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# Identification of *Escherichia coli* in PDAM Drinking Water of Kladufu District, Sorong City

## Identifikasi Bakteri *Escherichia Coli* Pada Air Minum PDAM Di Kelurahan Kladufu Kota Sorong

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**Abstract**

*Escherichia coli* is a gram-negative bacterium that causes intestinal and extraintestinal diseases in humans due to the consumption of unhygienic beverages. Its virulence allows *Escherichia coli* to evade the host's immune defense system. This study aims to identify the presence of *Escherichia coli* bacteria in PDAM drinking water consumed by residents of RT 010 RW 002, Kladufu Village, Sorong City. This study uses a descriptive method with a laboratory observation approach and a cross-sectional research design. The population in this study consists of all heads of households who consume untreated PDAM drinking water, totaling 60 households. The sampling technique is purposive sampling, considering the established inclusion and exclusion criteria. Out of 60 research samples, only 38 were willing to become respondents and met the criteria, resulting in 38 water samples for laboratory testing. The research results show that out of the 38 water samples tested, 20 samples (57.9%) were identified as positive for *Escherichia coli* bacteria, while 18 samples (42.1%) did not contain the bacteria. These findings indicate that the majority of PDAM water consumed by residents does not meet the safe microbiological quality standards for drinking water, which can pose health risks.

*Escherichia coli adalah bakteri gram negatif yang mengakibatkan penyakit usus dan ekstraintestinal pada manusia akibat dari mengonsumsi minuman yang tidak higienis. Virulensinya memungkinkan Escherichia coli menghindari sistem pertahanan tubuh inang. Penelitian ini bertujuan untuk mengidentifikasi keberadaan bakteri Escherichia coli pada air minum PDAM yang dikonsumsi oleh warga RT 010 RW 002 Kelurahan Kladufu, Kota Sorong. Penelitian ini menggunakan metode deskriptif dengan pendekatan observasi laboratorium dan rancangan penelitian cross sectional. Populasi dalam penelitian ini adalah seluruh kepala keluarga yang mengonsumsi air minum PDAM tanpa dimasak, berjumlah 60 rumah. Teknik pengambilan sampel adalah purposive sampling dengan mempertimbangkan kriteria inklusi dan kriteria eksklusi yang telah ditetapkan. Dari 60 sampel penelitian, hanya 38 yang bersedia menjadi responden dan memenuhi kriteria tersebut, sehingga diperoleh 38 sampel air untuk diuji di laboratorium. Hasil penelitian menunjukkan dari 38 sampel air yang diuji, sebanyak 20 sampel (57,9%) teridentifikasi positif mengandung bakteri Escherichia coli dan 18 sampel (42,1%) tidak mengandung bakteri tersebut. Temuan ini menunjukkan bahwa sebagian besar air PDAM yang dikonsumsi oleh warga belum memenuhi standar kualitas mikrobiologis air minum yang aman, sehingga dapat menimbulkan resiko terhadap Kesehatan.*

**Article Information**

**Keywords:**
bacteria; *escherichia coli*; PDAM drinking water

**Kata kunci:**
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## A. INTRODUCTION

Water is an essential compound for the life of living beings on Earth that cannot be replaced by any other compound. Water consumed as drinking water is one of the most important substances for humans to continue living (Hariyanto., 2022). One of the steps to maintain the safety and quality of drinking water is by monitoring the quality of drinking water. This is important because water is the largest component needed by the human body (Oktavira et al., 2024). Humans are living beings that are easily infected with diseases thru water (Febriza et al., 2021). Pathogenic bacteria found in contaminated water mostly belong to the Enterobacteriaceae group (Apriani, 2023). Consuming drinking water that does not meet health standards will cause serious health impacts such as the risk of infectious diseases and toxin poisoning due to harmful substances in the water (Firmansyah, 2021). Additionally, water can also contain pathogenic bacteria due to contamination, such as *Vibrio cholera*, *Salmonella*, *Shigella*, *Escherichia coli*, etc. (Gulo et al., 2023).

*Escherichia coli* is a gram-negative bacillus bacterium that exists in various strains (Matthew & Cristopher R, 2023) microscopic in size, and has the ability to live in colonies (Engelkirk et al., 2020). *Escherichia coli* is one of the mandatory parameters in the assessment of the microbiological quality of drinking water. Good quality drinking water must be free from *Escherichia coli* bacteria. According to Damayanti (2025), this bacterium originates from the digestive tracts of humans and warm-blooded animals, and its presence in water indicates fecal contamination. Drinking water containing *E. coli* can potentially cause various gastrointestinal illnesses such as diarrhea, dysentery, typhoid fever, and other health problems. Therefore, the presence of *E. coli* in drinking water is not permitted under government-established drinking water quality standards.

Research by the Ministry of Health in 2020 showed that 74.4% of households in Indonesia have access to drinking water contaminated with *Escherichia coli* bacteria (Oktavira et al., 2024). A report by UNICEF and WHO in 2022 found that 2.2 billion people still lack access to safe drinking water (WHO & UNICEF, 2020). The main issue with drinking water in Indonesia is the low public awareness of drinking water quality, which poses health risks due to the use of drinking water that does not meet the standards set by the Indonesian Minister of Health Regulation No. 492/Menkes/Per/IV/2010 on drinking water requirements. The microbiological requirement for drinking water regarding *Escherichia coli* is 0 per 100ml of water sample (Arsad & Faisal, 2022). The use of drinking water in Indonesia generally still relies on borehole water, rainwater, and PDAM water in urban areas (Ayu P et al., 2019). Differences in drinking water sources will result in variations in the water composition produced (Susanti, 2019). The region of Southwest Papua Province is a coastal city where some of the population is located along the coastal area. Many people are not yet aware of the consumption of drinking water according to health requirements and standards (Annisa & Susilawati, 2022).

Thru the researchers' observation in the RT 010 RW 002 area of Kladufu Village, there are four types of water consumed by the local community, namely gallon water, well water, PDAM water, and rainwater. The community in RT 010 RW002 still largely uses PDAM water as a direct drinking water source. Water that is consumed directly without being cooked first allows for the possibility of contamination with *Escherichia coli* bacteria, which can impact health. This research aims to determine that PDAM drinking water, which is not cooked and consumed directly by the community, does not contain *Escherichia coli* bacteria that can be harmful to health. Based on this background, this research is important to conduct as an effort to ensure the microbiological quality of the water consumed by the community. The presence of *Escherichia coli* as an indicator of fecal contamination indicates potential health risks, thus testing is necessary to assess the suitability of water quality according to the standards set in Permenkes RI No.492/Menkes/Per/IV/2010.

## B. METHOD

The type of research used is descriptive laboratory observation because it describes the *Escherichia coli* bacteria in drinking water in RT 010 RW 002 in Kladufu Village, Sorong City. The research design uses a cross-sectional approach, which is a research design that analyzes the relationship between cause and effect factors thru various methods such as observation and data collection. The research location is in RT 010 RW 002 Kladufu Village and the TLM Microbiology Laboratory at the Papua School of Health Sciences. The research period is from June 23 to July 30, 2025. The sampling technique used is purposive sampling, which is a sampling technique based on certain considerations made by the researcher based on the known characteristics or traits of the population. The research instrument is shown in Table 1.

**Table 1. Assessment Aspects/Indicators**

| No | Observed Aspect | Indicator | Measurement Methode | Data Scale |
|---|---|---|---|---|
| 1 | Respondent Characteristics | Name | Interview/Observation Sheet | Nominal |
| 2 | | Age | Interview | Ratio |
| 3 | | Gender | Interview | Nominal |
| 4 | Drinking Water Source | PDAM water | Observation | Nominal |
| 5 | | Treatment (Cooked/Not) | Interview | Nominal |
| 6 | Environmental Condition | Number of House Resident | Interview | Ratio |
| 7 | | Water Storage Duration | Interview | Ratio |
| 8 | Laboratory Examination | Presence of *Escherichia coli* | MPN Method | Nominal |
| 9 | | MPN value of *Escherichia coli* | MPN calculation | Ratio |
| 10 | Media and Growth | Grown on Lactose Broth | Observation (Turbidity/gas) | Nominal |
| 11 | | Growth on *Escherichia coli* Broth | Observation | Nominal |

After the respondents agreed, sampling was conducted using sterile bottles, writing instruments, label paper, and taken to the laboratory for sample examination using Durham tubes, Pyrex brand test tubes, test tube racks, stirring rods, volumetric pipettes, Pyrex brand measuring cups, Bunsen burners, Pyrex brand Erlenmeyer flasks, inoculating loops, horn spoons, analytical balances, autoclaves, incubators, B'ONE brand laminar air flow, and materials used such as aquades, HVS paper, aluminum foil, unboiled PDAM water samples for direct consumption, and bacterial growth media including Lactose Broth with catalog number M103-500G and *Escherichia coli* broth with catalog number M127-500G. Sample examination was conducted using the Most Probable Number (MPN) method. This research instrument is equipped with a master table used as a guide for recording and processing examination data, which is then entered into Excel and analyzed using SPSS 20 statistical tests. The MPN method is one of the methods for identifying coliform and *Escherichia coli* bacteria. This method uses liquid media in test tubes to observe positive results based on the amount of gas in the Durham tube. In this study, two testing stages were used, and each test utilized different growth media, namely the presumptive test using lactose broth (LB) and the confirmation media using E.C. Broth.

## C. RESULTS AND DISCUSSION

To provide an overview of the characteristics of the respondents in this study, the frequency distribution based on gender is presented below.

**Table 2. Frequency of PDAM Drinking Water Utilization Based on Gender in RT 010 RW 002 Kaldufu Village, Sorong City**

| No | Gender | Frequency (f) | Percentage (%) |
|---|---|---|---|
| 1 | Male | 12 | 31,6% |
| 2 | Female | 26 | 68,4% |
| | Total | 38 | 100% |

Based on Table 2, female respondents are more numerous at 68.4% compared to males at 31.6%. This indicates that women are more dominant in household water management, thus potentially being more frequently exposed to water contaminated with *Escherichia coli*. This condition emphasizes the importance of education regarding drinking water quality for women to prevent health risks (Nurkhalisa, 2024).

**Table 3. Frequency of Respondents by Age in the Identification of *Escherichia coli* Bacteria in PDAM Drinking Water in RT 010 RW 002 Kaldufu Village, Sorong City**

| No | Age | Frequency (f) | Percentage (%) |
|---|---|---|---|
| 1 | 21-30 | 11 | 28,9% |
| 2 | 31-40 | 9 | 23,7% |
| 3 | 41-50 | 9 | 23,7% |
| 4 | 51-60 | 6 | 15,8% |
| 5 | 61-65 | 3 | 7,9% |
| | Total | 38 | 100% |

Based on Table 3, the majority of respondents are in the 21-30 age group (28.9%), while the least are in the 61-65 age group (7.9%). This indicates that the productive age group is more dominant in the use of PDA drinking water. This age group tends to be more active in household activities, thus having a higher potential exposure to water contaminated with *Escherichia coli.* These findings are in line with the research by Sari et al., (2022), which states that the use of PDAM drinking water is dominated by the productive age group.

**Table 4. Distribution of Respondents Based on Type of Occupation in the Use of PDAM Drinking Water in RT 010 RW 002 Kaldufu Village, Sorong City**

| No | Occupation | Frequency (f) | Percentage (%) |
|---|---|---|---|
| 1 | Temporary Labor | 1 | 2,6% |
| 2 | Housewife | 16 | 42,1% |
| 3 | Fisherman | 2 | 5,3% |
| 4 | Private Employe | 9 | 23,7% |
| 5 | Self Employed | 3 | 7,9% |
| 6 | Security | 1 | 2,6% |
| 7 | Enterpreneur | 1 | 2,6% |

| | | | |
|---|---|---|---|
| 8 | Farmer | 2 | 5,3% |
| 9 | Driver | 1 | 2,6% |
| 10 | Civil Servant | 1 | 2,6% |
| 11 | Retired Civil Servant | 1 | 2,6% |
| | Total | 38 | 100% |

Based on Table 4, the majority of respondents are housewives (42.1%), followed by private employes (23.7%) and self-employed individuals (7.9%). This indicates that the majority of respondents do not work in the formal sector and are dominated by groups involved in household management. The IRT group plays an important role in the management of drinking water presentation, thus having a greater potential to be exposed to water contaminated with *Escherichia coli*. This is in line with the research by Pratama & Lestari, (2022), which states that the IRT group plays a crucial role in maintaining water sanitation, from the process of collection, storage, to the presentation of water for family consumption. In addition, there is a significant relationship between the level of knowledge about drinking water quality and the risk of *Escherichia coli* contamination.

**Table 5. Distribution of Respondents Based on the Number of Household Members in the Use of PDAM Drinking Water in RT 010 RW 002 Kaldufu Village, Sorong City**

| No | Occupants (people) | Frequency (f) | Percentage (%) |
|---|---|---|---|
| 1 | 2 | 1 | 2,6% |
| 2 | 4 | 7 | 18,4% |
| 3 | 5 | 16 | 42,1% |
| 4 | 6 | 9 | 23,7% |
| 5 | 7 | 4 | 10,5% |
| 6 | 12 | 1 | 2,6% |
| | Total | 38 | 100% |

Based on Table 4, the largest number of household members is 5 (42.1%), followed by 6 people (23.7%). This indicates that the majority of respondents have a relatively large number of family members. The more occupants there are, the higher the water consumption level, and the greater the potential for contamination of unhygienic water storage. This is in line with the research by Widodo et al., (2022). The study found a significant relationship between the density of household occupants and the quality of household drinking water, which has the potential to be contaminated with *Escherichia coli*

**Table 6. Distribution of Respondents Based on the Duration of Storing PDAM Drinking Water in RT 010 RW 002 Kaldufu Village, Sorong City**

| No | Duration of Water Storage | Frequency (f) | Percentage (%) |
|---|---|---|---|
| 1 | < 3 weeks | 3 | 7,9% |
| 2 | 3-4 weeks | 20 | 52,6% |
| 3 | >4 weeks | 15 | 39,5% |
| | Total | 38 | 100% |

Based on Table 6, the majority of respondents store water for 3-4 weeks (52.6%), followed by more than 4 weeks (39.5%), and less than 3 weeks (7.9%). This indicates that the duration of water storage is relatively long, which potentially increases the risk of microorganism growth if not accompanied by hygienic management. The longer the water is stored, the microbiological quality of the water tends to decrease and increases the risk of *Escherichia coli* contamination. These findings are consistent with the research by Hidayat & Maulida, (2022), which states that storing water for a long time, especially in open containers, can increase bacterial growth.

**Table 7. Distribution of Respondents Based on the Type of Drinking Water Storage Container PDAM in RT 010 RW 002 Kaldufu Village, Sorong City**

| No | Water Storage Container | Frequency (f) | Percentage (%) |
|---|---|---|---|
| 1 | Profile Tank | 18 | 47,37% |
| 2 | Drum | 20 | 52,63% |
| | Total | 30 | 100% |

Based on Table 7, the majority of respondents use water storage containers in the form of drums (52.6%), while the rest use profile tanks (47.4%). These results indicate that the types of water storage containers vary and can affect the quality of the stored water. Containers that are not covered or are rarely cleaned have the potential to increase the risk of microorganism contamination, including *Escherichia coli*. Additionally, the process of transferring water from one container to another can also increase the risk of contamination if not done hygienically. This is in line with the research by (Ramadhani & Yusuf, 2022), which states that the type and condition of the storage container affect the level of bacterial contamination.

**Table 8. Distribution of Coliform Most Probable Number (MPN) Test Using Lactose Broth in PDAM Drinking Water in RT 010 RW 002 Kaldufu Village, Sorong City**

| No | Examination Results | Frequency (f) | Persentage (%) |
|---|---|---|---|
| 1 | Positive | 22 | 57,9% |
| 2 | Negative | 16 | 42,1% |
| | Total | 38 | 100% |

Based on Table 8, the majority of samples showed positive results in the presumptive test (MPN) for Coliform using lactose broth (LB) media, with 22 samples (57.9%) testing positive, while 16 samples (42.1%) tested negative. The positive results in the presumptive test indicate the presence of coliform bacteria in drinking water, which suggests the possibility of fecal contamination. However, the presumptive test does not specifically indicate the presence of *Escherichia coli*, so a confirmation test using selective E.C Broth media is needed to ensure the presence of *Escherichia coli*. Therefore, water with positive results does not necessarily contain *Escherichia coli* but indicates the potential for microbiological contamination.

**Table 9. Distribution of Bacterial Count Based on Most Probable Number (MPN) Value in PDAM Drinking Water in RT 010 RW 002 Kaldufu Village, Sorong City**

| No | Examination Results | Frequency (f) | Persentage (%) |
|---|---|---|---|
| 1 | Little (≤1 MPN/100ml) | 18 | 47% |
| 2 | Moderate(2-8 MPN/100ml) | 16 | 42% |
| 3 | High(9-12 MPN/100ml) | 4 | 11% |
| | Total | 38 | 100% |

Based on Table 10, the distribution of bacterial counts shows that out of 38 PDAM drinking water samples examined, 18 samples (47%) fall into the low category (≤ 1 MPN/100ml), 16 samples (42%) fall into the medium category (2-8 MPN/100ml), and 4 samples fall into the high category (9-12 MPN/100ml). These results indicate that some samples have varying levels of coliform bacterial contamination, ranging from low to high. The moderate and high categories indicate the presence of microbiological contamination in PDAM drinking water.

**Table 10. Distribution of Escherichia coli Confirmation Test Using E.C Broth in PDAM Drinking Water at RT 010 RW 002, Kaldufu Village, Sorong City**

| No | Examination Results | Frequency (f) | Persentage (%) |
|---|---|---|---|
| 1 | Positive | 20 | 57,9% |
| 2 | Negative | 18 | 42,1% |
| | Total | 38 | 100% |

Based on Table 9, the confirmation test results using E.C. Broth media show that out of 38 PDAM drinking water samples examined, 20 samples (52.6%) tested positive for *Escherichia coli*, while 18 samples (47.4%) tested negative. Positive samples indicate the presence of fecal contamination and show that the microbiological quality of the water does not meet health standards. Negative results indicate that the samples do not contain *Escherichia coli.*

**Table 11. The Relationship Between Storage Containers and the Results of Escherichia coli Bacteria Examination in PDAM Drinking Water at RT 010 RW 002, Kaldufu Village, Sorong City**

| No | Storage Container | Examination Results | | | | Total | |
|---|---|---|---|---|---|---|---|
| | | Positive | | Negative | | | |
| | | F | % | F | % | F | % |
| 1 | Profil Tank | 9 | 23.68% | 9 | 23.68% | 18 | 47.37% |
| 2 | Drum | 11 | 28.95% | 9 | 23.68% | 20 | 52.63% |
| | Total | 20 | 52.63% | 18 | 47.37% | 38 | 100% |
| α > 0.05 | | | | | | *pvalue* = 0.76 | |

Based on Table 11, it shows that in the profile tank storage container, there are 9 samples (23.68%) positive and 9 samples (23.68%) negative for *Escherichia coli.* In the drum storage container, there are 11 samples (28.95%) positive and 9 samples (23.68%) negative. Overall, there are 20 samples (52.63%) positive and 18 samples (47.37%) negative for *Escherichia coli*. Based on the statistical test, a p-value of 0.76 was obtained with a significance level of α > 0.05, thus p >

0.05. This indicates that there is no statistically significant relationship between the type of container and the results of the *Escherichia coli* examination. This may be due to external factors such as the cleanliness of the container, the container's lid, the location where the container is placed, and the method of drawing water from the container. Although descriptively, drum-type containers show a higher number of positive samples compared to tank profiles, statistically, the type of storage container has not been proven to be a factor influencing the presence of *Escherichia coli.*

**Table 12. The Relationship Between Storage Duration and the Results of Escherichia coli Bacteria Examination in PDAM Drinking Water in RT 010 RW 002 Kaldufu Village, Sorong City**

| No | Duration of water storage | Examination Results | | | | Total | |
|---|---|---|---|---|---|---|---|
| | | Positive | | Negative | | | |
| | | F | % | F | % | F | % |
| 1 | < 3 Weeks | 1 | 2,6% | 2 | 5,3% | 3 | 7,9% |
| 2 | 3-4 Weeks | 8 | 21,1% | 12 | 31,6 % | 20 | 52,6 |
| 3 | > 1 Month | 11 | 28.9% | 4 | 10,5% | 15 | 39,5% |
| | Total | 20 | 52.6% | 18 | 47.4% | 38 | 100% |
| $\alpha > 0.05$ | | | | | | *pvalue* = 0.116 | |

Based on Table 12, it shows that for water storage duration of less than 3 weeks, there was 1 sample (2.6%) positive and 2 samples (5.3%) negative for *Escherichia coli*. For a storage duration of 3-4 weeks, there were 8 samples (21.1%) positive and 12 samples (31.6%) negative. Meanwhile, for a storage duration of more than 1 month, there were 11 samples (28.9%) positive and 4 samples (10.5%) negative for *Escherichia coli.* The results of the chi-square test yielded a p-value of 0.116 with a significance level of $\alpha = 0.05$, thus $p>0.05$. This indicates that there is no relationship between the duration of water storage and the results of the *Escherichia coli* examination. However, descriptively, it appears that the longer the water is stored, the number of positive *Escherichia coli* samples tends to increase. These conditions can be influenced by other factors such as the cleanliness of the container, environmental sanitation conditions, and the method of storage and water collection. This is in line with the research by Hidayat & Maulida, (2022), which states that the longer water is stored without hygienic treatment, the more it causes a decline in the microbiological quality of the water.

**Table 13. The Relationship Between the Number of Bacteria and the Results of Escherichia coli Bacterial Examination in PDAM Drinking Water at RT 010 RW 002, Kaldufu Village, Sorong City**

| No | Number of Bacteria | Examination Results | | | | Total | |
|---|---|---|---|---|---|---|---|
| | | Positive | | Negative | | | |
| | | F | % | F | % | F | % |
| 1 | Little (≤ 1 MPN/100ml) | 0 | 0,0% | 18 | 47,4% | 18 | 47,4% |
| 2 | Moderate (2-8 MPN/100ml) | 16 | 42,1% | 0 | 0 % | 16 | 42,1% |
| 3 | Many (9-12 MPN/100ml) | 04 | 10,5% | 0 | 0 % | 4 | 10,5% |
| | Total | 20 | 53% | 18 | 47.4% | 38 | 100% |
| $\alpha \geq 0.05$ | | | | | | *pvalue* = 0.000 | |

Based on Table 13, the chi-square test results show a p-value of 0.000, indicating a significant relationship between the number of bacteria and the results of the PDAM drinking water examination.

## D. CONCLUSION

Based on the research results of 38 samples of untreated PDAM drinking water in RT 010 RW 002, Kladufu Village, Sorong City, the presumptive test results using the Most Probable Number (MPN) method on Lactose Broth (LB) media showed that 22 samples (57.9%) were coliform positive and 16 samples (42.1%) were coliform negative. The confirmatory test results using E.C Broth media showed that 20 samples (52.6%) were identified as Escherichia coli positive and 18 samples (47.4%) were Escherichia coli negative. Additionally, the analysis of bacterial counts based on MPN values showed that 18 samples (47.4%) were in the low category (≤1 MPN/100 ml), 16 samples (42.1%) were in the medium category (2–8 MPN/100 ml), and 4 samples (10.5%) were in the high category (9–12 MPN/100 ml). The results of the statistical tests show that there is no significant relationship between the type of storage container and the duration of water storage with the presence of Escherichia coli ($p > 0.05$). However, there is a significant relationship between the number of bacteria based on the MPN value and the presence of Escherichia coli ($p < 0.05$). Based on these results, it can be concluded that some samples of untreated PDAM drinking water in the RT 010 RW 002 area of Kladufu Village, Sorong City, have been contaminated with Escherichia coli bacteria, thus the microbiological quality of the water does not meet drinking water health standards.

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