American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-12, Issue-1, pp-57-62
www.ajer.org
Research Paper Open Access

Analysis of Microbiological Air Quality in Traditional Market Based On Bacteria and Fungus Parameters

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ABSTRACT :*Oneofthemarketsthat canbeasourceofmicrobiologicalpollution is theBongkokMarket,whichis locatedinthevillageofBojongKoneng,WestCikarang.The average number of bacterial colonies at clothing stalls is367.6CFU/m^3andchicken meatstallsis250.4CFU/m^3which notexceedthe quality standard,andinvegetable stallsthe average numberof bacterialcolonies, about735.4CFU/m^3exceedsthequalitystandard. Meanwhile,theaveragenumberoffungalcoloniesfromthethreestalls didnot exceed the standard ofthe Minister of Health Decreeno. 1405 of 2002concerning IndoorAirRequirements. There are determined thatthe standardfor total microbes (bacteria and fungi)are less than 700 CFU/m^3. Theaverage numberoffungalcoloniesatclothingstallsis30.6CFU/m^3,invegetablestalls is 211.8 CFU/m^3, and at chicken meat stalls is 303.8 CFU/m^3.*

KEYWORDS *Bongkokmarket, bacterialcolony, fungal colony, indoor air, quality.*

Date of Submission: 01-01-2023 Date of acceptance: 11-01-2023

I. INTRODUCTION

Market is one of the public places frequented by the public to carry out buying and selling activities that can cause the emergence or transmission of various diseases. This is because dirty and slum markets can be breeding grounds for microbes and various diseases and can pollute the environment and reduce indoor air quality. Bongkok Market is a market located in the village of Bojong Koneng, West Cikarang. The market has a low level of sanitation such as disposal of washing water in the chicken stall which is located near the market visitors passing by which makes the booth floor muddy. The vegetable booth at Bongkok market was the most numerous booth. In the air quality study, the microorganism research was carried out at the vegetable booth which is located next to the chicken stall. This is because the condition of the damp floor and the waste water from washing the chicken stalls can cause the growth of microorganisms in the vegetable stalls. The condition of the non-tiled floor also sometimes causes several puddles around the stalls during the rainy season. Then the clothing stall is a booth that often becomes a place for many people to pass by in the market and is one of the stalls with a long working time compared to other stalls.

Based on the conditions and activities that exist in the environment around Bongkok market which trigger the growth of bacteria and fungi, this research can will observe air quality with microbiological parameters. Sampling was carried out in places suspected of being a good environment for the growth of bacteria and fungi. Based on RI Government Regulation No. 41 of 1999 concerning air pollution control, what is meant by air pollution is the entry or inclusion of substances, energy and/or other components into the ambient air by human activities so that the ambient air quality drops to a certain level causing the ambient air to not fulfil its function. Poor ventilation systems can result in accumulation of indoor pollutants. Pollutants can be found indoors from various sources, both from the outside air and from equipment and activities in the room itself.

Pollutants from outside the building can enter through the ventilation system or be carried by occupants [1]. Indoor air quality is very good affects human health because almost 90% of human life is indoors compared to outdoors, this can cause indoor air pollution [2]. Therefore, indoor air quality is also a problem that needs attention because it will affect human health. According to the National Institute of Occupational Safety and Health (NIOSH) quoted by the Indonesian Ministry of Health [3] the causes of indoor air quality problems are generally caused by several things, namely lack of air ventilation, sources of contamination indoors,

contamination from outdoors, microbes , building materials, and others. Regulations regarding indoor air room listed in the Decree of the Minister of Health of the Republic of Indonesia No.1405/MENKES/SK/XI/2002 which contains Health Requirements for the Office and Industrial Work Environment. In this regulation there are several requirements regarding indoor air such as the temperature allowed in the room between 18-28 ºC, room humidity between 40%-60%, air exchange 0.283 m^3/minute/person with ventilation rate of 0.15-0.25m/sec. For work rooms that do not use coolers, they must have minimal ventilation holes 15% of the floor area by implementing a cross ventilation system, as well as a minimum lighting of 300 lux.

Microbiological pollutant in the air can come from the outside environment (such as pollen, mold, and spores) and can also come from indoors (such as insects, fungi, in damp spaces, animal fleas, and bacteria) [4]. Microorganisms cannot survive long in the atmosphere due to lack of nutrients and the influence of ultraviolet radiation from sunlight. However, some organisms can form spores so that they can survive for a longer time. The length of time that microbes are in the air depends on wind speed and humidity, while the number of microbes is largely determined by local environmental activities. Although air is not a habitat for living microbes, human activities, whether intentional or not, can help create temporary living media in the air, for example humidity that occurs when humans breathe or sneeze, wet furniture or room mats, piles of books, indoor plants, and so on.

In present study, the microbes that will be focused on in this study are bacteria and fungi. Factors that can affect the growth of bacteria and fungi include: nutrient content, pH, temperature, humidity, and lighting, such as chicken stalls, vegetable stalls, and clothing stalls. This research will focus on analyzing the concentration of microorganisms in the air with the parameters of bacteria and fungi which will then be compared with the standard for total microbes (bacteria and fungi) which refers to the Decree of the Minister of Health Number 1405 of 2002 which is less than 700 CFU/m^3 and free of pathogenic microbes. Based on the background above, a problem formulation was prepared to find out how the microbiological air quality and the number of bacterial and fungal colonies in the Humpback Market at the chicken stall, vegetable booth, and clothing stall were then carried out to compare the results of the analysis based on bacterial and fungal parameters referring to the Ministerial Decree Health No. 1405 of 2002. The purpose of this study was to determine the air quality and the number of bacterial and fungal colonies in the Bongkok Market based on the parameters of bacteria and fungi in the Bongkok Market at the chicken stalls, vegetable stands and clothing stalls referring to Minister of Health Decree No. 1405 of 2002.

II. MATERIAL AND METHOD

This research was conducted at the Huddle Market at the chicken stall, vegetable stall, and clothing stall. Sampling of bacteria and fungi was carried out by placing petri dishes containing each PCA (Plate Count Agar) and PDA (Potato Dextrose Agar) media at five points around the chicken stalls, vegetable stalls, and clothing stalls.

Sampling of bacteria and fungi in the air is carried out by means of sampling carried out during 15 minutes using a petri dish that already has PCA media for bacterial sampling and PDA for fungal sampling. Then placed petri dishes at each sampling point of the chicken booth, vegetable booth, and clothing stall at 5 points of each booth. The samples at each point were left for 15 minutes, then the temperature and humidity were measured at each sampling point. After that the sample was taken to the laboratory to see the results of the bacterial colonies that formed after incubation for 24-48 hours at ± 37 ℃ and adjusted fungal colony yields at normal room temperature. Colonies of bacteria and fungi that grow are observed and counted using a colony counter. Colonies that grow after incubated for 2x24 hours at room temperature 37 ºC is then calculated using a colony counter with units of CFU/m3. After calculating the number of bacterial and fungal colonies, the results obtained from the study were compared with the microbial count standard KEPMENKES No.1405 year of 2002.

III. RESULT AND DISCUSSION

3.1. The average temperature and humidity at booths and stalls

Based on the table. 1 shows that the average temperature of the clothing stall is 30.9 °C with an average humidity of 54.6%. Then at the vegetable counter the average temperature is 32.7 °C with a humidity of 50.8%. Whereas in the broiler booth the average temperature is 33.8 °C with a humidity of 50.3%. Based on the Decree of the Minister of Health of the Republic of Indonesia No.1405/Menkes/SK/XI/2002 the average temperature of the three stalls and kiosks exceeds the threshold for healthy air in the room with the specified quality standard of 18-28 ºC, while the humidity value from clothing stalls, vegetable counters and broiler stalls meet the standard requirements for indoor healthy air quality, which ranges from 40% -60%.

Table 1. The average temperature and humidity at booths and stalls

Booths/stalls	Temperature(°C)	Humidity(%)
Clothing	30.9	54.6
Vegetable	32.7	50.8
Chicken	33.8	50.3
Standard	18-28	40-60

3.2. Calculation of the average number of bacterial and fungal colonies

Table 2 and Table 3 present average number of bacterial and fungal colonies, respectively.

Table 2. Average number of bacterial colonies

No	Booths/stalls	Read (CFU)	Calculated (CFU/ m^3)	Standard [5](CFU/m^3)	Results
1	Clothing	28.8	367.6	700	Not Exceed
2	Vegetable	57.6	735.4	700	Not Exceed
3	Chicken	19.6	250.4	700	Not Exceed

Table 3. Average number of fungal colonies

No	Booths/stalls	Read (CFU)	Calculated (CFU/ m^3)	Standard [5] (CFU/m^3)	Results
1	Clothing	2.4	30.6	700	Not Exceed
2	Vegetable	16.6	211.8	700	Not Exceed
3	Chicken	23.8	303.8	700	Not Exceed

3.3. Effect of temperature on quantity bacterial colonies in each stall and booth

An effect of temperature on quantity bacterial colonies in each stall and booth is given in Table 4. Based on Table 4, a correlation values obtained were 0.459, this indicated that temperature had a correlation with the number of bacterial colonies in the clothing stalls with a moderate and positive degree of relationship. Meanwhile, the significance value of the SPSS test results in the table above obtained a sig (2-tailed) value of 0.436, where 0.436 > 0.05. Thus it can be seen that there is no significant relationship between temperature and the number of bacteria in the clothing stall or there are other factors from the environment and the activities of the occupants in the clothing stall. Due to the direction of the positive correlation relationship, an estimate is made of the increase in the variable x (temperature) which is in line with the increase in the variable y (bacterial colonies) using forecasting analysis which can be seen in Table 5.

The correlation value for vegetable stall obtained was -0.128, this indicated that the correlation between temperature and the number of bacterial colonies in the vegetable stands was very low and had a negative relationship. While the significance value of the SPSS test results is in Table 5 obtained a sig (2-tailed) value of 0.837, where 0.837 > 0.05. Thus it can be known that there is no significant relationship between temperature and the number of bacteria in the vegetable stalls. The correlation value between the effect of temperature and the number of bacterial colonies in chicken meat stalls was 0.130. This shows that room temperature has a very low correlation with the number of bacterial colonies in broiler stalls and has a positive relationship. While the significance value of the SPSS test results is in Table 4 obtained a sig (2-tailed) value of 0.835, where 0.835 > 0.05. Thus it can be seen that there is no significant relationship between room temperature and the number of bacteria in the chicken meat stall. Due to the direction of the correlation relationship is positive, then an estimate is made of how much the increase in the variable x (temperature) is compared to the increase in the variable y (bacterial colonies) using forecasting analysis which can be seen in the Table 5.

Table 4. Correlations of the effect of temperature on the number of bacterial colonies

Correlation		Clothing stall		Vegetable Stall		Chicken meat stall	
		Temp.	Bacterial	Temp.	Bacterial	Temp.	Bacterial
Temperature	Pearson	1	0.459	1	-.128	1	.130

	Sig. (2-tailed)		0.436		.837		.835
	N	5	5	5	5	5	5
Bacterial	Pearson	0.459	1	-.128	1	.130	1
	Sig. (2-tailed)	0.436		.837		.835	
	N	5	5	5	5	5	5

Based on the results of forecasting analysis using Microsoft Excel in Table. 5 it can be seen that at the optimum temperature (45°C) the estimated growth of the number of bacterial colonies can reach 234.4 CFU. Meanwhile, results of forecasting analysis using Microsoft Excel in Table. 8 it can be seen that at the optimum temperature (45°C) number growth forecast bacterial colonies can weigh up to 58 CFU

Table 5: Forecasting analysis of the effect of temperature rise on the increase in the number of bacterial colonies

Clothing stall(x)		Chicken meat stall	
Temp. (x)	**Bacterial (y)**	**Temp. (x)**	**Bacterial (y)**
29.5	11.0	33.0	9.0
30.0	23.0	33.5	6.0
31.3	7.0	34.3	18.0
31.8	87.0	34.5	18.0
31.7	16.0	33.6	47.0
33.0	59.9	35.0	23.8
35.0	89.0	40.0	40.9
40.0	161.7	45.0	58.0
45.0	234.4		

3.4. Effect of humidity on the number of bacterial colonies in each stall and booth

Table 6 shows that the correlation value between the influence of humidity and the number of bacterial colonies in each stall. The correlation value between the effect of humidity and the number of bacterial colonies in clothing stalls is 0.159, this indicates that humidity has a very low relationship or correlation to the number of bacterial colonies in clothing stalls and has a negative relationship. While the significance value of the SPSS test results obtained a sig (2-tailed) value of 0.799, where 0.799 > 0.05. Thus it can be seen that there is no significant relationship between humidity and the amount of bacteria in the clothes stall. Meanwhile, the correlation value between the effect of humidity and the number of bacterial colonies in the vegetable stands is 0.007. This shows that humidity has a very low relationship or correlation to the number of bacterial colonies in vegetable stalls and has a positive relationship. While the significance value of the SPSS test results is in Table. 10 obtained a sig (2-tailed) value of 0.992, where 0.992 > 0.05. Thus it can be seen that there is no significant relationship between room humidity and the number of bacteria in the vegetable stalls. Due to the direction of the positive correlation relationship, an estimate is made of how much the increase in the x variable (moisture) is compared to the increase in the y variable (bacterial colonies) using forecasting analysis. The correlation value between the effect of humidity and the number of bacterial colonies in the broiler booth is 0.167, this indicates that humidity has a very low relationship or correlation to the number of bacterial colonies in the broiler stall and has a negative relationship. While the significance value of the SPSS test results obtained a sig (2-tailed) value of 0.789, where 0.789 > 0.05. Thus it can be seen that there is no significant relationship between humidity and the number of bacteria in the broiler stalls.

Table 6. Correlations of the effect of humidity on the number of bacterial colonies

Correlation		**Clothing stall**		**Vegetable Stall**		**Chicken meat stall**	
		Temp.	**Bacterial**	**Temp.**	**Bacterial**	**Temp.**	**Bacterial**
Temperature	Pearson	1	-0.159	1	0.007	1	-0.167
	Sig. (2-tailed)		0.799		0.992		0.789
	N	5	5	5	5	5	5
Bacterial	Pearson	-0.159	1	0.007	1	-0.167	1
	Sig. (2-tailed)	0.799		0.992		0.789	

	N	5	5	5	5	5	5

3.5. Effect of temperature on the number of fungal colonies

Table 7 show an effect of temperature on the number of fungal colonies. The correlation value between the effect of temperature and the number of fungal colonies in the clothing kiosk is 0.865, this indicates that temperature has a correlation to the number of fungal colonies in the clothing stall with a very strong and positive degree of relationship. While the significance value of the SPSS test results obtained a sig (2-tailed) value of 0.058. Due to the p value of 0.058, a comparison was made of the Pearson correlation with the r table. The value of r table at 5% significance is 0.878. Thus 0.865 < 0.878, so it can be seen that there is no significant relationship between temperature and the number of fungal colonies in the clothing stalls.

The correlation value between the effect of temperature and the number of fungal colonies in the vegetable stands is -0.601, this indicates that humidity and the number of fungal colonies have a strong and negative relationship or correlation. While the significance value of the SPSS test results obtained a sig (2-tailed) value of 0.283, where 0.283 > 0.05. Thus it can be seen that there is no significant relationship between temperature and the number of fungal colonies in the vegetable stands. Meanwhile, the correlation value between the effect of temperature and the number of mushroom colonies in broiler stalls was 0.465, this indicated that temperature and the number of mushroom colonies had a moderate and negative relationship or correlation. While the significance value of the SPSS test results obtained a sig (2-tailed) value of 0.430, where 0.430 > 0.05. Thus it can be seen that there is no significant relationship between room temperature and the number of fungal colonies in the broiler stalls.

Table 7. Correlations of the effect of temperature on the number of fungal colonies

Correlation		Clothing stall		Vegetable Stall		Chicken meat stall	
		Temp.	Fungal	Temp.	Fungal	Temp.	Fungal
Temperature	Pearson	1	0.865	1	-0.601	1	-0.465
	Sig. (2-tailed)		0.058		0.283		0.430
	N	5	5	5	5	5	5
Bacterial	Pearson	0.865	1	-0.601	1	-0.465	1
	Sig. (2-tailed)	0.058		0.283		0.430	
	N	5	5	5	5	5	5

3.6. Effect of humidity on the number of fungal colonies

Table 8 shows the effect of humidity on the number of fungal colonies. The correlation value between the effect of humidity and the number of fungal colonies at the clothing stall is -0.323, this indicates that humidity and the number of fungal colonies have a low and negative relationship or correlation. While the significance value of the SPSS test results obtained a sig (2-tailed) value of 0.595, where 0.595 > 0.05. Thus it can be seen that there is no significant relationship between humidity and the number of fungal colonies in the clothing stalls. The correlation value between the effect of humidity and the number of mushroom colonies in the vegetable stands is 0.518, this shows that humidity and the number of mushroom colonies have a moderate and positive relationship or correlation. While the significance value of the SPSS test results obtained a sig (2-tailed) value of 0.371, where 0.371 > 0.05. Thus it can be seen that there is no significant relationship between humidity and the number of fungal colonies in the vegetable stands. Meanwhile, the correlation value obtained was 0.671, this indicated that humidity and the number of fungal colonies had a strong and positive relationship or correlation. While the significance value of the SPSS test results obtained a sig (2-tailed) value of 0.215, where 0.215 > 0.05. Thus it can be seen that there is no significant relationship between humidity and the number of fungal colonies in broiler chickens.

Table 8.Correlations of the effect of humidity on the number of fungal colonies

Correlation		Clothing stall		Vegetable Stall		Chicken meat stall	
		Temp.	Fungal	Temp.	Fungal	Temp.	Fungal
Temperature	Pearson	1	-0.323	1	0.518	1	0.671
	Sig. (2-tailed)		0.595		0.371		0.215
	N	5	5	5	5	5	5
Bacterial	Pearson	-0.323	1	0.518	1	0.671	1

	Sig. (2-tailed)	0.595		0.371		0.215	
	N	5	5	5	5	5	5

Based on the results of forecasting analysis using Microsoft Excel, it can be seen that at optimum humidity (85%) the estimated growth of the number of bacterial colonies can reach 150.8 CFU. While at optimum humidity (85%) the estimated growth of the number of bacterial colonies can reach 109.5 CFU.

IV. CONCLUSSION

Based on the results of the analysis and discussion above, it can be concluded that the average number of bacterial colonies at the clothing stall was 367.6 CFU/m3, at the broiler booth was 250.4 CFU/m^3, and for vegetables, it was 735.4 CFU/m^3. When compared with the standards set for total microbes (bacteria and fungi) air quality with bacterial parameters in the vegetable stalls exceeds the quality standards. Meanwhile, the average number of fungal colonies in clothing stalls was 30.6 CFU/m^3, at the vegetable booth was 211.8 CFU/m^3, and at the broiler booth was 303.8 CFU/m3. When compared with the standards set for total microbes (bacteria and fungi) air quality with bacterial parameters at clothing stalls, vegetable stalls, and broiler stalls did not exceed the set quality standards.

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