



UNIVERSITI PUTRA MALAYSIA

***FECAL CONTAMINATION IN DRINKING WATER OBTAINED FROM
WATER VENDING MACHINES AT SERI KEMBANGAN, SELANGOR***

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WATER VENDING MACHINES AT SERI KEMBANGAN, SELANGOR**

BY

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**This thesis submitted in fulfillment of the requirement for the degree of Bachelor
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and Health Sciences, Universiti Putra Malaysia**

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ABSTRACT

FECAL CONTAMINATION IN DRINKING WATER OBTAINED FROM WATER VENDING MACHINES AT SERI KEMBANGAN, SELANGOR

NURUL FATIHAH BT KAMAL HUYOK

Introduction: Nowadays, water vending machines become popular among public due to its convenience and accessibility factor. This source of drinking water has potential to cause waterborne outbreaks. The common symptoms related by drinking fecal contamination water are gastrointestinal illness, respiratory symptoms, sore throat and mucosal symptoms. There is high possibility that not well maintains water vending machines can cause growth of bacteria. So, it is necessary to ensure the continuous supply of clean and safe drinking water for the public health protection. **Objectives:** The aim of this study is to determine and compare fecal contamination (*E. coli*) in water vending machines from Seri Kembangan with Malaysian Drinking Water Quality Standard (MDWQS). This study is also to determine experience of health symptoms from drinking water vending machines. Microbial (*E. coli*) and physicochemical analysis (pH, dissolve oxygen (DO), conductivity, total dissolved solid (TDS), salinity, and temperature) of drinking water samples from water vending machines was carried out at Seri Kembangan, Selangor. **Methodology:** A total of thirty drinking water samples from water vending machines from Seri Kembangan, Selangor were analyzed for *E. coli* using membrane filtration method through Lauryl Sulphate Broth. **Results and Discussion:** 26 drinking water samples were found contaminated with *E. coli*. Physicochemical parameters were found to be within the standard limits set by MDWQS. For association of daily water intake ($p=0.244$), perception on water vending machines ($p=0.431$) and perceived health symptoms experience after consume drinking water, there were no significant complaint from respondents. However, there is significant association ($p=0.009$) between preferred brand and experience health symptoms. **Conclusion:** The results obtained from this study suggested that more frequent monitoring and further research need to be done for more understand regarding to potential health effects among public. In addition, it is advised to always make sure water vending machines in clean and good condition to lower the chance for bacterial growth and presence of waterborne pathogens.

Keywords: Faecal contamination, drinking water, vending machines, health symptoms

ABSTRAK

PENCEMARAN SISA BUANGAN DALAM AIR MINUM DARI SUMBER MESIN AIR LAYAN DIRI DI SERI KEMBANGAN, SELANGOR

NURUL FATIHAH BT KAMAL HUYOK

Pengenalan: Pada masa kini, mesin menjual air menjadi popular di kalangan orang awam kerana faktornya yang mudah untuk digunakan dan senang didapati. Sumber air minuman ini, mempunyai potensi untuk menyebabkan wabak bawaan air. Gejala umum yang berkaitan dengan meminum air pencemaran sisa buangan ini ialah penyakit gastrousus, gejala pernafasan, sakit tekak dan gejala mukosa. Jika keadaan mesin tidak dijaga dengan baik, besar kemungkinan boleh menyebabkan pertumbuhan bakteria. Jadi, ia adalah perlu untuk memastikan orang awam mendapat bekalan air minuman yang bersih dan selamat secara berterusan. **Objektif:** Tujuan kajian ini adalah untuk menentu dan membandingkan pencemaran sisa buangan dalam mesin air layan diri di Seri Kembangan dengan Standard Kualiti Air Minum di Malaysia. Kajian ini juga untuk menentukan pengalaman gejala kesihatan dari meminum air dari mesin air layan diri. Oleh itu, analisis mikrob (*E. coli*) dan analisis fizikokimia (pH, membubarkan oksigen, kekonduksian, jumlah dibubarkan pepejal, kemasinan dan suhu) sample air minum dari mesin air layan diri di Seri Kembangan, Selangor telah dijalankan. **Metodologi:** Tiga puluh sampel air minuman dari mesin air layan diri di 6 lokasi di Seri Kembangan, Selangor sudah dianalisis dengan menggunakan kaedah penapisan membran untuk mengesan kehadiran *E. coli* dengan menggunakan Lauryl Sulphate Broth. **Keputusan dan Perbincangan:** 26 sample air ditemui mengandungi *E. coli*. Nilai-nilai bagi setiap parameter fizikokimia didapati masih dalam had yang ditetapkan oleh Standard Kualiti Air Minum di Malaysia. Manakala, untuk hubungan pengambilan air setiap hari ($p=0.244$) dan persepsi terhadap mesin air layan diri ($p=0.431$) dan gejala kesihatan yang dialami selepas meminum air ialah tiada aduan yang ketara daripada responden. Bagaimanapun, untuk jenama yang disukai dan gejala kesihatan yang dialami selepas meminum air terdapat hubungan yang signifikan ($p=0.009$). **Kesimpulan:** Keputusan yang diperolehi daripada kajian ini mencadangkan bahawa pemantauan yang lebih kerap dan kajian lanjut perlu dilakukan untuk lebih memahami mengenai kesan-kesan kesihatan yang berpotensi di kalangan orang ramai. Di samping itu, adalah dinasihatkan untuk sentiasa memastikan mesin menjual air layan diri dalam keadaan bersih dan baik untuk mengurangkan peluang pertumbuhan bakteria dan kehadiran patogen bawaan air.

Kata kunci: pencemaran najis, air minuman, mesin layan diri, gejala kesihatan

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LIST OF ABBREVIATIONS

DO	Dissolved Oxygen
EC	Electrical Conductivity
TDS	Total Dissolved Solid
MSDWQ	Malaysian Standard Drinking Water Quality
CFU	Colonies Forming Unit
EIEC	Enteroinvasive
ETEC	Enterotoxigenic
EPEC	Enteropathogenic
VTEC	Verotoxigenic
EHEC	Enterohaemorrhagic
EAEC	Enteroadherent
EAggEC	Enter aggregative
DAEC	Diffusely adherent
NTEC	Necrotoxicogenic
UPEC	Uropathogenic

CHAPTER 1

INTRODUCTION

1.1 Study background

The development of vending machines in industry had been growing dramatically over the past few decades this is because, these machines can operate whole day and it has ability for consumers to buy the products with self-service. This vending machines more user friendly compare to traditional shops in most country and also have offered a numerous type of products such as foods, beverage, sanitary utensil and drinking water (Lin et al., 2011; Magtibay, 2015). Since there is increasingly demand for clean water, water vending machines was a good solution cause it cheaper and convenient to the public. These water vending machines purified water inlet by using sediments filters, carbon filters, water softeners, reverse osmosis membranes, ultraviolet lamps, and ozone generators (Magtibay, 2015).

Access to clean drinking water was important because according to World Health Organization (WHO) stated that there were estimated 4 billion cases diarrhea and 2.2 million deaths mostly causes by consumption of contaminated water (WHO, 2002). In addition, UN-Water state that, around 780 million people unable to consume clean and safe drinking water and around 2.5 billion people had improper sanitation cause around 6-8 million people die every year regarding to water related illness (UN-Water,2013). Although the precaution step was taken to prevent from water being contaminated, but there still the risks associated with water vending machines.

The most common hazard is microbiological hazards. There have been a number of robust scientific studies around the world which have shown that the presence of bacteria such as *Escherichia Coli* (*E. coli*), *Staphylococcus aureus*, *Ralstonia pickettii* and *Pseudomonas aeruginosa* (Chaidez et al., 1999; Hunter & Burge, 1986; Rahmanian et al., 2015) in water sample from water vending machines. *Escherichia coli* (*E. coli*), total bacteria count and total coliform was commonly used as indicator for water contamination which can contribute to pathogens causing disease (Ye et al., 2013)

1.2 Problem statement

Majority of public are prefer to take water from water vending machines due to its convenient and accessibility factor. In addition, water from water vending machines were cheaper compare to other drinking water sources such as bottled water. Access to reverse osmosis in water vending machines may increase the drinking water quality through organic, inorganic and also bacteria content (Ee et al., 2016). However, earlier study conducted by Chaidez et al., (1999) showed that drinking water quality from water vending machines need to be improved as total coliform and *E. coli* found in drinking water samples with concentration range from 1000 to 56 000 CFU. Study was done by Schillinger & Du Vall Knorr (2004) also find out that there is microbial content in drinking water from water vending. In addition, Ee et al., (2016) stated that even if the water vending machines were invent with well water treatment via reverse osmosis, carbon filtration and UV radiation, but there still probability for drinking water being contaminated. Consumption of contaminated water may cause serious illness (DOH, 2011), but mostly public unaware about drinking water quality from water vending machines

because they assume that the water were safe from microbial contamination (Idris, 2014). In addition, in Malaysia study regarding to water vending machines quality still unclear.

1.3 Study justification

There have been limited studies on drinking water quality from water vending machines especially in Malaysia. Aruna & Camoens (2014) was reported that there were microbial contamination in water sample taken from water vending machines at Petaling Jaya, Subang Jaya, Cheras, Klang and also Kuala Lumpur. Thus, it is important to know that there is *E. coli* in water vending machines due to its potential to cause waterborne outbreaks. Since Seri Kembangan has low cost housing such as flats and high density area, it was a suitable and target place for agents or owners of water vending machines to install their machines there (Lee, 2016). In addition, Seri Kembangan area has several commercial, business and education organizations so, the water vending machines has highly demand but so far there is no microbial contamination data in drinking water vending machines for this area.

1.4 Objectives

1.4.1 General objective:

To estimate fecal contamination (*E. coli*) in drinking water sample from water vending machines.

1.4.2 Specific objectives:

- i) To determine the socio-demographic among respondents at Seri Kembangan, Selangor

- ii) To determine *E. coli* colonies in drinking water vending machines at Seri Kembangan, Selangor.
- iii) To compare *E. coli* colonies in drinking water sample from water vending machines with Malaysian Standard Drinking Water Quality (MSDWQ).
- iv) To determine relationship between physicochemical of water with *E. coli*.
- v) To determine commonly reported health symptoms among respondent after drinking water from water vending machines.

1.5 Hypothesis

- i) There are significant relationships between physicochemicals of drinking water from vending machines and *E. coli* colonies.
- ii) There are significant relationships between perceived health symptoms and daily water intake.

1.6 Study Variables

Independent variables:

- a. *Escherichia coli* (*E. coli*)
- b. Physicochemical parameters
(pH, dissolved oxygen (DO), electrical conductivity (EC), total dissolved solid (TDS), salinity and temperature)

Dependent variables:

- a. Perceived health symptoms among water vending machines consumers.

1.7 Definition of Variables

1.7.1 *Escherichia coli* (*E. coli*)

Conceptual definition

E. coli are a large and diverse group of bacteria which normally live in the intestines of human and animals. Most *E. coli* are harmless and an important part of a healthy human intestinal tract and some are pathogenic that can cause illness. (CDC, 2015)

Operational definition

E. coli was determined by using standard membrane filtration technique provided by Environment Agency: The Microbiology of Drinking Water (2009) - Part 4 - Methods for the isolation and enumeration of coliform bacteria and *Escherichia coli*.

1.7.2 Physicochemical Parameters

Conceptual definition

Physicochemical parameters are used to assess water quality (WHO, 1992). It is defined as instrumental methods of analysis such as turbidimetry, colorimetry, polarography, adsorption spectrometry, spectroscopy and nuclear radiation.

Operational definition

The physicochemical for this study refer to pH, dissolved oxygen (DO), electrical conductivity (EC), total dissolved solid (TDS), salinity and temperature of drinking water from water vending machines. The readings for these parameters were taken by using measuring meter.

1.7.3 Perceived Health Symptoms

Conceptual definition

Perceived health is an indicator of overall health status. It is subjective measure of overall health status (Statistics Canada, 2015). Symptoms refer to subjective indication of a disorder or disease, such as nausea. It may accompanied by objective signs of disease (Dictionary.com, 2016).

Operational definition

The perceived health symptoms among respondents were investigated by using questionnaire.

1.8 Conceptual frame work

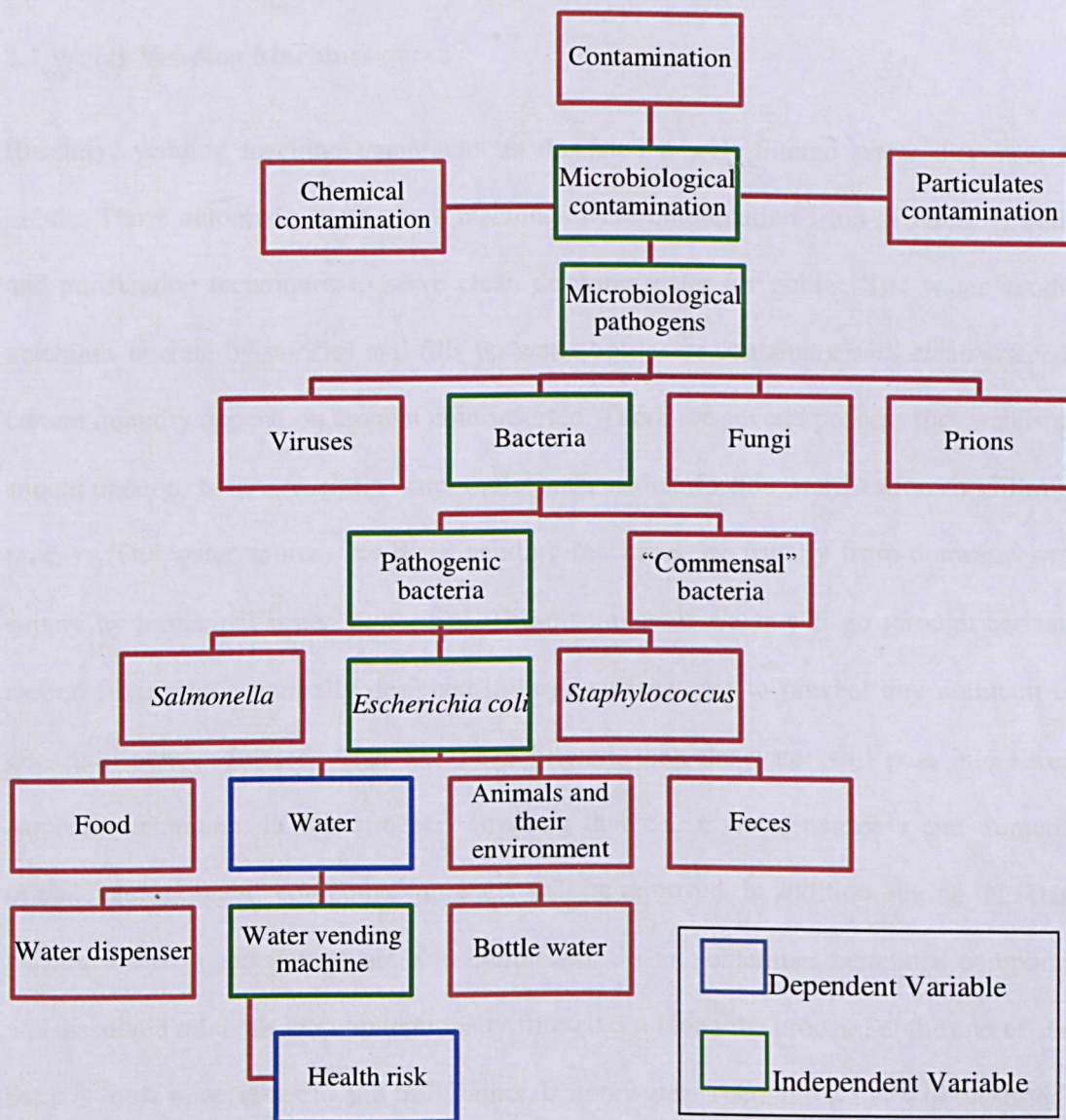


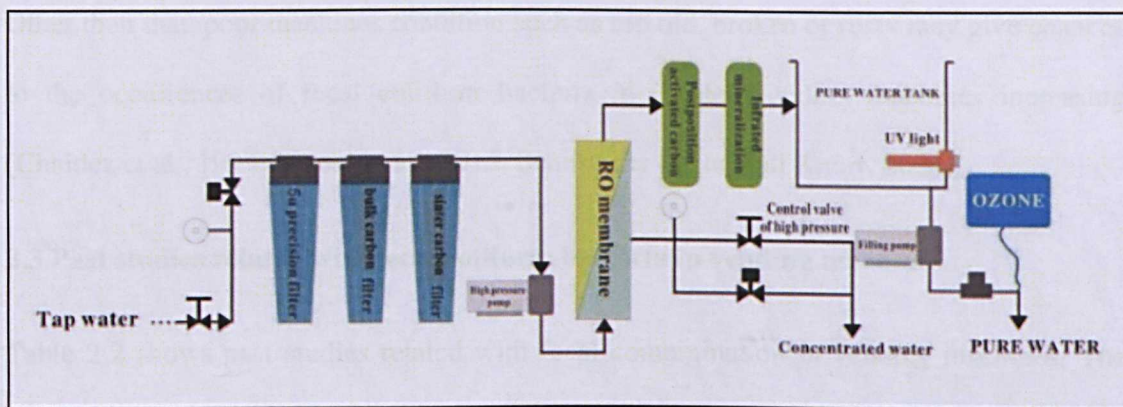
Figure 1.8: Conceptual framework for fecal contamination assessment

CHAPTER 2

LITERATURE REVIEW

2.1 Water Vending Machines

Recently, vending machine manufacturers designed a well filtered water dispenser for public. These automatic stand alone machines were combination from different filtration and purification techniques to serve clean drinking water for public. The water vending machines operate by purifies and fills up water bottles or containers with clean water for certain quantity depend on amount coin inserted. There are several process that water inlet should undergo before reaching water outlet such as disinfection, sterilization and filtration process. The water sources for these vending machines are usually from domestic water supply by municipal water authorities. These sources of water will go through activated carbon filter which normally designed in large surface area to prevent any pollutant can goes into next processes. After had been filtered, then the water will pass into reverse osmosis membrane. In this process, anything that cause water hardness and numerous organic and inorganic compounds in water will be removed. In addition, during this stage, harmful bacteria and viruses are also eliminated. Since, sometimes beneficial compounds and dissolved minerals are unintentionally filtered out along the process, at the end of stage there is ionic mineralizer to add back minerals into water. Then, the water will be stored in water vending machines tanks which are fitted with ultra violet lamps to make sure drinking water are free from all bacteria, germs and viruses (Axeon Water Technology, 2015)



(Adapted from genesis machinery.com)

Figure 2.0: Water vending machines process

2.2 Water Quality in Water Vending Machines

Microbiological analysis in water vending machines around the world shows that mostly drinking water samples were contaminated with fecal coliform bacteria (Chaidez et al., 1999; Ee et al., 2016; Schillinger & Du Vall Knorr, 2004; Rutz, 1996; Lee, 2016). The quality of drinking water depends on water source, design and maintenances of machines (Barrell et al., 2000). According to Ee et al., (2016) fecal coliform bacteria may grow at carbon filters of water vending machines and cause high concentration of coliform bacteria such as *E.coli* at water vended outlet. In addition, (Rutz, 1996) stated that drinking water were clean before it reaches the machines nozzle which contaminated cause of birds land there or children play with nozzle. Ee et al., (2016) also reported that the fecal contamination can occur from lack of safety and hygiene practices when handling water vending machines which may transmit the fecal coliform bacteria and toxic chemicals to public.

Other than that, poor machines condition such as too old, broken or rusty may give chances to the occurrences of fecal coliform bacteria in water vending machines increasing (Chaidez et al., 1999; Moosa et al., 2015; Schillinger & Du Vall Knorr, 2004).

2.3 Past studies related with fecal coliform bacteria in vending machines

Table 2.2 shows past studies related with fecal contamination in vending machines. The previous studies done showed that not all water vending machines were contaminated with microbe. For example, at Gran Canaria Island the results reported that there is no *E.coli* found in drinking water sample (Raposo et al., 2015). In contrast, according to (Hunter & Burge, 1986) the study conducted in United Kingdom for bacteriological quality of drinks from vending machines shows that the fecal contamination may occur. In addition, at United State two studies were carried out by (Kneller et al., 1990; Chaidez et al., 1999) and reported that the fecal coliform bacteria in drinking water samples were present. Lastly, in Malaysia the study that was conducted at Kelantan found out that 94% of water vending machines were contaminated with fecal coliform bacteria (Ee et al., 2016).

Table 2.2: Past studies related with fecal coliform bacteria in vending machines

Study done	Fecal coliform bacteria found in drinking water sample (cfu/100mL)
United Kingdom (Hunter & Burge, 1986)	44% of samples
United State (Kneller et al., 1990)	23% of samples
United State (Chaidez et al., 1999b)	20% of samples
Gran Canaria (Raposo et al., 2015)	Fecal coliform bacteria not detected
Malaysia (Yau Tan et al., 2016)	94% of samples

2.4 *Escherichia coli* (*E. coli*)

Escherichia coli (*E. coli*) are bacteria that live in digestive tract of animals and humans. It is commonly harmless but some are pathogenic which can contaminate food, water and environment. It can be differentiated through their ability to cause sickness consequence from their genetic elements for toxin production, adhesion and invasion of host cells, interference with cell metabolism and tissue destruction. The most popular sources of foodborne infections are unpasteurized dairy products and juice, under cooked and processed meat, fruits and vegetables and also unhygienic handling and storage of prepared food (FAO, 2011).

2.4.1 Faecal contamination pathways

Poor sanitation and hygiene are the factors for *E. coli* transmission. *E. coli* is acquired by consumption of contaminated food, water and by cross-contamination through direct human contact. Several microorganisms such as bacteria, viruses, protozoa and parasites can cause disease when ingested. Mostly these pathogens come from human or animal faeces and transmitted through faecal-oral route. The bacteria also may spread through one person to another when infected person did not practice personal hygiene such as not properly washed hand after using toilet. In addition, according to study conducted by Ee et al., (2016) fecal coliform may contaminated the water vending machines through human contact by public or cleaners that were infected with *E. coli*. Despite the fact that both animal and human faeces are risk to human health, human faeces are usually the most threatening. Fecal coliform bacteria such as *E. coli* are also listed in the main pathogens of matter in drinking water (Greg Keast & Rick Johnston, 2008). Thus, human may get *E. coli* infection through drinking water contaminated with faeces (WebMD Medical Reference,

2014). The transmission pathways also often include raw or inadequately processed animal or horticulture products, contact with animal manure, contaminated water and cross-contamination with raw food (FAO, 2011).

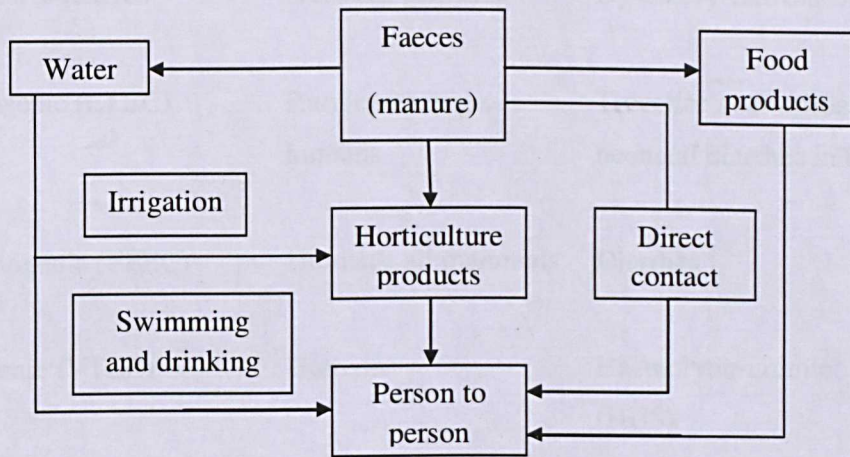


Figure 2.3: Faecal contamination pathways

2.4.2 Health risk

E. coli strains mostly were harmless. However, it can cause diarrheal disease. Table 2.3 shows the summary on pathogenic *E. coli* detailed by Mainil (2013). Generally, the susceptible person such as children and infants was at high risk to get infection because their immune system is not well developed and is unable to protect their body from contaminants and being infected (NRDC, 1998). According to National Resources Defense Council, diarrhea illness causes more than 20 million children death every year with 90% of them is under 5 years old. In addition, the population that is vulnerable to infection is elderly and pregnant women. The *E. coli* symptoms include mild watery diarrhea, abdominal cramps, nausea, headache and vomiting (WHO, 2001).

Table 2.3: Strain of pathogenic *E. coli*

Name	Host range	Diseases
Enteroinvasive (EIEC)	Humans, primates	Dysentery-like diarrhea
Enterotoxigenic (ETEC)	Ruminants, pigs, humans	Traveller's diarrhoea; profuse neonatal diarrhea in babies
Enteropathogenic (EPEC)	Humans, all mammals	Diarrhea
Verotoxigenic (VTEC)	Humans	Haemolytic-uremic syndrome (HUS)
Enterohaemorrhagic (EHEC)	Humans	(Haemorrhagic) colitis and HUS
Enteroadherent or enteroaggregative (EAEC or EAggEC)	Humans	Diarrhea
Diffusely adherent (DAEC)	Humans, animals	Diarrhea, urinary tract infections, septicaemia
Necrotoxigenic (NTEC)	Humans, animals	Diarrhea, urinary tract infections, septicaemia
Uropathogenic (UPEC)	Humans, animals	Cystitis, pyelonephritis, bacteraemia, septicaemia

CHAPTER 3

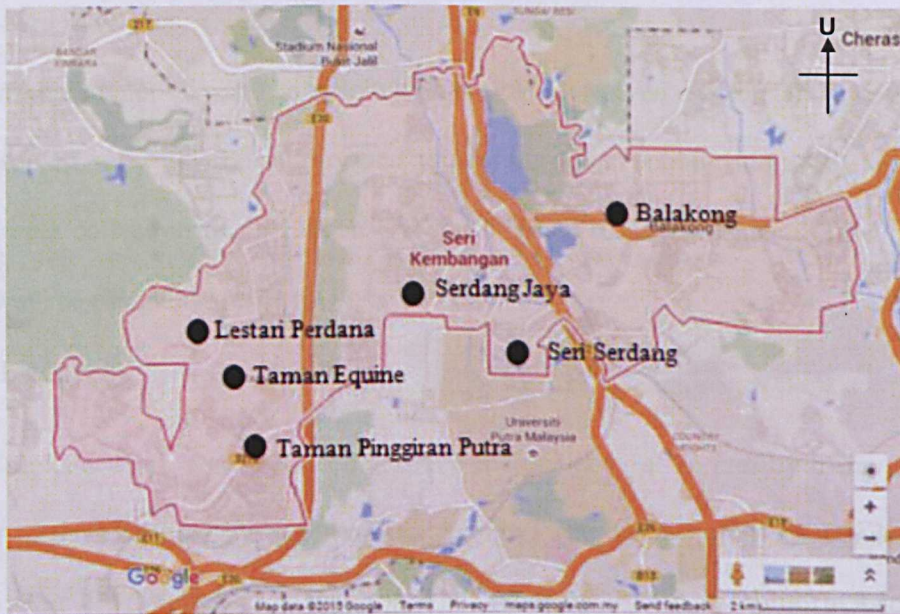
METHODOLOGY

3.1 Study Design

This study was conducted by using cross sectional study design. The advantages of cross sectional study are its relatively inexpensive and less time consuming. This study had been carried out at define time which is from January until February (2016) to determine fecal contamination in water obtained from water vending machines and also information about perceived health symptom experience after consume water from water vending machines.

3.2 Study Location

This study was conducted at Seri Kembangan, Selangor (Figure 3.1) because since there are several commercial, business and educational organizations in the area such as AEON Equine Park, Alice Smith International School and also Universiti Putra Malaysia. The strategic places also made it easy for people to access to Damansara through Lebuhraya Damansara Puchong (LDP), Klang by using South Klang Valley Expressway (SKVE), Kuala Lumpur to Seremban Highway and others, because all this reason the population of Seri Kembangan resident become increase (Keat, 2013). It is believed that mostly in high populated area, water vending machines were mainly used as drinking water sources due to its convenient and accessibility factors.



(Adapted from Google maps)

Figure 3.1: The map of study areas for drinking water sample

3.3 Study Population

The population that was involved were those who meet the criterias which are water vending machines consumer and Seri Kembangan residents.

3.4 Study instruments

3.4.1 Questionnaire

A set of self-construct questionnaire were administered to each volunteer respondents which consist of:

PART A: Background Information of Respondent

PART B: Water intake information

PART C: Health Status

PART D: Experience of Health Symptoms from Drinking Water Vending
Machines

3.4.2 In-Situ Analysis

The *in-situ* parameter of water sample which are pH, dissolved oxygen (DO), conductivity, total dissolved solid (TDS), salinity and temperature were conducted at site of drinking water sample collection using Eutech Cyberscan DO 110 meter, Eutech 600 Cond meter and Milwaukee pH meter, respectively.

3.4.3 Lab analysis

Lauryl Sulphate Broth was used to determine the presence of *E. coli* by using membrane filtration method adopted by Environment Agency: The Microbiology of Drinking Water (2009) - Part 4 - Methods for the isolation and enumeration of coliform bacteria and *Escherichia coli*.

3.5 Sample size

The number of sample size for respondents were calculated according to Kirkwood and Sterne (2009) equation:

$$N = \frac{P(1 - P)}{e^2}$$

N = Sample size

P = Prevalence or proportion

e = Probability standard error or mean (0.05)

P is the expected prevalence or proportion is 0.5 if there is no idea or clue for P value

$$\text{So, } N = \frac{0.5(1-0.5)}{0.05^2}$$

$$N = 100$$

Then, the sample size were rounded up to 20 % to recover any loss of respondents. Thus, the total size population of this study is 120 people.

Then, the ideal sample volumes for fecal coliform testing suggested for filtration membrane method is 100 mL (Table 3.5).

Water Source	Volume to be Filtered (mL)							
	100	50	10	1	0.1	0.01	0.001	0.0001
Drinking water	X							
Swimming pools	X							
Wells, springs	X	X	X					
Lakes, reservoirs	X	X	X					
Water supply intake			X	X	X			
Bathing beaches			X	X	X			
River water				X	X	X	X	
Chlorinated sewage				X	X	X		
Raw sewage					X	X	X	X

* *Standard Methods for the Examination of Water and Wastewater*, 19th ed., Table 9222:1, page 9-56.

Table 3.5: Suggested Sample Volumes for Membrane Filter Test

3.6 Sampling method

Schott Duran laboratory bottles with caps in capacity 500 ml was used to get 300 ml of drinking water sample from water vending machines. All of the water samples were taken from public water vending machines at Seri Kembangan, Selangor. The bottles were autoclaved with Hirayama HVE-50 Autoclave. Then, the samples were numbered from 1 against their location. Next, the samples were placed immediately in ice box and maintain under 1-4°C. Then, the drinking water samples were brought or transferred to laboratory for analysis within 12 hours from collection.

3.7 Data collection flow chart

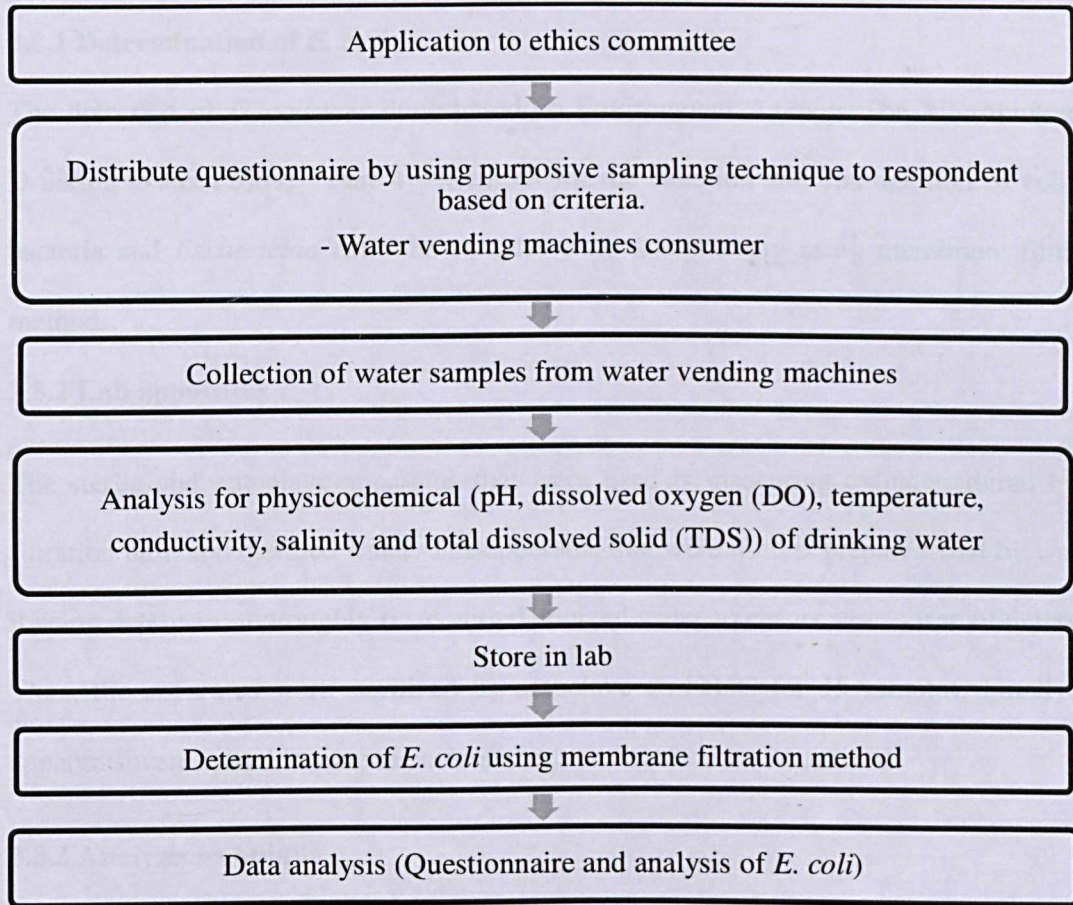


Diagram 3.7: Data collection flowchart

3.8 Sample analysis

3.8.1 Determination of *E. coli*

The detection of *E. coli* was done based on Environment Agency: The Microbiology of Drinking Water (2009) - Part 4 - Methods for the isolation and enumeration of coliform bacteria and *Escherichia coli*. The samples were analyzed by using membrane filtration method.

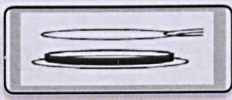
3.8.2 Lab apparatus


The sterile and autoclave apparatus that were used is measuring cylinder, duran bottle, filtration unit, and distilled water. The apparatus that were used is prepared first by washed it using detergent, thoroughly rinse with deionized water to ensure it was free of detergent. Then, the apparatus were sterilized by autoclave at 121°C for 15 minutes. Finally, the apparatus were stored in a clean environment.


3.8.3 Analysis technique


Lauryl Sulphate Broth was used to analyze the drinking water samples. This broth is used for detection of coliform bacteria including *E. coli* in water.


The procedure was as follow:

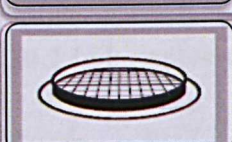
- 


1. The sterilized forceps were used by burn it in Bunsen burner and let them cool before used. Then, it were used to placed a sterile, absorbent pad in a sterile petri dish. The lid on the dish were placed.
- 


2. The Lauryl Sulphate broth were poured evenly over the absorbent . Then, the petri dish lid was replaced.
- 

3. The Membrane Filter Apparatus were set up and the membrane filter were placed using sterile forceps.
- 

4. The water samples were shaken vigorously. Then, 100 mL of samples were poured into funnel. The vacuum were applied and filtered the sample. The funnel wall were rinsed three times with 20 to 30 mL of sterile buffered dilution water.
- 

5. The vacuum were turned off and the funnel top were lift off. By using sterile forceps, the filter were transfered to the prepared petri dish previously.
- 

6. The filter were placed with a slight rolling motion, grid side up, on the absorbent pad. The trapped air under filter were checked and make sure the filter touches the entire pad. Then, the petri dish lid will be placed.
- 

7. The petri dish were inverted and incubated at $35 \pm 2^\circ\text{C}$ for 24 hours.
- 

8. The petri dish were removed from the incubator and the filters were examined for growth.

(Adapted from Environment Agency: The Microbiology of Drinking Water (2009) - Part 4)

3.8.4 Bacteria calculation

The *E. coli* counts were reported as the number of colonies forming unit (CFU) per 100mL of sample. The formula was used is:

$$E. coli \text{ per } 100 \text{ mL (CFU)} = \frac{\text{Number of yellow colonies counted} \times 100}{\text{Volume of sample filtered (mL)}}$$

3.9 Data analysis

The IBM Statistical Package for Social Sciences (SPSS) Software Version 21 was used to analyze the data. Descriptive analyses were used to determine socio-demographics data and commonly reported health symptoms among respondents. The spearman rho's correlation analyses also were used to determine the relationship between *E. coli* and physicochemical parameter of drinking water.

3.10 Quality control

3.10.1 Pre-test questionnaire

The questionnaires were pre-test first before given to the respondents to ensure it comprehensibility and precision.

3.10.2 Lab analysis using standard method

Analysis to determine the presence of *E. coli* in drinking water samples were based on Environment Agency: The Microbiology of Drinking Water (2009) - Part 4 - Methods for the isolation and enumeration of coliform bacteria and *Escherichia coli* (including *E. coli* O157:H7).

3.10.3 Sample quality control

Sterile equipment and autoclave apparatus were used to avoid any contamination during sample analysis. In addition, a drinking water samples were collected based on standard drinking water sampling procedure for microbiological by Department of Health Western

Australia. The samples also were analyzed three times to make sure laboratory analysis precision.

3.10.4 Calibration

The measuring meters were calibrated first before used to prevent any measurement error happen during analysis.

3.11 Ethics and human subject issues

The questionnaire in this study was carried out by giving respondents consent form first before doing questionnaire interview. All information regarding to respondents were remained private and confidential for research purpose only. This study also has been approved by Ethics Committee of Faculty of Medicine and Health Sciences before being conducted.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Socio-demographic data

This study was conducted from January to February (2016) at Seri Kembangan, Selangor (Malaysia). The total number of respondents involved in this study was 121 with response rate is 100%. The internal consistency of questionnaire was tested and value for Cronbach's alpha coefficient is 0.76 which consider as acceptable.

Table 4.1 shows the socio-demography of respondents that include age, gender, race, education level and smoking habit. For age data, respondent mostly among 15-24 years, 52.9% followed by 25-34 years with 24.8%, 35-44 years old, 16.5% and lastly 45-64 years old, 5.8%. This is because youngsters are more active comparing to above 35 years old and due to location of university and school where near to Seri Kembangan area. Majority respondent was female, 60% and male only 39.7% from 121 total of respondent. Then, the races for respondent was more from Malay, 66.1% compare to Chinese, 14.9%, Indian, 10.7% and others, 8.3%. For education level, mostly respondent having degree, 35.5%, higher secondary level, and diploma/STPM/college with 22.3%. Next, for lower secondary, primary and master level the result was 9.9%, 4.1% and 0.8%. The smoking habit for respondent was higher in no, 76.9% than yes, 23.1%.

Table 4.1: Socio-demography of respondent (n=121)

Socio-demographic characteristic	Number of respondents	Percentage (%)
Age		
15-24	64	52.9
25-34	30	24.8
35-44	20	16.5
45-64	7	5.8
Gender		
Male	48	39.7
Female	73	60.3
Race		
Malay	80	66.1
Chinese	18	14.9
Indian	13	10.7
Others	10	8.3
Education level		
Diploma/STPM/College	27	22.3
Degree	43	35.5
Masters	1	0.8
Primary level	5	4.1
SPM / Higher secondary level	33	27.3
SRP/PMR/Lower secondary level	12	9.9
Smoking		
No	93	76.9
Yes	28	23.1

4.2 Water intake information

The respondents were asked about their water intake information to determine the relationships with perceived health symptoms after consume the water from water vending machines. Table 4.2 shows the data about water intake information among respondent.

Overall, 47.1% of respondents consume water 5-7 cups daily and 23.1% taking 8-10 cups. This is because based on size of drinking water recommended by Malaysian Dietary Guidelines 2013, an adult should drink 6 to 8 glasses of plain water daily to stay hydrate and healthy. Next, 15.7% respondents prefer taking water 2-4 cups and 12.4% respondent consume more than 10 cups. Lastly, only 2% respondents drink 1-2 cups of water daily due to their sedentary activity.

The location that mostly respondent buy water was at shop with 56% because of the accessibility factor followed by at college 28.1% and others 14.9%. For the quantity to buy water, 47.1% of respondent choose to use 1.5L bottle, while for bottle size 5L is 19.0% and 500ml is 18.2%. This is because of most respondent recycled the mineral bottle that they buy at shops. Only 11.6% of respondent prefer to buy water in 1L size of bottle while the other using 3L and 10L of bottle which were 3.3% and 0.8%.

The respondent also was asked about consideration before buying water and most of them take concern of brand with 38.0% this is because of their perception that only certain brand will give good water for drinking. Then, for the availability is 27.3% and price is 25.6%. Lastly, only 9.1% of them do not care about water that they buy at water vending machines. Next, the brand that gets highest percentage is Dr Sukida, 57.0%.

Second is Sipsipwater, 15.7% and Imtiyaaz Bio Energy with 14.9%. Only 11.6% of respondent choose Water Drops and 0.8% other.

Majority of respondent which is 56.2% had heard of news on water vending machines contamination and 43.8% were not heard about the contamination. For the perception on water vending machine, 53.7% of respondent choose good while for fair is 33.9% and bad is 6.6%. The others choose very good and very bad which is 3.3% and 2.5%.

Table 4.2: Water intake information (n=121)

Water intake information	Number of respondents	Percentage (%)
Frequency of drinking water daily		
1-2 cups	2	1.7
2-4 cups	19	15.7
5-7 cups	57	47.1
8-10 cups	28	23.1
More than 10 cups	15	12.4
Location of buying water		
Shops	69	57.0
College	34	28.1
Others	18	14.9
Quantity to buy water		
500ml	22	18.2
1L	14	11.6
1.5L	57	47.1
3L	4	3.3
5L	23	19.0
10L	1	0.8

Consideration before buying water

Price	31	25.6
Brand	46	38.0
Availability	33	27.3
Don't care	11	9.1

Prefer brand for buying water

Other	1	0.8
Dr Sukida	69	57.0
Imtiyaz Bio Energy	18	14.9
Sipsipwater RO water	19	15.7
Water drops	14	11.6

Heard of news on water vending machines contamination

No	53	43.8
Yes	68	56.2

Perception on water vending machine

Good	65	53.7
Fair	41	33.9
Very good	4	3.3
Very bad	3	2.5
Bad	8	6.6

4.3 Normality test of variables

Shapiro Wilk results showed that most of the variables were not normally distributed. Table 4.4 shows the p value for pH, dissolved oxygen (DO) and temperature were greater than 0.05 which means that the variables were normally distributed. While for electric conductivity (EC), total dissolved solid (TDS), salinity and *E. coli* the p value were less than 0.05 indicated that data was not normally distributed.

Table 4.3: Normality test for each variable

Variables	p	Normality
pH	0.243	Normal
DO	0.159	Normal
EC	0.000	Not normal
TDS	0.002	Not normal
Salinity	0.013	Not normal
Temperature	0.131	Normal
<i>E. coli</i>	0.000	Not normal

4.4 Descriptive statistics of drinking water sample from water vending machines

Table 4.4 shows the descriptive statistics of drinking water samples variables from water vending machines at Seri Kembangan, Selangor (Malaysia). The value of pH for drinking water sample still within Malaysian Standard Drinking Water Quality which is 6.5 – 7.5 which means that the concentration of H^+ and OH^- ion were equal in drinking water sample (Kemker & Christine, 2014). Then, the temperature for drinking water samples were range between 21.7 °C to 22.4 °C.

Dissolved oxygen and electrical conductivity values were in range from 56.5% to 73.3% and 110.1 μ s/cm to 244.6 μ s/cm. Total dissolved solid that was a sum of overall ion particles that present in water samples including ion that make up salinity concentration (Kemker & Christine, 2014). In study this, total dissolved solid value were 110.3 mg/L - 238.9 mg/L and 114.0 mg/L – 230.8 mg/L for salinity.

Figure 4.1, shows the *E. coli* colonies count and sampling points. Firstly, in Lestari Perdana, there is no *E. coli* colonies count were found. While at Taman Pinggiran Putra, 6 out of 7 water vending machines were contaminated with *E. coli*. Next, drinking water sample taken at Taman Equine showed that only one water vending machine was contaminated with *E. coli*. However, at Serdang Jaya and Seri Serdang the results have shown that all water samples collected from water vending machines were contaminated with *E. coli*. Lastly, at Balakong, only 2 water vending machines had contaminated with *E. coli*. The counts were range between 1 to 45 per 100mL (Figure 4.2).

This is because due to environment of water vending machines installed. During the sampling day, it was noted that the date for water vending machines service or maintenance was delayed which can cause drinking water were contaminated. This was stated by previous study conducted by Du and Knorr, (2004) and Tobin et al., (1981) as in Figures 4.4 and 4.5. This result also was consistent with previous study which state that there is statistically significant association that the quality of machine maintenance may contribute to microbial level (Schillinger & Du Vall Knorr, 2004).

Table 4.4: Descriptive statistics of drinking water sample from water vending machines (n=30)

Parameter	Minimum	Maximum	Median	IQR	MSDWQ
pH	6.5	7.5	7.10	0.2	6.5-9.0
DO (%)	56.5	73.3	65.53	7.1	-
EC ($\mu\text{s}/\text{cm}$)	110.1	244.6	200.03	22.0	-
TDS (mg/L)	110.3	238.9	194.15	20.9	1000
Salinity (mg/L)	114.0	230.8	188.10	21.1	-
Temperature ($^{\circ}\text{C}$)	21.7	22.4	22.00	0.2	-
<i>E. coli</i> (cfu/100mL)	0	100	12.00	7.6	0 in 100mL

Note: DO: dissolved oxygen; EC: electrical conductivity; TDS: total dissolved solid; MSDWQ: Malaysian Standard Drinking Water Quality.

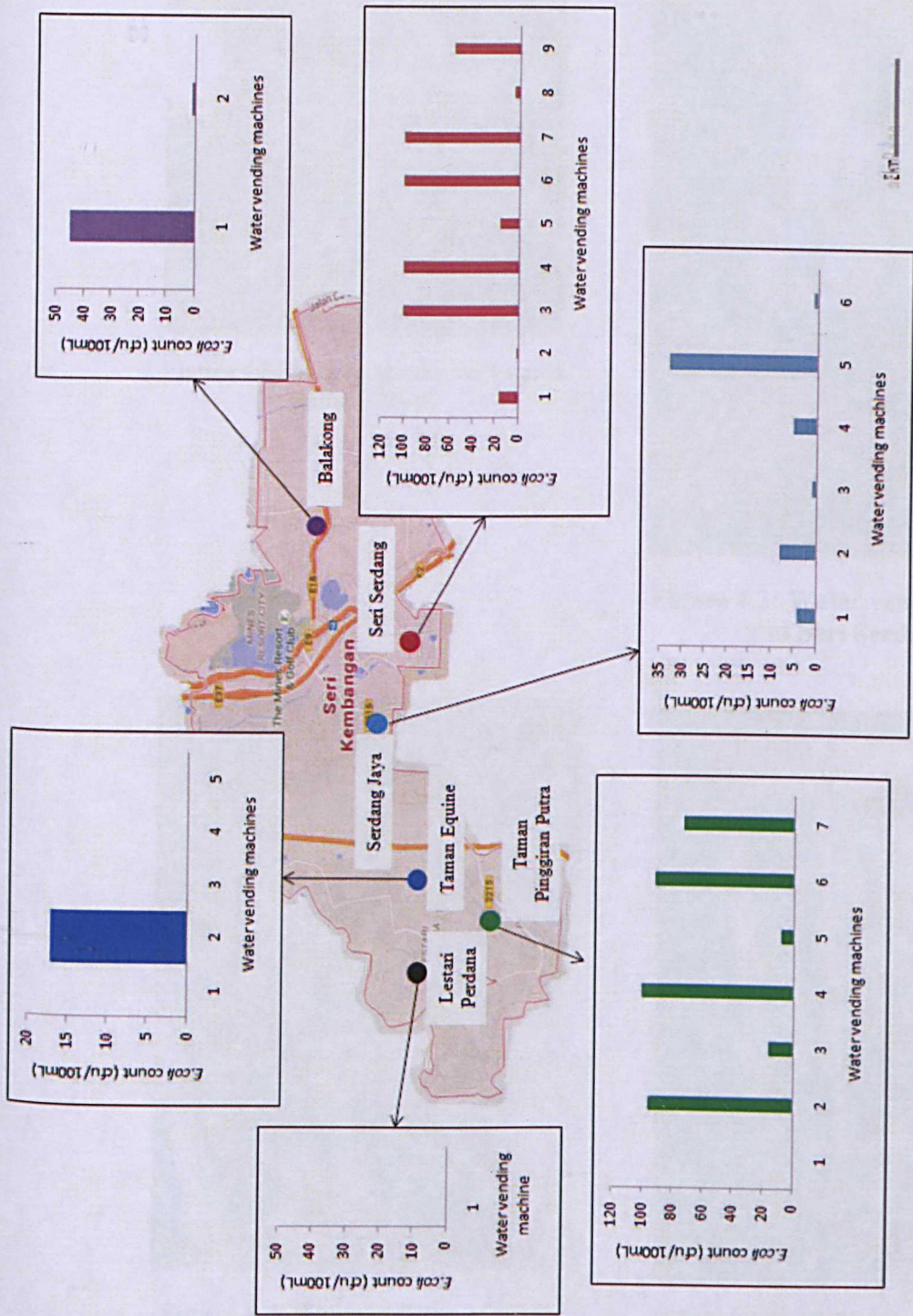


Figure 4.1: The location of water sample with *E. coli* count

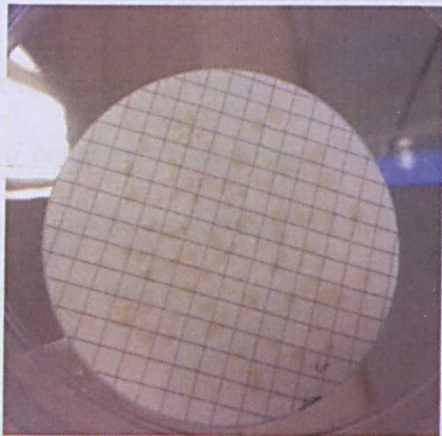


Figure 4.2: *E. coli* colonies on Lauryl Sulfate Broth



Figure 4.3: Water vending machine at Seri Serdang



Figure 4.4: The condition of water vending machine



Figure 4.5: Water vending machines at Serdang Jaya

4.5 Correlation between *E. coli*, and physicochemical parameters

Spearman's rho correlation coefficient test was used to know the relationships between *E. coli* count and physicochemical parameters of drinking water. Table 4.5 shows that conductivity was positively correlated with total dissolved solid (TDS), salinity and temperature. This is because, conductivity is the ability of any medium such as water to carry an electric current. The existence of total dissolved solids in drinking water samples such as calcium, chloride, and magnesium carries the electric current through water (Rahmanian et al., 2015) therefore, salinity is total amount of dissolved salt obtain in water sample such as sodium and chloride (SAH, 2016) which also has ability to conduct electric current. In addition, temperature also can affect conductivity through ionic mobility and solubility of salts and minerals (Kemker & Christine, 2014).

However, there is no correlation found between *E. coli* and all physicochemical parameters. This result was consistent with study by Chaidez et al. (1999) that showed no significant correlation were found between physiochemical and bacteriological parameters in water vending machines at United States. This is because, *E. coli* is a normal inhabitant in gastrointestinal tract. As a result, the optimum growth conditions for *E. coli* might as well be conditions in the average mammalian gut (Hartsock, 2016). In addition, the formation of *E. coli* biofilm that made up from bacterial colony embedded in matrix of extracellular polymeric substance (EPS) may protects the microbes from adverse environmental conditions and results in infection (Sharma et al., 2016).

Table 4.5: Spearman's rho correlation coefficient (r) between *E. coli* and physicochemical parameters

Variable	pH	DO	EC	TDS	Salinity	Temperature	<i>E. coli</i>
pH	1.000	0.033	0.191	0.170	0.194	0.193	0.073
DO		1.000	-0.127	-0.093	-0.090	-0.157	0.102
EC			1.000	0.996**	0.988**	0.434*	-0.207
TDS				1.000	0.986**	0.437*	-0.202
Salinity					1.000	0.425*	-0.182
Temperature						1.000	-0.062
<i>E. coli</i>							1.000

Significant at $p < 0.01$ and $p < 0.05$.

DO: dissolved oxygen; EC: electrical conductivity; TDS: total dissolved solid.

4.6 Perceived health symptoms

Table 4.7 shows the information about perceived health symptom after respondents consume the water from water vending machines that were extracted from questionnaire survey. 71.1% of respondents answer that they never had any experienced health symptom after consume water, while only 3.3% of respondent experience gastroenteritis which is including vomiting, diarrhea, nausea, abdominal cramp, or stomach ache. Then, 9.9% were experience headache or dizziness. Finally, 15.7% of respondents' answer they had experience respiratory symptoms which are cough, sore throat and running nose.

Mostly respondent answer that they did not perceive any health symptoms after consuming the water, this is because the symptoms usually are same with flu which is nausea, vomiting, diarrhea or headache. Although respondent had experienced *E. coli*

infection, they might not realize it and assume it was stomach flu (Roberts & Cynthia A., 2003). Next is respiratory symptom, despite the fact that some strain of *E. coli* can cause respiratory illness and pneumonia (CDC, 2015) but there were confounder such as smoking, asthma, chronic cough and air pollution through occupational or environmental exposures.

Table 4.7: Perceived health symptoms among respondent

Experience health symptoms	Yes		No	
	N	Percentage (%)	N	Percentage (%)
None	86	71.1	35	28.9
Gastroenteritis	4	3.3	117	96.7
Headache, dizziness	12	9.9	109	90.1
Respiratory symptoms	19	15.7	102	84.3

Chi-square test was performed to understand perceived health symptoms and factor associated with drinking water. Table 4.8 shows there is no association between perceived health symptoms and quantity of daily water intake, $X^2 (12, n = 121) = 14.951, p > 0.05 (0.244)$. Even though the quantity of *E. coli* ingested can give health symptoms (Reid, 2011), but there are others factors that required for *E. coli* to develop health symptoms.

The factors are condition for pathogenic *E. coli* to survive, reproduce and ability to disturb normal functions of cells in intestine by injected or secreted a toxin (Doyle et al., 2011). In addition, other factors are ability of an individual which varies from age, immunity level and gender (Doyle et al., 2011; Laupland et al., 2008). Gender can be the factor cause, women were particularly more prone to get infection because *E. coli* more easy to stray in

urinary tract and cause urinary tract infections (UTI's) compared to men because of anatomical differences (Doyle et al., 2011; Magliano et al., 2012).

In addition, *E. coli* species comprises different strains, some are pathogens and others not. These pathogenic *E. coli* was subdivided into several strains causing different illness such as intestinal, urinary tract and infections (Mainil, 2013). Enteroinvasive, Enterotoxigenic, Enteropathogenic, Enterohemorrhagic, Enteroaggregative, and Necrotoxigenic *E. coli* can cause diarrhea by attached to intestine and produce toxin (Doyle et al., 2011). However, the strain that causes trouble are rare which had different genetic characteristic than normal *E. coli* that lives in the gut (Thiel, 1999).

Yet despite all concern given to their harmful strain, most of *E. coli* was beneficial to human as it producing vitamins such as vitamin K and B-complex vitamins that are important to our health which are cannot being produce by bodies and helps for digestion. (Doyle et al.,2011; Kaper et al.,2004;Thiel,1999). Since *E. coli* used oxygen in intestine which are toxic to other microorganisms, it create a perfect condition for other microbes (Doyle et al., 2011). In facts, *E. coli* typically growth in gastrointestinal tract of human infants in few hours after birth and they rarely cause disease except in immunocompromised hosts or growth in other areas of the body (Kaper et al., 2004)

In addition, the relationship of preferred brand and experience health symptom, the result showed that there were significant association between preferred brand and experience health symptom, $X^2 (12, n = 121) = 26.497, p < 0.05 (0.009)$. This is because, all brand give different drinking water quality due to their service and maintenance schedule, the staff or cleaners also play a role since contamination may happen cause of employed poor hygiene practices, such as not washing hands after visiting toilet and touching the water outlet (Tan et al., 2016). Next, there is no association between perception on water vending machines and reported health symptoms $X^2 (9, n = 121) = 9.068, p > 0.05 (0.431)$. This is because, based on previous

study, it stated that there are several factors which can affect public perception such as previous experience, trust in suppliers, past problems about water quality and also knowledge gain from mass media and interpersonal sources (Doria et al., 2009).

Table 4.8: Chi-square test of contingency between reported health symptoms and daily water intake

Variables	Reported health symptoms				χ^2 (df)	P
	None	Gastroenteritis	Headache, dizziness	Respiratory symptoms		
Daily water intake					14.951 (12)	0.244
1-2 cups	2	0	0	0		
2-4 cups	15	2	1	1		
5-7 cups	33	2	8	14		
8-10 cups	23	0	2	3		
More than 10 cups	13	0	1	1		
Preferred brand					26.497 (12)	0.009
Desa	1	0	0	0		
Dr Sukida	56	1	8	4		
Imtiyaaz Bio	11	0	1	6		
Energy						
Sipsipwater	8	3	2	6		
Water drops	10	0	1	3		
Perception on water vending machines					9.068 (9)	0.431
Good	42	2	7	8		
Fair	28	1	4	8		
Best	4	0	1	3		
Bad	12	1	0	0		

Significant at $p < 0.05$

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The socio demography of respondents has been determined which is majority are female Malays and mostly from age 15 to 24. For daily water intake, frequently respondents were drinking water 5 to 7 cups daily which regularly buy it at shops. In addition, *E. coli* was found in all drinking water samples which exceed the limit given by Malaysian Drinking Water Quality Standard (MDWQS) except for 4 drinking water samples in Taman Equine, and 1 at Lestari Perdana, Taman Pinggiran Putra and Seri Serdang. This contamination of fecal coliform bacteria was not significantly influenced by pH, dissolved oxygen (DO), electrical conductivity (EC), total dissolved solid (TDS), salinity and temperature of drinking water. There was no significant number of serious perceived health symptoms experience by water vending machines consumers at Seri Kembangan, Selangor. However, there is significant association between preferred brand and experience health symptoms Although there is no significant complaint from respondents, but it is necessary to give attention cause water vending machines may contribute to dangerous infections in human especially those with weakened immune systems.

5.2 Study limitation

1. The symptoms reported were based on previous experiences of respondents after drinking water from water vending machines. So, the symptoms reported perhaps have been caused by other exposure to food poisoning. Further study need to be done for better correlate the health perceived from drinking water from water vending machines.
2. Cross sectional study design only determines outcome for this case presence of *E. coli* at specific period of time only. However, incubation period of *E. coli* usually 3-4 days after exposure, the direct cause effect relationship cannot be done because the health symptoms were not experienced by respondents on the same time drinking water were taken from water vending machines.
3. This study only investigates fecal contamination bacteria such as *E. coli*. However, other types of bacteria such *Salmonella* spp., *Shigella*, *Vibrio cholera* and *Campylobacter* are considered to be very important since these bacteria might pose high health risks and occur in drinking water as well.

5.3 Recommendation

Further and more frequent monitoring was needed to make sure the water vending machines at Seri Kembangan were save from fecal contamination. State and local authorities should strictly enforce the regulations regarding to water vending machines. In addition, consumers should always aware the condition of water vending machines. They need to report broken or rusty machines to vendor or health authorities for further action.

Since the presence of pathogenic *E. coli* in drinking water can causes illness, it is extremely important to make sure that regular maintenance, cleaning and sanitation of water vending machines being carried out by correctly trained staff and also are aware for the chance for contamination to occur during cleaning procedures. The consumers also should be well informed about good personal hygiene practices to prevent cross contamination such as dirty water containers in contact with drip trays or nozzle and dirty hands in touch with buttons.

Further research may be done on actual perceived health symptoms experiences after drinking water from water vending machines by enlarging the sample size and give attention to various confounders such as food intake and smoking habit.

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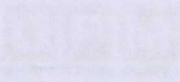
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APPENDIX A:

APPROVAL ETHIC BY ETHICS COMMITTEE FOR RESEARCH INVOLVING
HUMAN SUBJECTS (JKEUPM)



UNIVERSITI KEBANGSAAN MALAYSIA
INSTITUT PENYELIDIKAN DAN KEMAJUAN MASYARAKAT (IKEM)
JALAN KEMUNING, 43400 UPM SERDANG,
SELANGOR, MALAYSIA

FORM B1. RESPONDENT'S INFORMATION SHEET AND CONSENT

Please read the following information carefully and do not hesitate to discuss any questions you may have with the researcher.

1. STUDY TITLE

Food Contamination in Drinking Water Sources Owned by Young Mothers at Tempeh Factory, Grogong

2. INTRODUCTION

APPENDIX B:

RESPONDENT'S INFORMATION SHEET AND CONSENT FORM

(ENGLISH & MALAY VERSION)

3. WHAT WILL YOU HAVE TO DO?

The researcher will be asking you to provide information about your drinking water source. The information will be used for the study. You will be asked to complete a questionnaire.

4. WHO ONLY IS NOT PARTICIPATING IN THE STUDY?

The researcher will not be asking you to provide information about your drinking water source.

Please take time to read this form and discuss it with the researcher if you have any questions.



UPM
UNIVERSITI PUTRA MALAYSIA

**JAWATANKUASA ETIKA UNIVERSITI UNTUK
PENYELIDIKAN MELIBATKAN MANUSIA (JKEUPM)
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG,
SELANGOR, MALAYSIA**

FORM B1: RESPONDENT'S INFORMATION SHEET AND CONSENT

Please read the following information carefully and do not hesitate to discuss any questions you may have with the researcher.

1. STUDY TITLE :

Fecal Contamination in Drinking Water Samples Obtained from Water Vending Machines at Seri Kembangan, Selangor

2. INTRODUCTION:

Nowadays, water vending machines can be found easily in many different places and majority of public are prefer to take water from it due to its convenient and accessibility factor. There is high possibility that not well maintains water vending machines can cause growth of bacteria. Although in Malaysia the outbreaks of disease related to drinking water are not common but still can occur and lead to serious acute, chronic, or sometimes fatal health consequences, especially for sensitive and immunocompromised populations. The common symptoms related by drinking fecal contamination water are gastrointestinal illness, respiratory symptoms, sore throat and mucosal symptoms. So, this are the first study conducted at Seri Kembangan, Selangor with limited resources of information about experience of health symptoms after drinking water from vending machines. The data can provide the scientific prove that water vending machines expose to fecal contamination or not.

3. WHAT WILL YOU HAVE TO DO?

The respondent will be ask to answer the questionnaire to obtain the information regarding to the study. 15 minutes will be given to complete the questionnaire.

4. WHO SHOULD NOT PARTICIPATE IN THE STUDY?

The person who do not consume water vending machines.

Please initial here if you have read and understood the contents of this page _____

9. CONSENT

I Identity Card No.
address.....

.....hereby voluntarily agree to
take part in the research stated above *(clinical /drug trial/video recording/ focus
group/interview-based/ questionnaire-based).

I have been informed about the nature of the research in terms of methodology,
possible adverse
effects and complications (as written in the Respondent's Information Sheet). I
understand that I have the right to withdraw from this research at any time without
giving any reason whatsoever. I also understand that this study is confidential and all
information provided with regard to my identity will remain private and confidential.

I* wish / do not wish to know the results related to my participation in the research

I agree/do not agree that the images/photos/video recordings/voice recordings related
to me be used in any form of publication or presentation (if applicable)

* delete where necessary

Signature
(Respondent)

Signature
(Witness)

Date :.....

Name :.....

I/C No. :.....

I confirm that I have explained to the respondent the nature and purpose of the above-
mentioned research.

Date

Signature
(Researcher)



UPM
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**JAWATANKUASA ETIKA UNIVERSITI UNTUK
PENYELIDIKAN MELIBATKAN MANUSIA (JKEUPM)
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG,
SELANGOR, MALAYSIA**

BORANG B1: PENERANGAN DAN PERSETUJUAN RESPONDEN

Sila baca maklumat berikut dengan teliti. Sekiranya anda mempunyai sebarang pertanyaan, sila kemukakan kepada penyelidik.

1. TAJUK KAJIAN

Pencemaran sisa buangan dalam air dari sumber Mesin Air Layan Diri di Seri Kembangan, Selangor

2. PENGENALAN

Pada masa kini, mesin menjual air boleh didapati dengan mudah di banyak tempat yang berbeza dan majoritinya orang awam memilih untuk mengambil air dari mesin air layan diri kerana faktornya yang mudah untuk didapati dan senang digunakan. Terdapat kebarangkalian yang tinggi bahawa mesin air yang tidak diselenggara dengan baik akan menjadi tempat yang sesuai untuk pertumbuhan bakteria. Walaupun di Malaysia wabak penyakit yang berkaitan dengan air jarang berlaku, tetapi mungkin boleh terjadi dan menyebabkan penyakit akut yang serius, kronik atau gejala – gejala kesihatan yang lain terutamanya bagi golongan yang mempunyai sistem pertahanan badan yang lemah. Gejala yang sering berlaku jika terminum air yang tercemar dengan sisa buangan ialah penyakit gastrousus, gejala pernafasan, sakit tekak dan gejala mukosa. Jadi kajian ini dianggap sebagai kajian pertama yang dijalankan di Seri Kembangan, Selangor dengan sumber yang terhad mengenai maklumat pengalaman gejala kesihatan selepas meminum air dari mesin air layan diri. Data yang diperolehi dapat memberikan bukti saintifik sama ada mesin air layan diri tercemar dengan sisa buangan atau tidak.

3. APAKAH YANG PERLU ANDA LAKUKAN?

Respoden diminta untuk menjawab borang soal selidik untuk mendapatkan maklumat data mengenai kajian ini. 15 minit akan diberikan untuk melengkapkan borang soal selidik ini.

4. SIAPA YANG TIDAK BOLEH MENYERTAI KAJIAN INI?

Individu yang tidak meminum air dari mesin air layan diri.

Sila tandatangan di sini sekiranya anda telah membaca dan memahami kandungan halaman ini _____

9. PERSETUJUAN

Saya..... No Kad Pengenalan.
beralamat.....
.....dengan ini bersetuju untuk mengambil bahagian secara sukarela
dalam penyelidikan yang tersebut di atas *(kajian klinikal/percubaan ubat-ubatan/rakaman
video/kumpulan sasaran/temuduga/ soal selidik).

Saya telah diberi penjelasan secara menyeluruh mengenai penyelidikan ini dari segi metodologi,
risiko dan komplikasi (seperti tertulis pada Helaian Penerangan Responden). Saya memahami
bahawa saya berhak menarik diri dari penyelidikan ini pada bila-bila masa tanpa memberi
sebarang alasan.Saya juga memahami bahawa sebarang maklumat yang berkaitan identiti saya
akan dirahsiakan.

Saya* berminat / tidak berminat untuk mengetahui keputusan kajian yang melibatkan saya.

I setuju/tidak bersetuju untuk imei/gambar/rakaman video/ rakaman suara digunakan dalam
apa jua bentuk penerbitan atau pembentangan. (sekiranya berkaitan).

*potong yang tidak berkenaan

Tandatangan Tandatangan
(Responden) (Saksi)

Tarikh :..... Nama :.....

No. K/P:

Saya mengesahkan bahawa saya telah menerangkan kepada responden ini sifat dan tujuan
penyelidikan yang tersebut di atas.

Tarikh Tandatangan
(Penyelidik)

WORLDWIDE WATER QUESTIONNAIRE

RESPECTABLE LOCAL CONTAMINATION OF DRINKING WATER OBTAINED
FROM WATER VENDING MACHINES AT TTDI LEMBANG,
SELANGOR

FROM FACULTY OF MEDICINE AND HEALTH SCIENCES, UNIVERSITY
PUTRA MALAYSIA

COURSE BACHELOR'S DEGREE IN ENVIRONMENTAL AND OCCUPATIONAL
HEALTH

A. Personal Data (Please Print Name, Address, Telephone or Faxing)

APPENDIX C:

QUESTIONNAIRE

REF NO

BORANG SOAL SELIDIK/ QUESTIONNAIRE FORM

PROJECT TITLE : FECAL CONTAMINATION IN DRINKING WATER OBTAINED
FROM WATER VENDING MACHINES AT SERI KEMBANGAN,
SELANGOR

FROM : FACULTY OF MEDCINE AND HEALTH SCIENCES, UNIVERSITY
PUTRA MALAYSIA

COURSE : BACELOR SCIENCE OF ENVIRONMENTAL AND OCCUPATIONAL
HEALTH

A. Maklumat Latar Belakang Responden/ Background Information of Respondent

1. Umur/ Age: 15-24 25-34 35-44 45-64 65+

2. Jantina/Gender: Lelaki/ Man Perempuan/ Female

3. Bangsa/Race: Melayu/ Malay Cina/ Chinese India/ Indian

Lain- lain / Others

4. Tahap Pendidikan / Education Level :

Sekolah Rendah / Primary level SRP/PMR/Lower secondary level

SPM / Higher secondary level Diploma/STPM/College

Ijazah /Degree

5. Adakah anda merokok? / Are you smoking?

Ya/ Yes

Tidak/ No

B. Maklumat Penggunaan Air/ Water intake information

6. Apakah sumber air minuman yang anda minati? / Which most preferable drinking water that you take?

Air paip/ Tap water

Air botol/ Bottle water

Mesin jual air layan diri/
Water vending machines

Others:.....

7. Apakah faktor yang di ambil kira sebelum anda mengambil air dari mesin jual air layan diri? / What are the factors you take into consideration before taking water from water vending machines?

Harga/Price

Jenama/Brand

Ketersediaan /Availability

Tidak peduli/ Don't care

8. Adakah penting bagi anda jenama mesin jual air layan diri yang anda beli? /How important to you is the brand of water vending machines you buy?

Sangat penting/
Very important

Penting/
Important

Tidak penting /
Unimportant

Tidak minum air dari mesin jual air layan diri/ I don't drink water from water vending machines

9. Jika anda menjawab ' Sangat penting ' atau ' Penting ' dalam soalan sebelum ini , mengapa? /If you answered 'Very important' or 'Important' in the previous question, why?

Kesetiaan kepada
jenama/Brand loyalty

Menjaga kesihatan/
Health concerns

Rasa/ Taste

Tidak minum air dari mesin jual air layan diri/ I don't drink water from water vending machines

10. Jenama apakah mesin jual air layan diri yang anda pilih? /Which brand's water vending machines do you prefer?

Dr Sukida

Sipsipwater RO water

Water drops

Imtiyaz
Bio Energy

Lain-lain /Others.....

11. Apakah saiz botol yang anda biasa gunakan untuk membeli air dari mesin jual air layan diri? /What size of bottle do you usually use to buy water from water vending machines?

500ml 1L 1.5L 5L Lain-lain /Others:.....

12. Di manakah biasanya anda membeli air dari mesin jual air layan diri? /Where do you usually buy water from vending machines?

Kolej/College Stesen kereta api/
Railway stations Kedai/Shops
 Lain-lain/Others

13. Apakah persepsi anda terhadap mesin layan air? /What is your perception of water vending machines?

Terbaik/Best Baik/ Good Biasa/Fair
 Tidak memuaskan/Bad

14. Adakah anda merawat air yang diambil dari sumber diatas? / Do you treat your water after taking from the sources above?

Ya / Yes Tidak / No

15. Apakah yang selalu anda lakukan untuk memastikan air minum selamat untuk diminum? / What do you usually do to the water to make it safer to drink?

Jerang / Boiled Tapis air / Use a water filter

Lain-lain/ Others:.....

16. Berapa banyak air yang anda minum setiap hari? / How much water do you drink in a typical day?

(1 gelas/ cup = 200 ml)

Kurang dari 1 gelas 1-2 cups 2-4 cups 5-7 cups
/Less than 1 cup
 8-10 cups Lebih dari 10 gelas /More than 10 cups

Lain-lain/ Others:.....gelas/cups

17. Adakah anda pernah mendengar berita berkenaan pencemaran air minuman melalui mesin jual air layan diri? / Have you ever heard any news on water contamination by water vending machines?

Ya/Yes Tidak/ No

C. Status Kesihatan / Health Status

18. Adakah anda sedang menghadapi penyakit kronik seperti penyakit perut? / *Do you have any chronic health condition such as frequent diarrhea?*

Ya / *Yes* Tidak/ *No*

Jika ya, sila nyatakan / *If yes, please state:*

19. Adakah anda pernah mengalami pencemaran microb dalam air minuman?/ *Have you ever experience microbial contamination in drinking water?*

Ya/ *Yes* Tidak/ *No*

D. Pengalaman Tanda-Tanda Kesihatan Dari Meminum Air dari mesin jual air layan diri / *Experience of Health Symptoms from Drinking Water Vending Machines.*

20. Adakah anda pernah mengalami tanda-tanda yang dinyatakan di bawah selepas meminum air dari ? / *Have you ever experienced these symptoms after drinking water from water vending machines?*

(Boleh tanda lebih dari 1 jawapan / *can tick more than one answer*)

Gastroenteritis (muntah, loya, cirit-birit, kejang di abdomen, sakit perut) / *Gastroenteritis (vomiting, diarrhea, nausea, abdominal cramp, stomach ache)*

Masalah salur pernafasan (batuk, sakit tekak, hidung berair) / *Respiratory symptoms (cough, sore throat, running nose)*

Headache, dizziness / *sakit kepala, pening*

Tiada / *None*

21. Apakah pandangan anda akan kualiti air dari mesin jual air layan diri?

What rating would you give to the water quality in water vending machines?

Sangat baik/ *Very good* Baik/ *Good* Biasa/ *Fair*

Teruk / *Very bad* Tidak memuaskan / *Bad*

SOALAN TAMAT

TERIMA KASIH DIATAS KERJASAMA ANDA/

END OF QUESTION

THANK YOU FOR YOUR COOPERATION

APPENDIX D:

WATER VENDING MACHINES CHECKLIST

Water Vending Machines	Environment	Condition	Halal certificate	Last date of service
1.	Nearby dustbin	Good and well functioning		03.02.2016
2.	Nearby dustbin	Good and well functioning	✓	03.02.2016
3.	Nearby drain	Good and well functioning		NA
4.	Nearby dustbin	Bit rusty and well functioning		27.11.2015
5.	Nearby drain	Good and well functioning	✓	14.10.2015
6.	Nearby dustbin and drain	Good and well functioning	✓	03.02.2016
7.	In laundry shop	Rusty and not function well		NA
8.	Nearby drain	Good and well functioning		NA
9.	Nearby drain and dustbin	Good and well functioning		20.10.2015
10.	Nearby dustbin and workshop	Good and well functioning		NA
11.	Nearby drain	Rusty and not well maintained		NA
12.	Nearby dustbin	Bit rusty and well functioning		03.02.2016
13.	Nearby laundry shop	Rusty and well functioning		10.02.2016
14.	Nearby drain	Rusty and not function well		NA
15.	Nearby dustbin	Not function well and full with sticker		NA
16.	Nearby drain	Good and well functioning	✓	15.02.2016
17.	Nearby drain	Good and well functioning		16.02.2016
18.	Nearby drain	Good and well functioning		25.01.2016

Water Vending Machines	Environment	Condition	Halal certificate	Last date of service
19.	Nearby drain	Rusty and not function well		NA
20.	Nearby drain and dustbin	Good and well functioning		NA
21.	Nearby drain	Good and well functioning		09.02.2016
22.	Nearby clothing stores	Good and well functioning	✓	09.02.2016
23.	Nearby dustbin	Good and well functioning		29.01.2016
24.	Nearby stores	Good and well functioning		05.02.2016
25.	Nearby grocery stores	Had bird droppings and well functioning		14.01.2016
26.	Nearby grocery stores	Good and well functioning	✓	NA
27.	Nearby drain	Good and well functioning		NA
28.	Nearby dustbin and drain	Good and well functioning		05.01.2016
29.	Nearby drain and workshop	Rusty and not function well		NA
30.	Nearby drain and workshop	Full with sticker and not well maintained		NA

APPENDIX E:

SCHEDULE OF STUDY FOR RESEARCH PROJECT

