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BACTERIOLOGICAL QUALITY TEST OF AIR IN THE CLASSROOMS OF DARUR ABROR FOUNDATION SCHOOL WEST LOMBOK REGENCY IN 2022

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Abstract: This study aims to determine the air quality in the classroom. The study showed the quality of air bacteria in the classrooms at the Darur Abror Foundation School (Sudak Gardens Hamlet, Terong Tawah Village, Labuapi District, West Nusa Tenggara, Indonesia) exceeded the predetermined limit on the number of germs in the room. According to Minister of Health Regulation No. 1405/MENKES/SKXI/2002, the germ number is 200-500 CFU/m3. The number of bacteria in the classroom is 2,699 CFU/m^3. The most abundant characteristic according to the size of the bacteria is pinpoint. The shape of bacteria based on the number is circular, and the color of most bacteria is white.

Keywords: *Air Bacteria, Colony Number, Bacteria Characteristics*

INTRODUCTION

Air is the essential component in life; the composition of normal Air consists of a mechanical mixture of 78.1% nitrogen gas, 20.93% oxygen, and 0.03% carbon dioxide, the rest in the form of argon, neon, krypton, xenon, and helium gases. Air contains moisture, dust, bacteria, spores, and plant debris. Air plays a role in providing oxygen, regulating the earth's temperature according to the needs of human life, and protecting the earth from sunlight, especially ultraviolet rays [1]. Indoor pollution is increasing because humans spend 93% of their time indoors, 5% traveling, and only 2% in the open Air. In addition, the importance of maintaining indoor air quality is related to the comfort of the work environment and the health of room users. Health problems can occur, especially in areas of the body or organs in direct contact with the Air, such as the skin, eyes, and nose.

Sources of air pollution can be in the form of physical, chemical, and biological pollution. Microorganisms cause sources of indoor biological air pollutants. Based on data from research conducted by the National Institution for Occupational Safety and Healthy (NIOSH), is explained that microorganisms are one of the harmful pollutants in indoor Air. Microorganisms present in the Air are identified as the cause of various diseases, such as irritation of the eyes and skin and respiratory problems, and the Air is capable of being a medium for the spread of various infectious diseases such as diphtheria, tuberculosis, pneumonia, whooping cough [2].

Indoor air quality is the Air in a building inhabited for at least 1 hour by people with different health conditions [3]. The diversity of bioaerosols in the circulation system in a room determines air quality. Examples of airborne bioaerosols are bacteria (*Legionella, Actinomycetes*), fungi (*Histoplasma, Alternaria, Penicillium, Aspergillus, Stachybotrys, aflatoxins*), protozoa (*Naegleria, Acanthamoeba*), viruses (*Influenza*). To a limited extent, the existence of bioaerosols cannot affect anything, but in certain quantities and inhaled will cause respiratory infections such as asthma and allergies [4]. One of the biological substances found in the Air is microorganisms. Microorganisms scattered in space are known as bioaerosols. Bioaerosol is a collection of particles such as spores, pollen, bacterial cells, and viruses suspended in a gas medium [5].

One of the microorganisms that are often found in the room is bacteria. Bacteria in the Air is a significant element of pollution because it can cause upper respiratory tract infections, tuberculosis, pneumococcal pneumonia, meningococcal meningitis, and troop disease. According to the Decree of the Minister of Health of the Republic of Indonesia, the number of bacteria in the room must meet indoor air quality standards. Types of bacteria such as Staphylococcus sp and Streptococcus sp are found in the Air through coughing, sneezing, and talking. Several other species were detected to contaminate the Air, including Pseudomonas sp Klebsiella sp, Proteus sp, Bacillus sp, and fungi [2].

Indoor air bacteria are commonly found in public places, including classrooms. As one of the educational institutions, the factors that can support the teaching and learning process must be met. One of the factors that can support the teaching and learning process are health and the learning environment. The Darur Abror Foundation school classrooms are used as a place for teaching and learning. The room that is often used has the

potential to pollute the air quality in the room. Especially microorganisms in the form of bacteria if not done with proper hygiene care. As explained above, poor air quality will have a high risk of contracting a disease. According to the Decree of the Minister of Health of the Republic of Indonesia No. 1405/Menkes/SK/XI/2002, the indoor air bacteria count index has a maximum concentration limit of 200-500 CFU/m3.

RESEARCH METHODS

This type of research is Experimental. The tools used are (1) Cool Box; (2) Autoclave; (3) Rubber Bulb; (4) Bunsen; (5) Petri dish; (6) Erlenmeyer; (7) Incubator. The materials used are (1) Aquades: (2) Alcohol; (3) Handscoon; (4) Labels; (5) Nutrient Agar (NA). The research procedure was carried out by making 250 milliliters of NA medium, which was previously sterilized for 20 minutes at 1210C in Petri dishes (tools) and NA media. Then after the manufacture of the agar medium and the sterilization process is complete, the agar medium is poured into a petri dish then, covered with a sterile Petri cover, and allowed to stand until the agar medium solidifies. Then it is ready to be used in the field. After that, six Petri dishes of NA media were prepared for indoor testing, of which 2 Petri dishes were in the morning and 4 Petri dishes in the afternoon. Each Petri containing agar medium was then placed at a predetermined sampling point. The Petri cover was left open, so the medium was exposed to room air and left for 15-30 minutes. After 15-30 minutes, the Petri is then put into a Cool box in the laboratory, and the sample is incubated for 2 times 24 hours. After incubation, the sample examination method was carried out; the colonies that grew after being incubated for 2 x 24 hours at 37ºC were counted on the media with units of CFU/m3. Bacterial colonies that grow after incubation are counted with the following requirements: (1) Large, small, spreading colonies are counted as 1 colony because they are considered to come from one bacterium; (2) Counting can be done manually by putting a dot on the counted colonies, and (3) According to the Permenkes the germ number index obtained is given in units of CFU/m3. Conversion: 1 colony CFU/m^3 = 35.32 CFU/m^3 Where the standard of the Minister of Health No. 1405/MENKES/SKXI/2004, the germ number is 200-500 CFU/m^3.

RESULTS AND DISCUSSION

Number of Bacteria Index

The results of measuring the number of germs in two classrooms at the Darur Abror Foundation were determined according to the Indonesian minister of Health category, which can be seen in Table 1.

Table 1. Bacteria Number Index

Code Sample	Parameter	Result	Units	Information	PERMENKES No.1405 2002
Class A Morning	Air bacteriology	1,171.52	CFU/m^3	DC	200-500
Class B Morning	Air bacteriology	2,699	CFU/m^3	DC	200-500

Noted:
Q = Qualify
DC = Did not fulfill the conditions

Bacteria Size Characteristics

Characteristics are the characteristics possessed by one bacterium in terms of shape, size, surface, color, elevation, and margins [6-8]. The observation of characteristics can be done utilizing macroscopic observations. Macroscopic morphological observation looks at the characteristics of bacteria according to size, shape, surface, color, elevation, and margins.

The results of Table 2 show that the 2 classrooms studied at the Darul Abror Foundation at the time of collection in the morning. The most bacterial size was pinpoint, with 50 colonies, and the lowest was large, with 10 colonies. Color is one of the more visible differentiators of a bacterium.

Table 2. Characteristics According to Colony Size

Code Sample	Size			
	Pinpoint	Small	Moderate	Large
Class A Morning	17	13	2	4
Class B Morning	33	19	17	6
Amount	50	32	19	10

Characteristics According to Colony Color

The most common colors found in the characterization of airborne bacteria are shown in Table 3.

Table 3. Characteristics by Colony Color

Code Sample	Color		
	White	Yellow	Pink
Class A Morning	26	5	2
Class B Morning	68	7	-
Amount	94	12	2

Characteristics According to Colony Form

Form is one of the visible differences from a bacterium. Based on research that has been done in 2 classrooms, the shapes observed are circular, irregular, filamentous, and rhizoid. The results of the characterization research according to the form of the colony based on the number can be seen in Table 4.

Tabel 4. Characteristics According to Colony Form

Sample Code	Characteristic			
	Circular	Irreguler	Filamentous	Rhizoid
Class A Morning	22	11	2	1
Class B Morning	50	19	6	-
Amount	72	30	8	1

Bacteriological Quality of Air in Classroom

Based on the research, colonies that grew after being incubated for 2 x 24 hours at 37ºC were counted on the media by manual calculation with units of CFU/m^3. Table 1 shows that from 2 classrooms studied at the Darur Abror Foundation with sampling at 08.26 am, the germ number exceeded the threshold determined regarding the number of germs in the room according to the Minister of Health. This study's results align with research, physical conditions and the number of germs in the room [9-13]. The results show that the index of germ numbers in the public health faculty lecture hall is 639.576 CFU/m^3, and the average index of germ numbers in the room is 200-500 CFU/m^3, so it is not by the maximum limit that has been determined. In the library room at Diponegoro University, where the air quality in the Diponegoro University environmental engineering library is 34 CFU/m^3 [14-19].

The study's results to examine the number of bacteria carried out in 2 classrooms at the Darur Abror Foundation obtained the highest germ number index in class B with a colony number of 2,699 CFU/m^3 in the morning. The number of bacteria in the corner of the classroom is relatively more. Because the corner of the room is often not cleaned, many bacteria gather there. It can be a reference that the cleanliness of the room in the classroom must be considered again. It not only sweeps the floor and cleans the table, but also in more detail, such as cleaning the dust in the cupboards and cleaning the room with room cleaners that contain disinfectants or other anti-bacterial. Most of the bacteria in the room can be removed so that the room becomes healthier and cleaner, the scale and schedule for cleaning the room can be rerouted, as well as optimizing the use of natural ventilation as a means of changing indoor Air so that the room can be healthier [20].

Based on previous research, the number of bacteria in each different room is influenced by several things: microbiologically, with indicators of the number of bacterial colonies in the room. Cleaning the room that needs to be carried out correctly or according to standards will affect the number of bacterial colonies in the room. High humidity will increase the growth of microorganisms. The air quality will be affected if the air temperature is too hot. Lighting in the room should be considered because lighting is also a disinfectant to kill bacteria. The condition of the door is not closed, which can cause contamination from outside.

Characteristics of Indoor Air Bacteria

Bacterial colonies were incubated at 370C for 24 hours on the surface of NA (Nutrien Agara) medium in a petri dish. In macroscopic observations on NA medium in a petri dish, including colony size, colony shape, and colony color. Based on the characteristic research according to the size of the bacteria, the highest number is pinpointed. Characteristics according to the shape of bacteria based on the number are Circular. Characteristics according to the color of the bacteria, the highest number is white.

In contrast to the results of the research on bacterial characteristics conducted by Veny [21], the characterization of bacteria according to their size based on their number was Small. The characterization of bacteria according to the shape based on the most numerous is Circular. The characterization of bacteria according to color based on the most numerous is yellow.

CONCLUSION

The classrooms studied at the Darur Abror Foundation school; two rooms did not meet the healthy air quality standards based on the Minister of Health Regulation No. 1405/MENKES/SK/2002. The two classrooms at the Darur Abror Foundation obtained a number of colonies, 2,699 CFU/m^3.

REFERENCES

[1] Chandra, B. (2006). Pengantar Kesehatan Lingkungan Jakarta. *Jakarta: Penerbit Buku Kedokteran*.

[2] Irianto, K. (2007). Mikrobiologi Menguak Dunia Mikrobiologi Jilid 2. *Bandung (ID): CV. Yrama Widya*.

[3] Dewi, W. C., Raharjo, M., & Wahyuningsih, N. E. (2021). Literatur Review: Hubungan Antara Kualitas Udara Ruang Dengan Gangguan Kesehatan Pada Pekerja. *An-Nadaa: Jurnal Kesehatan Masyarakat (e-Journal)*, *8*(1), 88-94.

[4] Kalwasinska, A., Burkowska, A., & Wilk, I. (2012). Microbial air contamination in indoor environment of a university library. *Annals of Agricultural and Environmental Medicine*, *19*(1).

[5] Santoso, I. (2015). *Kesehatan lingkungan permukiman perkotaan*. Gosyen Publishing.

[6] Padder, S. A., Dar, G. H., Bhat, Z. A., Verma, K., & Wani, A. B. (2017). Morphological metabolic and biochemical characterization of bacterial root endophytes associated with brown sarson (Brassica rapa L.). *Journal of Pharmacognosy and Phytochemistry*, *6*(2), 226-232.

[7] Zahan, K. A., Azizul, N. M., Mustapha, M., Tong, W. Y., & Rahman, M. S. A. (2020). Application of bacterial cellulose film as a biodegradable and antimicrobial packaging material. *Materials Today: Proceedings*, *31*, 83-88.

[8] Krishnamoorthy, A., Agarwal, T., Kotamreddy, J. N. R., Bhattacharya, R., Mitra, A., Maiti, T. K., & Maiti, M. K. (2020). Impact of seed-transmitted endophytic bacteria on intra-and inter-cultivar plant growth promotion modulated by certain sets of metabolites in rice crop. *Microbiological research*, *241*, 126582.

[9] Dewi, A. K., Sudaryanto, S., & Amalia, R. (2018). Penggunaan Ekstrak Kulit Jeruk Nipis (Citrus aurantifolia) pada Berbagai Jarak Paparan terhadap Penurunan Angka Kuman Udara di Puskesmas Sewon II Bantul. *Sanitasi: Jurnal Kesehatan Lingkungan*, *10*(2), 58-64.

[10] Schmidt, M. G., von Dessauer, B., Benavente, C., Benadof, D., Cifuentes, P., Elgueta, A., ... & Navarrete, M. S. (2016). Copper surfaces are associated with significantly lower concentrations of bacteria on selected surfaces within a pediatric intensive care unit. *American journal of infection control*, *44*(2), 203-209.

[11] Meride, Y., & Ayenew, B. (2016). Drinking water quality assessment and its effects on residents health in Wondo genet campus, Ethiopia. *Environmental Systems Research*, *5*(1), 1-7.

[12] Eisenlöffel, L., Reutter, T., Horn, M., Schlegel, S., Truyen, U., & Speck, S. (2019). Impact of UVC-sustained recirculating air filtration on airborne bacteria and dust in a pig facility. *PloS one*, *14*(11), e0225047.

[13] Skóra, J., Gutarowska, B., Pielech-Przybylska, K., Stępień, Ł., Pietrzak, K., Piotrowska, M., & Pietrowski, P. (2015). Assessment of microbiological contamination in the work environments of museums, archives and libraries. *Aerobiologia*, *31*(3), 389-401.

[14] Chaudhary, V., Ashraf, N., Khalid, M., Walvekar, R., Yang, Y., Kaushik, A., & Mishra, Y. K. (2022). Emergence of MXene–polymer hybrid nanocomposites as high-performance next-generation chemiresistors for efficient air quality monitoring. *Advanced Functional Materials*, *32*(33), 2112913.

[15] Rahayu, E. P., Saam, Z., Sukendi, S., & Afandi, D. (2019). The Factors of Affect Indoor Air Quality Inpatient at Private Hospital, Pekanbaru, Indonesia. Open Access Maced J Med Sci. 2019 Jul 15; 7 (13): 2208-2212.

[16] Noya, L. Y. J., Wahyuningsih, N. E., & Joko, T. (2020). Pemeriksaan Kualitas Udara Ruang yang Berhubungan dengan Angka Kuman di Ruang Operasi Rumah Sakit Sumber Hidup di Kota Ambon 2020. *Jurnal Kesehatan Masyarakat (Undip)*, *8*(5), 679-686.

[17] Rompas, C. L., Pinontoan, O., & Maddusa, S. S. (2019). Pemeriksaan angka kuman udara di ruang rawat inap rumah sakit umum GMIM pancaran kasih manado. *KESMAS*, *8*(1).

[18] Praptiwi, J., Rahardjo, S. S., & Sunarto, S. (2021). Environmental Management Strategy to Control Air Germs in Tjitrowardojo District Hospital. *JURNAL KESEHATAN LINGKUNGAN*, *13*(1), 9-16.

[19] Santri, I. N., & Suryani, D. (2015). Relation between temperature and wards humidity with air germs number in inpatient unit of RS PKU Muhammadiyah Jogjakarta. *JKKI: Jurnal Kedokteran dan Kesehatan Indonesia*, *7*(1), 19-24.

[20] Moerdjoko, M. (2004). KAITAN SISTEM VENTILASI BANGUNAN DENGAN KEBERADAAN MIKROORGANISME UDARA. *DIMENSI: Journal of Architecture and Built Environment*, *32*(1).

[21] Brągoszewska, E., & Biedroń, I. (2018). Indoor air quality and potential health risk impacts of exposure to antibiotic resistant bacteria in an office rooms in Southern Poland. *International Journal of Environmental Research and Public Health*, *15*(11), 2604.