 5 points in the Laboratory area, namely the air inside the instructor's workroom, the air in the main part of the laboratory, the air inside the laboratory equipment and materials storage room, the air outside the laboratory room, and the air near the laboratory bathroom.

The research procedure begins with the preparation of PCA (Plate Count Agar) medium which is a solid medium containing nutrients as an energy source for microorganisms to support their growth. Air sampling was carried out using a petri dish containing PCA media which was left open for 10 minutes, after that it was closed again and incubated at 37 ^{0}C for 24 hours. Furthermore, the number of colonies was counted and macroscopic observations were made based on the characteristics of the colony.

The results of the study of colony growth from air samples are as shown in Table 1., it can be seen that the colonies found in the air from the instructor's room were as many as 4 colonies. This could be due to the instructor's room being clean and rarely used because the instructor's activities were mostly in the center of the laboratory for practicum and preparation purposes. And for the microbes found in the tools and materials storage room, only 1 colony was found. This can be caused because the room is rarely used for activities. For microbes found in the main part of the laboratory as many as 19 colonies, outside the laboratory room as many as 16 colonies, and bathroom located outside the laboratory as many as 13 colonies. This can be due to the air outside the laboratory room, dynamic area conditions, and the mobility of motorized vehicles that can lead to the entry of pollutants, including microorganisms. This is following the report of (Yousefzadeh et al., 2021) which showed that the concentration of microorganisms in outdoor air was higher.

Based on literature studies, in general, microbes found in laboratory air come from samples brought to the laboratory, normal flora on the skin and nasal mucous membranes, dust, water, or microbes from the laboratory environment. Air is not a habitat for micro-organisms, the cells of microorganisms present in the air as contaminants are dispersed in the air through dust grains or the residue of dry droplets of saliva. According to (Irianto, 2006), microbial flora in the air is temporary and varied. Air is not a medium in which microorganisms grow but is a carrier of particulate matter, dust, and liquid droplets, all of which make it possible to carry microbes. The level of air pollution in the room by microbes is influenced by the density of people and the activities of the people who occupy the room. Research conducted by Hassan *et al*. (2021), stated that the test of microbiological contamination in the air in public libraries, it was found that several genera of bacteria were found in the library, including *Bacillus* spp., *Staphylococcus* spp., and *Micrococcus*. As is known, many *Staphylococcus aureus* are resistant ((Jamilatun, 2019). Added by Luksamijarulkul *et al*. (2014), microbial contamination was found in the laboratory at a hospital in Bangkok, Thailand also found microbes. The most common bacterial colonies were *Staphylococcus* spp., while the most common fungal colonies were *Aspergillus* spp.

There is no specific standard for the quality of air microorganisms in the laboratory, so the presence of microorganisms in the results of this study refers to indoor air quality standards in general. There is no specific standard for the quality of air microorganisms in the laboratory, so the

presence of microorganisms in the results of this study refers to indoor air quality standards in general. In the decision, it was determined that the standard for total microbes (bacteria, fungi, and fungal spores) was less than 700 CFU/m3 and free of pathogenic microbes. It is also supported by the World Health Organization (WHO) which defines 500 CFU/m3 as an acceptable condition (Hänninen, 2011). Thus, the microbes found at several sampling points indicate that the air quality still meets the Indonesian Government standards.

However, the presence of these microbes that have been found needs attention, because indoor air quality can affect human health (Mukono, 2006), and can cause *Sick Building Syndrome*. The World Health Organization (WHO) defines Sick Building Syndrome as a result of work-related irritation of the skin and mucous membranes and other symptoms including headaches, fatigue, and difficulty concentrating which are complained by workers in the building (Van Tran et al., 2020). The air in the laboratory room is unconsciously being shared by many people. Microorganisms that are spread in the air will be inhaled and cause infectious diseases if the microbes are pathogenic. According to Yusup *et al*. (2014), although it has not been included in the pollutant criteria, microorganisms that are spread in the air can pose a risk of contamination among humans. Microorganism contamination in the air has a bad effect on health, especially if there are pathogenic species because it can cause inflammation, allergic responses, and infections (Wei et al., 2017). Therefore, it is necessary to carry out disinfection efforts every day. These disinfectants are also used to disinfect the room and the contents of the laboratory. Also, there is an obligation to wash hands for laboratory visitors before and after activities in the laboratory.

CONCLUSION

Based on the results of the study, microbes were found in the air at a predetermined air sampling point at the Microbiology Laboratory of Campus III Poltekkes Kemenkes Surakarta. There were 4 colonies of air in the instructor's workroom, 19 colonies of air in the laboratory, 1 colony of air in the laboratory equipment and materials storage room, 16 colonies of air outside the laboratory, 13 colonies of air near the laboratory bathroom. The number of microbial colonies found at the five sampling points still met the standard. However, the presence of microbes in the air needs attention, because indoor air quality can affect human health.

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