Environmental and Toxicology Management (2025), **5.1**, 42–48

RESEARCH ARTICLE

Identification of the presence of indoor air bacteria in the kitchen installation of Rumah Sakit TNI AU Soemitro Lanud Muljono (RSAU) Surabaya

Wahyu Febriansa[1*]

[1]Department of Public Health, Faculty of Health, Universitas Nahdlatul Ulama Surabaya, Indonesia

[*]**Corresponding author:** wahyufebriansa0@gmail.com

Article history:
Received : 2025/01/07
Revised : 2025/02/17
Accepted : 2025/04/15
Available Online : 2025/04/25
DOI : 10.33086/etm.v5i1.6833

Abstract

In the new global economy, air pollution has become a central issue for Indonesia, especially in Jakarta and other major cities such as Surabaya. Air pollution in Indonesia not only causes serious health impacts on the population but also can lead to respiratory diseases, cardiovascular diseases, lung cancer, and respiratory tract infections. Several types of bacteria that can spread through the air include Staphylococcus, Streptococcus, Micrococcus, Pseudomonas, and type Sp1 bacteria. Initial studies conducted by researchers have found that until now, the kitchen space at the Rumah Sakit TNI AU Soemitro Lanud Muljono (RSAU) Surabaya has only been inspected for food, beverages, and rectal swabs. The specific aim of this study is to count the number of bacterial colonies in the hospital kitchen installation and to identify the types of bacteria present in the hospital kitchen installation. This type of research is quantitative analytic observational research with a cross-sectional approach. The population in the study is the air bacteria in the kitchen of the Air Force Hospital Surabaya. Samples were taken 4 times during kitchen activities, and the sample size was 24 samples taken over 6 days referring to Kepmenkes 1335/menkes/x/2002. The results of the study found that the average number of bacterial colonies was 55.75 CFU/m3, which still meets the requirements set by Kepmenkes RI Number 1204/Menkes/SK/X/2004. The types of bacteria identified were gram-negative bacill and gram-negative coccus.

Keywords: Bacteria, Colonies, Plate Count Agar

INTRODUCTION

In the new global economy, air pollution has become a central issue for Indonesia, especially in Jakarta and other major cities, the problem of air pollution in Indonesia not only has a serious impact on the health of the population but can also cause respiratory, cardiovascular, lung cancer and respiratory infections. Recent data from the 2021 Air Quality Life Index (AQLI) indicates that air pollution levels could cause Indonesians to lose about 2.5 years of their life expectancy. In addition,

the IQAir World Air Quality 2021 report released in March 2022 revealed that Indonesia was ranked as the 17th most polluted country in the world. The concentration of PM2.5 particles, which have serious health impacts, reached 34.3 g per cubic meter. This fact serves as a warning that the air pollution problem in Indonesia is not only local, but also has a global impact (Sipayung, 2023).

In addition to the problem of outdoor air pollution, it should also be noted that indoor air pollution has great potential as a serious health problem, such as lung disease. This is because humans tend to spend most of their time indoors (Pelczar and Setlow, 2008). The main source of indoor air pollutants is microorganisms. The types of microorganisms found in the air can be identified as the cause of various health problems, such as eye and skin irritation, respiratory problems, and act as a medium for spreading infectious diseases such as diphtheria, tuberculosis, pneumonia, and whooping cough. Research results from the National Institution for Occupational Safety and Healthy (NIOSH) show that microorganisms are one of the potentially dangerous indoor air pollutants (Council et al., 2006).

Some types of bacteria that can be airborne include Staphylococcus, Streptococcus, Micrococcus, Pseudomonas, and Sp1 bacterial strains (Umeh et al., 2021). However, the Sp1 bacterial strain has not been fully identified due to the limited information obtained by researchers, which may require further tests to be properly identified (Osawa et al., 2008). These bacteria can generally be found in the human body in small amounts without causing any serious impact. However, if the number of these bacteria increases significantly and are present in humans who may be more susceptible, they have the potential to cause various respiratory diseases (Smith and Sweet, 2002; Tran et al., 2020).

The Regulation of the Minister of Health of the Republic of Indonesia Number 43 of 2019 concerning Community Health Centers and Permenkes Number 2 of 2023 do not specifically explain that nutrition must be sterile. However, in Permenkes Number 7 of 2023, it is mentioned that medical instruments and materials that are sterilized must go through preparation, including arrangement, packaging, labeling, and sterilization. This shows that sterilization is part of the operational procedures that must be carried out to ensure the safety and quality of health services. The initial study conducted by the researcher resulted in the finding that until now, the kitchen room at the Rumah Sakit TNI AU Soemitro Lanud Muljono (RSAU) Surabaya has only undergone inspection of food, drinks, and rectal swabs. On the other hand, there has been no effort to check the quality of air bacteria in the kitchen. Based on the background description above, the researcher is interested in preparing a thesis proposal with the title "Identification of the Presence of Indoor Air Bacteria in the Kitchen Installation of Rumah Sakit TNI AU Soemitro Lanud Muljono (RSAU) Surabaya".

MATERIALS AND METHODS

Kind of study

This study is a kind of quantitative research using primary data obtained through site observation and air sampling in the kitchen area with Plate Count Agar (PCA) culture media. This procedure is designed to identify the presence of airborne bacteria by the settle plate method, in which PCA media is exposed to the environment for a certain period to capture microbial particles.

Tools and Materials

Sampling procedures were carried out using various laboratory tools, including an analytical balance with an accuracy of 0.001 g, Erlenmeyer with a capacity of 250 mL, ash-free weighing paper, 100 mL measuring cup, sterile Petri dish, glass stirring rod, autoclave at 121°C and 15 psi pressure, incubator at 35±1°C, and light microscope. Materials used include Plate Count Agar medium (Oxoid CM 325), sterile distilled water with a neutral pH (pH 7), and non-absorbent cotton. This combination of tools and materials ensures the sampling process is done accurately and aseptically to produce reliable data.

Procedure of study

Preparation of PCA media begins with weighing 1.35 g of PCA powder using an analytical balance, then dissolving it in 60 mL of distilled water in an Erlenmeyer while being homogenized. The solution was covered with cotton and sterilized in an autoclave for 15 minutes. After cooling to ±45°C, the media was aseptically poured into Petri dishes and allowed to solidify at room temperature before being used for air sampling. This step ensures that the media is ready to capture microbial particles during exposure at the research site. Furthermore, bacteria were taken using PCA, then the number of bacterial colonies was counted manually (Soleha et al., 2015).

RESULTS AND DISCUSSION

Number of Bacterial Colonies in Hospital Kitchen Installations

Table 1 shows the results of the calculation of the number of indoor air bacterial colonies in the kitchen installation of the RSAU Surabaya. Total bacterial colonies at the storage point have 69 colonies, the point of compounding ingredients before cooking has 56 colonies, the point of processing raw materials has 67 colonies, the point of serving has 31 colonies. This means that the average number of bacterial colonies from this study was obtained at 55.75 CFU/m^3, where the maximum standard of bacterial colonies according to the Indonesian Minister of Health Decree No. 1204 / Menkes / SK / X / 2004 concerning Hospital Environmental Health is 200-500 CFU/m^3.

Table 1. The number of indoor air bacterial colonies in the kitchen installation of RSAU Surabaya

Sampling Indoor Point	Day						Total	Average
	1	2	3	4	5	6		
Storage	8	17	9	12	14	9	69	11.5
Compounding ingredients pre-cooking	5	10	8	15	8	10	56	9,3
Processing of raw materials	3	7	16	6	20	15	67	11,2
Serving	7	3	5	7	3	6	31	5,2
TOTAL							223	9.3

Based on air sampling at several points in the kitchen area room. The results of the index number of bacteria at each point in the kitchen area room are still eligible when compared to the quality standard index of the Indonesian Minister of Health Number 1204 / Menkes / SK / X / 2004. Although it still meets the requirements for the number of bacterial colonies at each sampling point in the kitchen area, there are still bacterial colonies that grow even though the number is small. The presence of growing colonies can occur because kitchen area workers who go in and out of the room without removing Personal Protective Equipment (PPE) or washing their hands again, so that bacterial colonies from outside can be carried into the kitchen area. According to Pratiwi (2023), the spread of bacteria can be carried by individuals from outside the room by adhering to PPE clothing which will then spread and contaminate the area in the room through its spread in the air.

Environmental conditions in the kitchen area have poor circulation, uneven lighting levels are only found near the dishwasher, humid, and rather hot temperatures. The rather hot temperature conditions in this kitchen area can be the cause of the low number of colonies that grow, but there are still some bacteria that can grow. Factors that influence the presence of microorganisms that can be found in the air consist of temperature, humidity lighting and the type of microorganism itself (Asri et al., 2024). According to Sriwulan et al. (2023), the higher the temperature in the room, the lower the number of bacteria.

The condition of the kitchen area is not too crowded by individual activities, because in that area there are only kitchen staff and cleaning staff who clean the kitchen area at certain times. This can have an impact on the number of colonies that grow in the kitchen area, so that it does not exceed the quality standards in the Indonesian Minister of Health Decree No. 1204 / Menkes / SK / X /

2004. This is supported by research according to Pratiwi (2023), the density of occupancy in the kitchen area can have an impact on the spread of bacteria this is due to the increasing number of individual activities in the kitchen area.

Cleaning in the kitchen area is carried out regularly by cleaning staff, the point area where cleaning is often carried out is in storage, while for serving points, compounding ingredients before cooking, processing raw materials is carried out cleaning directly after use. However, at the storage point the number of bacterial colonies obtained is higher than the other three points, this can occur because when cleaning at the storage point the material does not use the right disinfectant or cleaning is not evenly distributed, and cleaning is only done at certain times. According to research by (Walid et al., 2019), there are factors that cause the number of microbes in the NonAC room to be high, namely indoor activities, the frequency of going in and out of the room. In the use of disinfectants for cleaning according to Apriliyanto et al. (2022), the use of surfanios disinfectants can reduce the number of bacterial colonies by 80%.

Types of Bacteria in Hospital Kitchen Installations

The results of bacterial identification showed that there are various types of bacterial colonies that grew at four points in the kitchen area. The presence of various types of airborne bacterial colonies that grow, indicates a risk factor for nosocomial infections (Putrayana et al., 2021). Table 2 shows that of the 24 samples there were bacteria, namely Bacillus Sp and Micrococcus Sp. Bacillus Sp bacteria were found in 23 test samples, while Micrococcus Sp bacteria were only found in one sample on day 5 of plate 18. This means that when Bacillus Sp bacteria are present, they can cause vomiting, diarrhea, and foodborne diseases, while Micrococcus Sp bacteria will cause food spoilage quickly.

Table 2. Identification types of bacteria by sampling points

Sample Point Kitchen	Types of Air Bacteria
Storage	Gram Negative, Bacillus
Compounding ingredients pre-cooking	Gram Negative, Bacillus
	Gram Negative, Coccus
Processing raw materials	Gram Negative, Bacillus
Serving	Gram Negative, Bacillus

In this study, from 4 points in the kitchen area taken and grown on PCA (Plate Count Agar) media, all experienced growth. The growing colonies were observed microscopically to see their characteristics through gram staining. From the results of gram staining in Table 2, it was found that 4 points were bacillus-shaped gram-negative bacteria, while at the 2nd point, namely the compounding of food ingredients, there was gram-negative coccus growth. Colonies of gram-negative bacteria look red in the microscope, this is because gram-negative bacteria cannot maintain the color of crystal violet after the addition of gram c (alcohol). According to Sarjono et al. (2020), gram-negative bacteria have the characteristics of a thin lipid layer, which will dissolve after the addition of alcohol, so that the safranin dye can enter the pores of the bacteria.

The types of bacteria obtained are gram-negative bacillus and gram-negative coccus which have been isolated from air samples at four points in the kitchen area (Figure 1), the growth of gram-negative bacillus bacteria in the kitchen area can cause symptoms of diarrhea, abdominal cramps, gastrointestinal infections, and decay. While the growth of gram-negative coccus bacteria in the kitchen area room can cause respiratory infections that have an impact on meningitis. According to Imaniar et al. (2015), the growth of gram-negative coccus bacteria in the air due to exposure through respiratory air, coughing, sneezing, or through saliva splashes, where these bacteria are normal flora of the human respiratory tract.

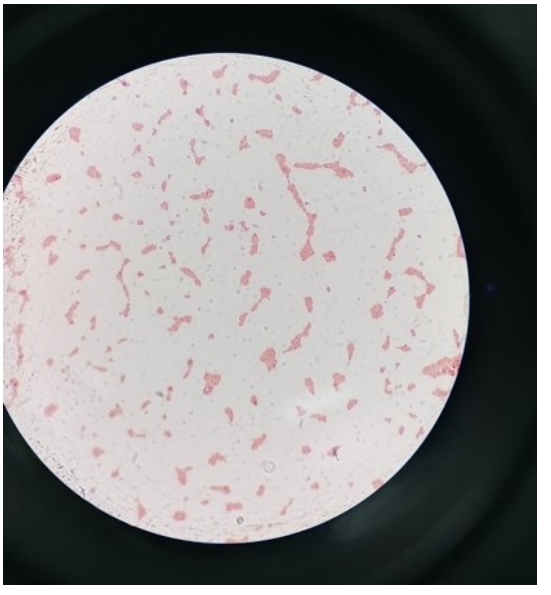

Figure 1. Bacillus and Cocus gram-negative bacteria

The Burden of Gram-negative Bacillus and Gram-negative Coccus Bacteria

Gram-negative bacteria, including Bacillus and Coccus, are significant pathogens to human health due to their ability to cause a variety of serious infections. Infections caused by gram-negative bacteria, such as pneumonia, bloodstream infections and meningitis, can result in severe complications and even death (Tran et al., 2020). In addition, gram-negative bacteria often have complex cell walls, which make them more resistant to antibiotics compared to gram-positive bacteria (Beveridge, 1999; Tavares et al., 2020). This adds to the challenges in the treatment of infections, where antibiotic resistance can lead to therapeutic failure and increase the risk of morbidity and mortality among infected patients.

In addition, the presence of gram-negative bacteria also has the potential to exacerbate public health problems. For example, bacteria such as Escherichia coli and Pseudomonas aeruginosa are known to have the ability to produce beta-lactamase enzymes that amplify resistance to many types of antibiotics. Research shows that the irrational use of antibiotics contributes to the increase of this resistance, thus requiring serious attention from the health sector to control its spread. With the increasing prevalence of resistant gram-negative bacteria in various communities, it is important for health systems to implement more effective infection prevention and control strategies.

CONCLUSIONS

The results of this study confirmed that there were bacteria identified in the kitchen area of RSAU Surabaya, namely gram-negative bacillus and gram-negative coccus. The average bacterial colony found was 55.75 CFU/m3 which still meets the requirements set by the Decree of the Indonesian Minister of Health No. 1204/Menkes/SK/X/2004. However, the existence of these bacteria needs to be aware because their presence can potentially cause problems for health. it is recommended to carry out regular monitoring to anticipate health hazards that may be caused by gram-negative bacillus bacteria and gram-negative coccus.

Author Contributions

Wahyu Febriansa: Conceptualization, analysis, draft writing, and data curration.

Conflict of Interest

There is no conflict of interest in this study.

Acknowledgment

The researcher would like to thank all who contributed to this research.

Data availability

Data related to the findings of this study are available at the corresponding author.

REFERENCES

Apriliyanto, A., Rahman, H. F., & Siswanto, H. (2022). Perbandingan desinfektan karbol dan surfanios terhadap jumlah koloni bakteri kamar operasi. *Jurnal Penelitian Perawat Profesional*, *4*(3), 845–854.

Asri, W. A., Fatimah, S., Hapsari, I. N., Rifansaputra, Y. P., et al. (2024). Identifikasi mikroorganisme di lingkungan pada udara dalam laboratorium mikrobiologi. *Intellektika: Jurnal Ilmiah Mahasiswa*, *2*(4), 42–47.

Beveridge, T. J. (1999). Structures of gram-negative cell walls and their derived membrane vesicles. *Journal of bacteriology*, *181*(16), 4725–4733.

Council, N. R., on Health Sciences Policy, B., & to Review the NIOSH Hearing Loss Research Program, C. (2006). *Hearing loss research at niosh: Reviews of research programs of the national institute for occupational safety and health* (Vol. 1). National Academies Press.

Imaniar, E., Apriliana, E., & Rukmono, P. (2015). Kualitas mikrobiologi udara di inkubator unit perinatologi rumah sakit umum daerah dr. abdul moeloek bandar lampung. *Jurnal Kualitas Udara*.

Osawa, Y., Ikebukuro, K., Motoki, H., Matsuo, T., Horiuchi, M., & Sode, K. (2008). The simple and rapid detection of specific pcr products from bacterial genomes using zn finger proteins. *Nucleic acids research*, *36*(11), e68–e68.

Pelczar, P. L., & Setlow, P. (2008). Localization of the germination protein gerd to the inner membrane in bacillus subtilis spores. *Journal of bacteriology*, *190*(16), 5635–5641.

Pratiwi, M. (2023). *Studi kualitas bakteriologis udara di rumah sakit islam faisal kota makassar tahun 2023* [Doctoral dissertation, fakultas Kesehatan masyarakat].

Putrayana, K. D. A. M., Permatasari, A. A. A. P., Rosiana, I. W., Widhiantara, I. G., et al. (2021). Uji kualitas ruangan igd secara bakteri di rumah sakit bedah dharma usadha sidhi dengan penggunaan desinfektan (natrium hipoklorit). *Jurnal Media Sains*, *5*(1).

Sarjono, P. R., Mahardika, H. D. R., Mulyani, N. S., Ngadiwiyana, N., Prasetyawibowo, N. B. A., & Ismiyarto, I. (2020). Aktivitas antidiabetes metabolit sekunder bakteri endofit asal kulit kayu manis. *Jurnal Penelitian Saintek*, *25*(2), 143–156.

Sipayung, R. (2023). Peningkatan polusi udara di indonesia: Perspektif ekonomi berdasarkan teori freakonomics. *Sekretariat Kabinet Republik Indonesia*.

Smith, H., & Sweet, C. (2002). Cooperation between viral and bacterial pathogens in causing human respiratory disease. *Polymicrobial diseases*, 199–212.

Soleha, T., Rukmono, P., & Hikmatyar, G. (2015). Kualitas mikrobiologi udara di ruang neonatal intensive care unit (nicu) rumah sakit umum daerah dr. h. abdul moeloek bandarlampung.

Sriwulan, S., Bachtiar, R. T., Asrofi, D., Safitri, D. A., Nurfitria, N., & Febriyantiningrum, K. (2023). Pengaruh faktor lingkungan terhadap jumlah bakteri udara kamar mandi. *Biology Natural Resources Journal*, *2*(1), 30–35.

Tavares, T. D., Antunes, J. C., Padrão, J., Ribeiro, A. I., Zille, A., Amorim, M. T. P., Ferreira, F., & Felgueiras, H. P. (2020). Activity of specialized biomolecules against gram-positive and gram-negative bacteria. *Antibiotics*, *9*(6), 314.

Tran, V. V., Park, D., & Lee, Y.-C. (2020). Indoor air pollution, related human diseases, and recent trends in the control and improvement of indoor air quality. *International journal of environmental research and public health*, *17*(8), 2927.

Umeh, S., Okafor, O., & Chidubem-Nwachinemere, N. (2021). Isolation and identification of bacteria from peeled and ready to eat pineapple (ananas comosus) fruits retailed at eke awka market, anambra state, nigeria.

Walid, A., Novitasari, N., & Wardany, K. (2019). Studi morfologi koloni bakteri udara di lingkungan fakultas tarbiyah dan tadris institut agama islam negeri bengkulu. *Jurnal IPA & Pembelajaran IPA*, *3*(1), 10–14.