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Minimizing coliform and *Escherichia coli* bacteria in clean water through a chlorine diffuser method combined with black sand

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Abstract

Background: Indonesia's 2016 health profile shows that the percentage of households with access to drinking water and potable water in Central Java Province is 75.88%, leaving 24.2% of the population without adequate drinking water sources. High concentrations of total Coliform are an indicator of pathogenic contamination that can lead to the spread of waterborne diseases. Contamination from *E. coli* and coliform bacteria in clean water sources can cause diarrhea if consumed.
Purpose: To assess the effectiveness of the chlorine diffuser method combined with black sand in reducing Coliform and *Escherichia coli* levels in clean water.
Method: A quantitative descriptive approach with a quasi-experimental design. Samples were collected four times over a ten-day period, with bacterial levels measured before and after treatment at intervals of 30 minutes, 45 minutes, and 60 minutes. The study utilized a chlorine diffuser as the primary research instrument. Data collection methods included direct observation and the compilation of both primary and secondary data. Laboratory testing of the samples was performed using the compact dry method, followed by univariate analysis to evaluate the effectiveness of the chlorine diffuser in reducing coliform bacteria in groundwater wells.
Results: Univariate analysis showed that before treatment, the coliform bacteria level was 60 CFU/100 ml. After treatment, the levels were 40 CFU/100 ml after 30 minutes, 45 CFU/100 ml after 45 minutes, and 40 CFU/100 ml after 60 minutes of contact time. For *E. coli*, the bacteria level before treatment was 3 CFU/100 ml. After treatment, it was 0 CFU/100 ml with 30 minutes of contact, 1 CFU/100 ml with 45 minutes of contact, and 1 CFU/100 ml with 60 minutes of contact. Bivariate analysis showed a significant difference in Coliform levels based on treatment duration, with a significance value of 0.014. However, no significant difference was observed in *E. coli* levels, with a significance value of 0.168.
Conclusion: The combination of the chlorine diffuser method and black sand effectively reduced coliform bacteria levels to meet environmental health standards. However, this method was less effective in eliminating *Escherichia coli* within the same treatment duration.

Keywords: Chlorine Diffuser; Coliform; E-Coli.

INTRODUCTION

Water is an essential resource for daily life, and its cleanliness significantly affects the quality of water used. According to Indonesia's 2016 health profile, 75.88% of households in Central Java Province have access to drinking water and potable water sources, leaving 24.2% of the population without proper access (Kuswanto, Yuniarto, & Hastawati, 2021). The quality of water consumed directly influences public health. The human body, composed of millions of cells, relies heavily on water, with approximately 67% of body weight consisting of water (Nabih, Takwanto, & Rahayu, 2023). Water

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serves critical functions such as aiding digestion, regulating metabolism, transporting nutrients, and maintaining body temperature balance (Mariyam, Devina, Wulandari, Nursafitri, & Syahriansyah, 2023).

One major biological contaminant in water is *E. coli* and coliform bacteria (Rosdiana, Hastiaty, Hartomy, Kango, Simbolon, Pradapaningrum, & Paramasatya, 2023). coliform bacteria, often used as an indicator, help determine whether water is contaminated (Mangkurat, Nurdiana, & Budianto, 2019). Contaminated clean water exceeding acceptable levels of *Escherichia coli* or coliform bacteria can lead to diarrhea (Afifah, 2019).

coliform bacteria serve as indicators of water quality and contamination, exhibiting rod-shaped, Gram-negative characteristics and the ability to ferment lactose, producing acid and gas at 37°C within 48 hours. High Total Coliform levels, exceeding wastewater quality standards, indicate infectious pathogenic contamination that can spread diseases through water (Sulistiyawati, 2019). Total Coliform is a standard parameter for microbiological quality due to its positive correlation with the presence of pathogenic microorganisms (Utami, 2020).

Reducing or eliminating microorganisms in water requires disinfectants to improve its bacteriological quality. Chlorine is a widely used and economical disinfectant in water treatment, but excessive use can have adverse health effects (Marchesi, Paduano, Frezza, Sircana, Vecchi, Zuccarello, & Bargellini, 2020). The effectiveness of chlorine must be evaluated to minimize potential risks (Mulyati, Azizah, Srikandi, Maidaswar, & Atikah, 2022). One method for reducing *E. coli* and Coliform levels is chlorine treatment, which remains commonly used to eliminate harmful microorganisms in water (Patmawati & Sukmawati, 2017).

However, directly dissolving chlorine into wells or storage tanks can result in high chlorine levels, posing health risks. An alternative approach involves using a chlorine diffuser, a device consisting of a PVC tube filled with chlorine-impregnated sand (Maulidia, Mirwan, & Aulidia, 2023). This method slows chlorine dissolution, preventing excessively rapid release. A chlorine diffuser functions by dispersing chlorine gradually from the tube into water, with fine sand acting as a release barrier (Luqman & Al-Ansari, 2021; Fibryanto & Santoso, 2023)

Chlorine diffusers are designed to eliminate bacterial contamination, including *E. coli* and Coliform. Chlorine, as an oxidizing agent, releases oxygen during disinfection, which can affect colloidal particles if they are not filtered (Mangkurat et al., 2019). This process can raise water pH, complicating neutralization and creating odors. Placing a chlorine diffuser in water storage tanks before distribution facilitates water treatment, as groundwater serves not only as a natural reservoir supporting ecosystems but also as a critical resource for human needs (Ganefati, Sanjtoko, Sudaryanto, Sutedjo, Eko, Haryono, & Sugianto 2023; Pratama & Hidayatullah, 2023).

One major cause of high *E. coli* and Coliform levels in water is the insufficient distance between toilets and clean water sources (Gufran & Mawardi, 2019). The presence of *E. coli* in water indicates it is unsuitable for consumption (Bonkoungou, Somda, Traoré, Zoma, Garba, Drabo, & Barro, 2021).

RESEARCH METHOD

A quantitative experimental approach with a quasi-experimental design was applied to analyze the development and effectiveness of a chlorine diffuser in testing *E. coli* and Coliform levels. The study was conducted at boarding house X in Gonila Village, Kartasura Subdistrict, from March 20 to 29, 2024. The inclusion criterion for the study was well water from the boarding house with the highest levels of Coliform and *E. coli* bacteria. The dependent variable in this research was black sand used in the chlorine diffuser device, while the independent variable was the bacterial counts of Coliform and *E. coli* after treatment.

Samples were collected four times over 10 days, with bacterial levels tested before and after treatment at intervals of 30 minutes, 45 minutes, and 60 minutes. The primary research instrument was a chlorine diffuser. Materials used to construct the diffuser included a 2-inch diameter, 30-cm-long pipe, a ¾-inch diameter, 25-cm-long pipe, 2-inch pipe caps, ¾-inch pipe caps, 2-inch pipe couplings, and 2-inch threaded caps. The materials used in the diffuser were 569.6 grams of black sand and 2.5 mg/L of chlorine.

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Data collection involved direct observation and the compilation of both primary and secondary data. Laboratory analysis was performed using the compact dry method for each sample, followed by univariate analysis to evaluate the effectiveness of the chlorine diffuser in reducing Coliform levels in well water.

This study was approved by the Ethics Review Committee of Universitas Muhammadiyah Surakarta, under ethics approval number: 410/KEPK-FIK/VII/2024.

RESEARCH RESULTS

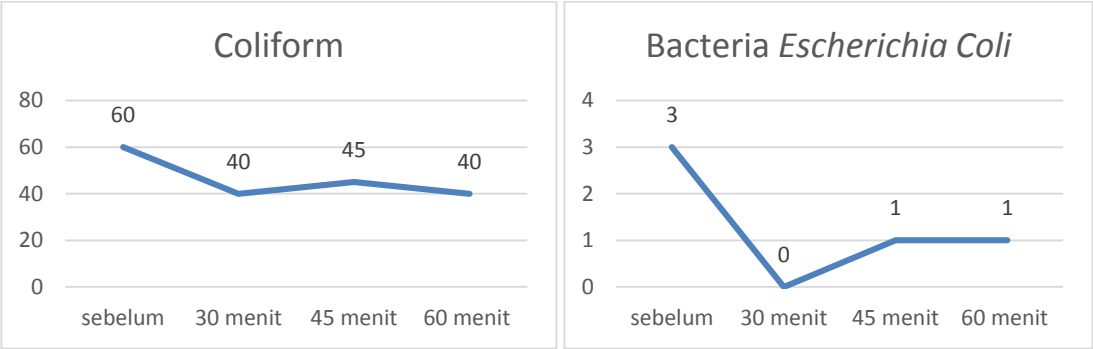


Figure 1. Coliform dan *E. coli* counts before and after treatment

Figure 1 shows that, prior to treatment, the levels of Coliform and *Escherichia coli* bacteria did not meet the standards as they exceeded the specified limits. After treatment, the results at 30 and 45 minutes indicated that coliform bacteria levels were within the standard (<50 CFU/100 ml), but *Escherichia coli* levels still did not meet the standard (>0 CFU/100 ml). At 60 minutes, the coliform bacteria levels met the standard (0 CFU/100 ml), but *Escherichia coli* levels remained non-compliant (1 CFU/100 ml).

Based on these findings, the coliform bacteria levels after 30, 45, and 60 minutes of treatment met the clean water quality standards. However, for *Escherichia coli*, the results after treatment still did not comply with the clean water standards, as 1 CFU/100 ml was still detected, whereas the standard requires 0 CFU/100 ml.

Table 1. Results of One Way Annova test

Testing_Results	Sum of Squares	df	Mean Square	F	Sig
Coliform					
Between Groups	844.667	3	281.556		
Within Groups	336.000	8	42.000	6.704	0.014
Total	1180.667	11			
E-Coli					
Between Groups	4.917	3	1.639		
Within Groups	6.000	8	0.750	2.185	0.168
Total	10.917	11			

Table 1 shows a difference in the number of coliform bacteria based on the duration of treatment, with a significance value of 0.014. However, there was no difference in the number of *Escherichia coli* bacteria based on the duration of treatment, as the significance value was 0.168.

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DISCUSSION

Water is an essential compound for all living beings on Earth. Approximately 70% of the planet is covered by water, found in oceans, ice sheets, rivers, surface freshwater, lakes, water vapor, and more (Efendy & Syamsul, 2019). Humans utilize water for various purposes, including daily needs, production processes, irrigation, electricity generation, and others (Alfin, Rahmatullah, & Suendarti, 2022). Water is a fundamental necessity for human consumption. Every day, people require drinking water to maintain hydration, which is vital for physiological functions such as digestion, circulation, and temperature regulation. Besides drinking, water is also used in cooking processes. Clean water is necessary for washing food, cooking, and preparing safe food and beverages for consumption.

Water also plays a crucial role in hygiene and sanitation. Daily activities such as bathing, hand washing, and brushing teeth rely on water and are essential for maintaining personal health and preventing the spread of disease. Laundry and household cleaning require water to ensure a clean and healthy living environment. Water is also utilized in sanitation systems such as toilets and drainage, which manage household waste safely and hygienically.

The demand for clean water continues to increase over time, but this contrasts with its decreasing availability in nature (Maliangkay, Erinaputri, Salsabila, & Setiawati, 2022). Rapid population growth, urbanization, and industrial development have amplified the need for clean water for drinking, cooking, bathing, irrigation, and industrial processes. On the other hand, the availability of clean water in nature is diminishing due to factors such as environmental pollution from industrial and household waste, climate change leading to unpredictable rainfall patterns and droughts, and excessive exploitation of water resources. Water pollution caused by chemicals, heavy metals, and pathogenic microorganisms further deteriorates the quality of available water.

Environmental changes have reduced the availability of clean water due to bacterial contamination (Patmawati & Sukmawati, 2019). Most freshwater and seawater contain microorganisms. However, pathogenic bacteria are typically absent unless the water is directly contaminated by human or animal urine and feces. Pathogenic microorganisms in water include *Escherichia coli* and coliform (Khairunnida, Rusmini, Maharyuni, & Warganegara, 2020).

Escherichia coli is one of the main species of gram-negative bacteria, typically part of the normal flora in the digestive tracts of humans and animals, playing an important role in digestion. This bacterium is usually found in feces (Sitaba & Nurlinda, 2022). coliform bacteria, on the other hand, serve as an indicator of the presence of other bacteria. Determining coliform as a pollution indicator is based on observing the number of bacterial colonies, which positively correlates with the presence of pathogenic bacteria (Saputri & Efendy, 2020). This aligns with research indicating that the presence of *E. coli* can influence the life cycle of bacteria in water, with *E. coli* persisting as a pathogen capable of causing diseases in humans and other living organisms (De Luca, Carginale, Supuran, & Capasso, 2022).

Clean water sources can become contaminated with *E. coli* due to human waste infiltrating the water supply, often originating from septic tanks in residential areas (Asyfiradayati, Sukmawati, Sriwahyuni, & Hadiana, 2023). In Muryoharjo, homes without septic tanks that discharge waste directly into rivers have shown lower levels of *E. coli* contamination in well water compared to homes with septic tanks (Porusia, Asyfiradayati, Putri, & Dwinanda, 2022).

coliform bacteria and *Escherichia coli* are pathogenic bacteria that can cause various serious infections in humans (Kartini, Kasman, Arsyad, & Ismail, 2024). coliform bacteria are often used as indicators of microbiological contamination in water, while *E. coli* can cause urinary tract infections, potentially leading to symptoms such as painful urination, increased frequency of urination, and in extreme cases, kidney damage. Additionally, infections caused by *E. coli* can develop into sepsis or meningitis, which are systemic infections affecting the entire body or inflammation of the membranes surrounding the brain and spinal cord, requiring intensive medical care. *E. coli* can also cause acute diarrhea, with symptoms such as abdominal cramps, nausea, vomiting, and bloody diarrhea, which pose a risk of severe dehydration, especially in children and the elderly.

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Chlorine diffuser is used as the main method for reducing the content of pathogenic bacteria in clean water, particularly *E. coli* and coliform. A chlorine diffuser is an effective clean water treatment technology, with the chlorination process used to prevent and address bacterial contamination, especially with the total coliform indicator (Saputri & Efendy, 2020). Chlorine diffusers are capable of reducing bacterial contamination by a significant amount while improving water quality by lowering pollution levels to meet water quality standards (Patmawati & Sukmawati, 2019). This technology works effectively in disinfecting water, ensuring that the produced water is safe for various purposes, such as consumption, sanitation, and industrial use. By using a chlorine diffuser, the risk of disease transmission caused by pathogenic bacteria such as *E. coli* and coliform can be minimized.

Based on the evaluation of univariate analysis results, it was shown that before treatment, the levels of coliform and *Escherichia coli* bacteria in the water did not meet environmental health standards as they exceeded the specified limits. This indicates that the water had a high level of microbiological contamination, posing a potential health risk to the public if used for daily activities such as drinking, cooking, and bathing. Water contaminated with *Escherichia coli* and coliform bacteria can lead to health disturbances and cause serious problems (Restiyani, 2019). This is consistent with previous research, which states that *E. coli* is an indicator of fecal contamination, with the presence of *E. coli* providing evidence of contamination from feces (Nowicki, Delaurent, de Villiers, Githinji, & Charles, 2021).

.For coliform bacteria, the most significant decrease occurred from before the treatment to after 30 minutes of treatment, where the bacteria level dropped from 60 CFU/100 ml to 40 CFU/100 ml. For *Escherichia coli* bacteria, the most effective reduction was from before the treatment to after 30 minutes of treatment, where the bacteria level decreased from 3 CFU/100 ml to 0 CFU/ml. This is because the chlorine diffuser combined with black sand is newly used and is still highly effective in reducing bacteria.

After treatment with the combination of the chlorine diffuser and black sand, the results showed a significant decrease in bacteria levels. Measurements taken after 30 and 45 minutes of treatment indicated that coliform bacteria levels were within the quality standards (below 50 CFU/100 ml), but *Escherichia coli* bacteria levels were still not compliant, as they remained above 0 CFU/100 ml. After a 60-minute treatment, the results showed that coliform bacteria had met the quality standard, reaching 0 CFU/100 ml, indicating the effectiveness of this method in eliminating coliform bacteria from water. However, although the number of *Escherichia coli* bacteria decreased, the final result still showed 1 CFU/100 ml, which exceeds the water quality standard requiring 0 CFU/100 ml. This indicates that while the method is effective in reducing bacteria overall, it is not able to completely eliminate *Escherichia coli* from clean water within the given time.

Based on the bivariate analysis, there was a significant difference in the number of coliform bacteria with treatment time, with a significance value (sig.) of 0.014. This difference occurred because the device worked most effectively in reducing coliform bacteria levels after being exposed to water for 45 minutes. This suggests that the combination of the chlorine diffuser and black sand method is consistently effective in reducing coliform bacteria levels in clean water at various tested time intervals. These results show that coliform bacteria can be effectively eliminated from water using this method, thus helping to meet the environmental health quality standards for clean water.

The study results showed that there was no significant difference in the levels of *Escherichia coli* bacteria with varying treatment durations, with a significance value (sig.) of 0.168. After treatment, the levels of *E. coli* still did not meet the clean water quality standards. This lack of difference suggests that the device was not fully effective in reducing *E. coli* levels after the treatment or after being exposed to water for 45 minutes. These findings indicate that while the combination of the chlorine diffuser and black sand method is effective in removing coliform bacteria to meet quality standards, it is less effective in completely eliminating *E. coli* within the same treatment period.

One of the methods for treating water to reduce the levels of *E. coli* and coliform bacteria is through the use of chlorine. The addition of chlorine is still one of the methods used to clarify water from

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harmful microorganisms (Patmawati & Sukmawati, 2017). Chlorination is the most commonly used disinfection method. Chlorine can be used in powder, liquid, or tablet form. Chlorine powder typically contains calcium hypochlorite, while liquid chlorine contains sodium hypochlorite. The process of adding chlorine is called chlorination. Chlorine used as a disinfectant can be in the form of chlorine gas (Cl2) or calcium hypochlorite [Ca(OCl)2]. However, improper addition of chlorine can cause odor and a bitter taste (Pambudi, Ismail, & Sudjanto, 2019).

The use of chlorine-based disinfection equipment can reduce microbiological contamination, including Coliform and *E. coli*, in clean water to meet the clean water quality standards for hygiene and sanitation, provided the correct dosage and treatment are applied (Habibi, Utami, Mulyana, & Amelia, 2019). The use of high doses of chlorine in disinfection equipment will further reduce microbiological contamination (total coliform) (Patmawati & Sukmawati, 2020). Based on this analysis, it can be understood that the combination of the chlorine diffuser and black sand method has been proven effective in reducing the number of coliform bacteria to meet environmental health standards. This is evident from the test results, which show a reduction in coliform bacteria.

This success demonstrates the great potential of using chlorine diffusers and black sand as clean water treatment technology, especially in addressing pathogenic bacteria represented by the total coliform indicator. However, although this method is effective for coliform bacteria, it is less effective in eliminating *Escherichia coli* (*E. coli*) within the same treatment time. Despite a significant decrease in *E. coli* numbers after treatment, the final results show that this bacteria is still detected and exceeds the quality standard, which requires no *E. coli* in clean water.

CONCLUSION

The combined chlorine diffuser and black sand method effectively reduced coliform bacteria levels to meet quality standards within 30-60 minutes. However, it failed to eliminate *E. coli*, which remained above acceptable limits despite a significant reduction.

REFERENCES

Afifah, F. (2019). Uji bakteriologis coliform dan *Escherichia coli* pada air tanah bebas.

Alfin, E., Rahmatulloh, R., & Suendarti, M. (2022). Infrastruktur Air Dan Tantangan Di Indonesia. *SENTRI: Jurnal Riset Ilmiah*, *1*(2), 382-391.

Asyfiradayati, R., Sukmawati, D., Sriwahyuni, E., & Hadiana, F. (2023). Uji Bakteriologis Air Bersih Pemukiman Sekitar Mata Air Cokro Desa Krajan Kabupaten Klaten. *Jurnal Ners*, *7*(2), 1407-1412.

Bonkoungou, I. J. O., Somda, N. S., Traoré, O., Zoma, S., Garba, Z., Drabo, K. M., & Barro, N. (2021). Detection of diarrheagenic *Escherichia coli* in human diarrheic stool and drinking water samples in Ouagadougou, Burkina Faso. *African Journal of Infectious Diseases*, *15*(1), 53-58.

De Luca, V., Carginale, V., Supuran, C. T., & Capasso, C. (2022). The gram-negative bacterium *Escherichia coli* as a model for testing the effect of carbonic anhydrase inhibition on bacterial growth. *Journal of Enzyme Inhibition and Medicinal Chemistry*, *37*(1), 2092-2098.

Efendy, I., & Syamsul, D. (2019). Faktor Yang Berhubungan Tingkat Konsumsi Air Bersih Pada Rumah Tangga Di Kecamatan Peudada Kabupaten Bireun. *Jurnal Biology Education*, *7*(2).

Fibryanto, E., & Santoso, L. (2023). Mouthwashes: a review on its efficacy in preventing dental caries. *Jurnal Kedokteran Gigi Terpadu*, *5*(1).

Ganefati, S. P., Sanjtoko, H., Sudaryanto, S., Sutedjo, S., Eko, S., Haryono, H., & Sugianto, S. (2023). Upaya Pengendalian Penyakit Menular Lapas Kelas II B Sleman Melalui Penyuluhan Kesehatan, Desinfeksi Kuman Udara Ruangan di Blok Tahanan, dan Penyehatan Air. *J-ABDI: Jurnal Pengabdian kepada Masyarakat*, *3*(6), 1177-1186.

Eka Nurul Fathonah*, Rezania Asyfiradayati

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Corresponding author: *E-mail: ekanurul532@gmail.com

DOI: https://doi.org/10.33024/minh.v7i10.553

Gufran, M., & Mawardi, M. (2019). Dampak pembuangan limbah domestik terhadap pencemaran air tanah di Kabupaten Pidie Jaya. *Jurnal Serambi Engineering*, *4*(1), 416-425.

Habibi, N. A., Utami, C. T., Mulyana, M., & Amelia, R. R. (2019). Efektifitas dan efisiensi penggunaan klorinator sebagai sarana pelarut disinfektan di Usaha Kecil dan Menengah (UKM). *JST (Jurnal Sains Terapan)*, *5*(1), 54-59.

Kartini, J., Kasman, R. A., Arsyad, R., & Ismail, H. (2024). Sosialisasi Kualitas Air Wisata Pantai: Dampak Pencemaran Bakteri Coliform dan Eschericia Coli. *Ininnawa: Jurnal Pengabdian Masyarakat*, *2*(1), 113-118.

Khairunnida, G. R., Rusmini, H., Maharyuni, E., & Warganegara, E. (2020). Identifikasi *Escherichia coli* Penyebab Waterborne Disease pada Air Mimun Kemasan dan Air Mimunm Isi Ulang. *Jurnal Ilmiah Kesehatan Sandi Husada*, *9*(2), 634-639.

Kuswanto, S., Yuniarno, S., & Hastawati, I. (2021). Making Chlorine Diffuser In Reducing Coliform Numbers In The Wells. *Kesmas Indonesia*, *13*(2), 168-181.

Luqman, M., & Al-Ansari, T. (2021). A novel integrated wastewater recovery, clean water production and air-conditioning system. *Energy Conversion and Management*, *244*, 114525.

Maliangkay, K. S., Erinaputri, N., Salsabila, N., & Setiawati, M. E. (2022). Analisis Hubungan Kondisi Ekonomi Masyarakat Terhadap Pemakaian Air Domestik. *Jurnal Kesehatan Tambusai*, *3*(4).

Mangkurat, W., Nurdiana, E., & Budianto, A. (2019, September). Penurunan Kadar Amonia, Nitrit, dan Nitrat pada Air Sungai Menggunakan Karbon Aktif sebagai Solusi Efisiensi Chlorine. In *Prosiding Seminar Nasional Sains dan Teknologi Terapan* (Vol. 1, No. 1, pp. 279-284).

Marchesi, I., Paduano, S., Frezza, G., Sircana, L., Vecchi, E., Zuccarello, P., & Bargellini, A. (2020). Safety and effectiveness of monochloramine treatment for disinfecting hospital water networks. *International journal of environmental research and public health*, *17*(17), 6116.

Mariyam, D., Devina, F., Wulandari, P., Nursafitri, E., & Syahriansyah, A. (2023). Rahasia Molekul Unsur yang terdapat dalam Air Putih Bagi Tubuh Manusia dalam Pandangan Islam. *Religion: Jurnal Agama, Sosial, Dan Budaya*, *1*(3), 96-109.

Maulidia, Z., Mirwan, M., & Aulidia, S. (2023). Pengelolaan Air Bersih di RS X Surabaya. *Nusantara Hasana Journal*, *2*(8), 36-41.

Mulyati, S. A., Azizah, M., Srikandi, S., Maidaswar, M., & Atikah, N. (2022). The effectiveness of chlorine tablets to reducing coliform in wastewater treatment plant. *Jurnal Sains Natural*, *12*, 10-16.

Nabih, F. N., Takwanto, A., & Rahayu, M. (2021). Pengaruh Konsentrasi Ozon Terhadap Nilai Ph Dan Total Dissolve Solid (Tds) Produk Air Minum Dalam Kemasan (Amdk). *Distilat: Jurnal Teknologi Separasi*, *7*(2), 347-352.

Nowicki, S., Delaurent, Z. R., de Villiers, E. P., Githinji, G., & Charles, K. J. (2021). The utility of *Escherichia coli* as a contamination indicator for rural drinking water: Evidence from whole genome sequencing. *PLoS One*, *16*(1), e0245910.

Pambudi, L., Ismail, K. M., & Sudjanto, H. (2019). Rancangan Sistem Otomatis Chlorinator Pada Distribusi Air Bersih Di Bandar Udara International Soekarno-Hatta. *Langit Biru: Jurnal Ilmiah Aviasi*, *12*(3), 127-136.

Patmawati, P., & Sukmawati, S. (2017). Pengaruh Dosis Klorin terhadap Total Coliform Wai Sauq Bantaran Sungai Mandar. *Higiene*, *6*(1), 1–4

Eka Nurul Fathonah*, Rezania Asyfiradayati

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Corresponding author: *E-mail: ekanurul532@gmail.com

DOI: https://doi.org/10.33024/minh.v7i10.553

Patmawati, P., & Sukmawati, S. (2019). Chlorinediffuser sebagai metode menurunkan total coliform Wai Sauq bantaran Sungai Mandar. *J-KESMAS: Jurnal Kesehatan Masyarakat*, *5*(2), 124-137.

Patmawati, P., & Sukmawati, S. (2020). Menurunkan Bakteri Total Coliform Wai Sauq Bantaran Sungai Mandar Dengan Chlorine Diffuser. *HIGIENE: Jurnal Kesehatan Lingkungan*, *5*(2), 106-112.

Porusia, M., Asyfiradayati, R., Putri, S. R. S., & Dwinanda, S. S. (2022, April). Comparison of Microbiological Quality of Well Water and Contaminated River Water in Open Defecation Area. In *International Conference on Health and Well-Being (ICHWB 2021)* (pp. 95-100). Atlantis Press.

Pratama, I. N., & Hidayatullah, H. (2023). Strategi Dan Kebijakan Pemerintah Dalam Mengatasi Masalah Pencemaran Air Tanah. *Journal of Environmental Policy and Technology*, *1*(2), 105-112.

Restiyani, A. A. (2019). Analisis Kandungan Bakteri Coliform dan *Escherichia coli* Pada Air Minum Dalam kemasan dan Air Minum Isi Ulang di Kecamatan Sukarame Bandar Lampung. *Universitas Raden Intan Lampung*

Rosdiana, D., Hastiaty, I. A., Hartomy, E., Kango, I., Simbolon, P. T., Pradapaningrum, P. G., & Paramasatya, A. (2023). Kontaminasi kimia dan biologi pada air dan udara dengan ARKM: analisis risiko kesehatan masyarakat. *Public Health Risk Assesment Journal*, *1*(1).

Saputri, E. T., & Efendy, M. (2020). Kepadatan bakteri coliform sebagai indikator pencemaran biologis di perairan pesisir sepuluh Kabupaten Bangkalan. *Juvenil: Jurnal Ilmiah Kelautan dan Perikanan*, *1*(2), 243-249.

Sitaba, T. F. N., & Nurlinda, A. (2022). Identifikasi Kandungan *Escherichia coli* pada Es Dawet di Jalan Urip Sumohardjo Kota Makassar. *Window of Public Health Journal*, *3*(1), 96-101.

Sulistiyawati, I. (2019). Kuantitas total bakteri coliform pada instalasi pengolahan limbah cair medis laboratorium klinik. *Jurnal Ilmiah Universitas Batanghari Jambi*, *19*(3), 675-677.

Utami, F. (2020). Metode Most Probable Number (MPN) Sebagai Dasar Uji Kualitas Air Sungai Rengganis Dan Pantai Timur Pangandaran Dari Cemaran Coliform dan *Escherichia coli*. *Jurnal Kesehatan Bakti Tunas Husada: Jurnal Ilmu-ilmu Keperawatan, Analis Kesehatan dan Farmasi*, *20*(1), 21-30.

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