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Analysis Factors of Bacteria in The Refill Water at Semarang District

Lusi Aprilia ✉, Yuni Wijayanti, Dyah Rini Indriyanti

Universitas Negeri Semarang, Indonesia

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Abstract

Refill Drinking Water is a drinking water industry business that processes raw water into drinking water. Semarang is an industrial city in Central Java, an increase in the number of industrial companies is raised so that the development activities in various fields can directly cause microbial pollution in raw water. The purpose of this study was to analyze the effect of raw water sources, filtration processes, disinfection processes, environmental sanitation conditions and personal hygiene in the presence of bacteria in refill drinking water in Semarang district. This research was a quantitative research, with a cross sectional approach. The research sample amounted to 33 refill drinking water stations with simple random sampling technique. The instrument used was the observation sheet and the form of laboratory test results. Data collection techniques used interviews, observations and laboratory tests. Data analysis in this study used Simple Logistic Regression. The results of the study were influential on raw water source variables (p = 0.019), filtration process (p = 0.017), disinfection process (p = 0.013), environmental sanitation conditions (p = 0.017), personal hygiene of employees (p = 0.013) on existence bacteria in refill drinking water in Semarang district. The presence of E. coli bacteria in refill drinking water indicates microbial pollution in drinking water, which can result.

✉address:
Jalan kelud utara III sampangan kampus Pascasarjana UNNES, Indonesia
E-mail: lusiaprilia55@gmail.com

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INTRODUCTION

Refill Drinking Water is an industrial business that processes raw water processing, into drinking water and sells directly to consumers. This type of drinking water can be obtained from depots at lower prices than branded bottled drinking water products (Suprihatin, 2008).

The presence of microorganisms in water is one of the biological parameters for determining water quality requirements. One of the groups of microorganisms that is very important to note is their presence in water, especially enter pathogenic bacteria which are harmful to humans, for example E. coli (Widiyanti et al., 2004). The higher level of Coliform bacteria contamination, the risk of the presence of other pathogenic bacteria is highly normally live in human and animal feces. One example of pathogenic bacteria is E. coli which is a microbe that causes symptoms of diarrhoea, vomiting, abdominal pain, intestinal infections, fever and other digestive disorders (Widiyanti et al., 2004).

Semarang is one of the industrial cities in Central Java; the increase of the number of industrial companies is increase from 2016 with the number 143 rapidly increasing in 2017 with 163 industrial companies, so that development activities in various fields can directly cause pollution to water standard (Semarang Regency Statistics Agency, 2017).

According to Semarang Regency Industry and Trade Agency (DISPERINDAG) and Semarang District Health Office (DINKES) in 2017, the development of refill drinking water depots in Semarang Regency is quite rapid, from 60% of refill drinking water producers recorded in May 2017, to the beginning of the year 2018 there are fifty-five producers of refill drinking water (Disperendag, 2017).

The purpose of this study was to analyze the influence of raw water sources, filtration processes, disinfection processes, environmental sanitation conditions and personal hygiene of employees on the presence of bacteria in refill drinking water in Semarang district.

METHOD

The study was conducted using a cross sectional approach. The industrial population of refill drinking water in Semarang Regency was 55 industrial refill drinking water depots. The sample in this study was obtained by calculating using the Honeyeshow formula, which is 30 samples to anticipate damage to the sample, then add 10% so that the number of 33 samples using the simple random sampling technique.

Raw water sources, filtration processes, disinfection processes, environmental sanitation conditions and personal hygiene of employees are independent variables, while the dependent variable is the presence of E. coli bacteria. The instrument in this study used observation sheets and laboratory test results form. Data collection techniques in this study were carried out by means of interviews, observations (observations) and laboratory tests

In this study multivariate analysis was conducted to see the effect on independent variables and dependent variables using the Simple Logistic Regression test.

RESULT AND DISCUSSION

This research was conducted in Semarang Regency, Ungaran, Ambarawa and Bandungan areas in October-November 2018 with the aim to determine the factors that influence the presence of bacteria in refill drinking water through laboratory tests.

Table 1. Univariate Analysis

Variable	Category	Frequency	Precentage
Raw Water Source	TMS	15	45.5
	MS	18	54.5
Filtration Process	TMS	12	36.4
	MS	21	63.6
Disinfection Process	TMS	14	42.2
	MS	19	57.6
Conditions of Environmental Sanitation	TMS	12	36.4
	MS	21	63.6
Personal Hygiene of employee	TMS	14	42.4
	MS	19	57.6
The existence of bacteria	TMS	8	24.2
	MS	25	75.8

The raw water source category does not meet the requirements of 15 depots (45.5%) it can se from table 1. On the results of observations in the field of raw water sources used by the drinking water industry refill using ground water and rivers, but the current conditions allow for the occurrence of pollution caused by raw water generation more than 12 hours and disinfection during the trip. The study of Khiki, *Et al* (2014) showed the relationship between the condition of raw water and bacteriological quality in refill drinking water. This means that to get good drinking water, raw water must be qualified is needed (Khiki et al., 2014).

The filtration process category does not meet the requirements of 12 depots (36.4%) because *black washing* is not carried out, the size of the microbiological filter does not match the lifetime, the filtration device is not turned on in the morning so that the filtration process is not optimal. The results of a similar study showed that the tools used is not in lifetime or non-stratified. So that, E. coli bacteria is found in refill drinking water (Veronika et al., 2012).

The disinfection process in the category of non-eligibility was 14 depots (42.2%) because disinfected equipment was not in its lifetime, it was not switched on from morning to evening so that the disinfection process was not maximal and was not disinfected on the tank's water spout faucet. A similar study of the disinfection process carried out by other researchers, Said *et al*. (2007) stated that the disinfection process had a significant effect on the reduction of *E. coli* bacteria.

Environmental sanitation conditions in the category do not meet the requirements of 12 depots (36.4%) due to the condition of the floor, wall, roof or ceiling, and the disposal of waste that is not in accordance with the stipulated conditions. Based on the results of research similar to drinking water depots in the city of Denpasar, most of the locations are close to pollution, for example laundry business, and workshops. Inadequate environmental sanitation is a potential source of drinking water contamination (Chemulity et al., 2002).

Employees' personal hygiene category does not meet the requirements of 14 depots (42.4%) due to not doing hand washing, smoking, eating and drinking every time they serve buyers. Research on the implementation of sanitary hygiene and drinking quality inspection with results showed that most did not meet sanitation cleanliness (Abdilanov *et al*., 2013). A similar study conducted by Jemes (2012) he found the determination of diarrhoea morbidity was due to poor hygiene. While Irwan (2013) stated that there is a relationship between clean behaviour and the incidence of diarrhoea.

The presence of 8 categories of non-compliant bacteria (24.2%) from the sample did not meet the requirements; it means that the bacterial levels in refill water were contaminated by *E. coli* above the required standard of the government. The study conducted by Wadrivel *et al* (2012) found the results of five out of nine samples containing *Coliform* bacteria and three of the five samples also contained *E. coli* bacteria, indicating that 55.6% of drinking water depots in *Bungsu* Sub district produced drinking water that did not meet predetermined microbiological requirements by the government.

The results of a similar study on Coliform detection of Municipal Waterworks

in several districts in Makassar in 2014 revealed the Most Probable Number was not fulfilling the requirements for consumption by the community (Alang, 2015).

In bivariate analysis, the relationship between the source of raw water, the filtration process, the disinfection process, the environmental sanitation conditions and the personal hygiene of the employee in the presence of E. coli bacteria used *Fisher's exact test.*

Table 2. Bivariat Analysis

Variable	*P – value Escheria coli* Bacteria
Raw water source	0.012
Filtration Process	0.015
Disinfection Process	0.005
Conditions of Environmental Sanitation	0.015
Personal Hygiene of employee	0.005

Based on Table 2, raw water source variables with *p*-value 0.012 means there is a significant relationship between *E. coli* bacteria and raw water source. Similar research on raw water sources was stated by Athena et, all (2004) that the storage of raw water is too long (more than 3 days) it can affect the quality of drinking water by causing the growth of microorganisms

The filtration process has *p* value of 0.015, which means that there is a significant relationship to E. coli bacteria in refill drinking water. The study was conducted by Sukmayanti (2010) which is influential in reducing filtration of dissolved solids, turbidity, colour, solids dissolved, iron and sulphate.

The disinfection process has *p*-value of 0.005 which means that there is a significant relationship to *E. coli* bacteria in refill drinking water. The study was conducted by Rolan (2013), namely the longer the raw water contact with disinfected devices, the higher the chance of irradiating raw water which causes the death of microbes.

Environmental sanitation conditions have *p*-value of 0.015, which means that there is a significant relationship to E. coli bacteria in refill drinking water; this research is also supported by Aswafi (2004) regarding the relationship significant between drinking water refill conditions and bacteriological quality

Employee personal hygiene has *p*-value of 0.005, which means that there is a significant relationship to *E. coli* bacteria in refill drinking water. Another similar study has to do between traders' hygiene practices in the presence of *Escherichia coli* in *Rujak* seller around the State University of Semarang with *p* value = 0.021 (Setyorini., 2013).

Table 3. Multivariate Analysis

Variable	*P – value Escheria coli* Bacteria
Raw water source	0.019
Filtration Process	0.017
Disinfection Process	0.013
Conditions of Environmental Sanitation	0.028
Personal Hygiene of employee	0.013

The results of multivariate analysis with Simple Logistic Regression test was shown on Table 3, the raw water source has a significant effect with *p*-value of 0.019 on the presence of *E. coli* bacteria in refill drinking water. The research conducted by Khiki et al (2014) on the quality of raw water sources is that there is a relationship between the condition of raw water sanitation and bacteriological quality of refill drinking water. The quality of good drinking water is required by raw water, which conditions meet the requirements; therefore it does not need more equipment and processing procedures.

The filtration process has a significant effect with *p*-value of 0.017 on the presence of *E. coli* bacteria in refill drinking water. The results of a similar study in Tanjung Pinang Barat Sub district showed that the tools used was non-multilevel filtration, it was a factor

found in *E. coli* bacteria in refill drinking water (Veronika et al., 2012). Another study conducted by Sukmawati (2010), she found that filtration equipment has an influence in reducing the amount of dissolved solids, turbidity, and colour.

The disinfection process has a significant effect with *p*-value of 0.013 on the presence of *E. coli* bacteria in refill drinking water. The research conducted by Rolan (2013) described the longer the raw water in contact with disinfected devices, the higher the chance of disinfected devices irradiating raw water which causes the death of microbes. In addition, a similar study by Yodoet al (2005) indicates the quality of refill drinking water needs to standardize processing systems and processing technologies.

Environmental sanitation conditions have a significant effect with a *p*-value of 0.028 on the presence of *E. coli* bacteria in refill drinking water. The results of the study conducted by Asfawi (2004) in Semarang stated there is a significant relationship between sanitation conditions environment in refill drinking water with bacteriological quality (p = 0.001). This proves that environment influences the quality of refill drinking water, especially water depots. The results of similar studies on environmental sanitation conditions show that not all drinking water station in other areas implement hygiene sanitation (Sri Malem, 2008). Similar studies describe environmental sanitation, hand washing and hygiene practices, personal health affecting drinks or meals can be polluted if they are not done properly (Triora et al., 2015).

Personal hygiene of employees has a significant influence with a *p*-value of 0.013 on the presence of *E. coli* bacteria in refill drinking water. A similar study of personal hygiene come from Pratiwi (2014) her research showed there was a relationship between the practice of hand washing using soap, washing raw materials, sanitary equipment and *E. Coli* bacteria in chilli sauce provided; and there is no relationship between personal hygiene of handlers and user of tools when taking food. Similar research on the level of hygiene and *E coli* content in sugarcane water, the results of the study showed a significant relationship between processing of sugarcane water with the presence of *E. coli* with p = 0.00. Sugarcane water consumption in the city of Medan has a high risk of diarrheal disease (Simanjuntak et al., 2018).

CONCLUSION

The conclusions in this study can be taken as follows: Factors that influence the presence of E. coli bacteria in refill drinking water are raw water sources, filtration processes, disinfection processes and environmental sanitation conditions and personal hygiene of employees

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