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Research Article

The Efficacy of Treated Water from Water Filtration Machines for Safe Drinking Water Supply in *Bandar Baru Bangi* and *Kajang*, Selangor

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This study was conducted to determine the physicochemical properties, microbiological quality, level of consumption, and effects of treated water from paid water filtration machines on health of the residents of *Bandar Baru Bangi* and *Kajang*, Selangor. The number of water samples taken for this study was 15 from the paid water filtration machines studied. The physicochemical assessment such as determination of pH, turbidity, total dissolved solids, conductivity, and dissolved oxygen was conducted, while the inductively coupled plasma mass spectrometry (ICP-MS) was used to determine the mineral content of the treated water. The microbiological quality was determined using the pour plate method for colony count (22°C incubation for 72 hours and 37°C for 24 hours), while for coliforms and *Escherichia coli*, the membrane filtration method was utilized. The samples of treated water from the paid water filters were based on triplicate sampling ($n = 3$). The pH, turbidity, total dissolved solid values, and heavy metal concentration were within the safe level according to the Malaysian National Standard for Drinking Water Quality, Ministry of Health (MOH). The overall range for the pH values of the treated water samples was between 6.50 and 7.15, where this was within the recommended range. The total dissolved solids showed that all the treated water samples were in the range of the recommended standard (27 to 92 mg/L). The range of turbidity values for all the treated water samples was from 1.7 to 6 NTU, and the dissolved oxygen range was from 7.7 to 8.2 mg/L. The colony count results showed that most of the water samples complied with the standards of <4 log cfu/mL at 37°C and <3 log cfu/mL at 22°C of incubation temperatures. However, there was the presence of coliforms in four (4/15) of the treated water samples being at more than 4 cfu/100 mL, while *E. coli* was absent in all of the treated water samples. The overall results showed that all samples were safe to drink according to the Industrial Guide to Good Hygiene Practice by Automatic Vending Association of Britain (2000) and Food Act (1983) except for the four treated water samples (C, D, H, and I). For that reason, the filtered waters require quality evaluation and management, while the filters need to be replaced according to their designated schedule in order to ascertain that the drinking water is safe to be consumed by the public.

1. Introduction

Water is part of the environment and is an essential requirement for humans as well as for industrial development [1]. Over the last few decades, there has been a huge increase in demand for safe and clean drinking water due to the rapid growth factor and the need for industry [2]. Water plays an important role in maintaining the health and welfare of human beings, and it is the right of every human to get safe drinking water. Water quality and suitability are determined by taste, odour, colour, and organic and inorganic content [3].

The provision of quality and clean household drinking water is often regarded as one of the important ways to improve the health of consumers [4]. Nowadays, various water treatments are available in the market for every household. Subsequently, this shows the difference in the types of filter media used the chemicals that can be removed, the location of the home, the operating facilities, the cost of a moderate filter unit, and the maintenance costs. Some materials used in this device's filter media include carbon or coal-based resin ion-exchange and reversed-osmosis filters [5].

Water is essential for maintaining human life, so a satisfactory supply of water must be provided to consumers. Every effort should be made to achieve the quality of drinking water that can make the water safe for use by consumers. Protection against water supply from pollution is the first level of defense. In addition, the protection of resources is the best way to ensure safe and preferable drinking water [6]. This is to treat contaminated water supply to make it suitable for use. Every time a potentially dangerous situation has been recognized, the risks to health, the availability of alternative resources, and the availability of appropriate remedial measures should be considered in order for decisions to be made regarding their acceptance [6].

Water quality is a relative concept that reflects the measurable physical, chemical, and biological features associated with certain uses. The suitability of water for domestic use is usually defined by its taste, odour, colour, and many organic and inorganic substances that can pose some risks to human health [7]. Water quality should be evaluated to improve and maintain the quality for drinking water with respect to microorganisms and other requirements, such as food preparation and hygiene in child care (breastfeeding and infant feeding) and treatment of diseases and thereby reducing the spread of the diseases [8]. Filtered water is the main source of safe and reliable drinking water. However, there is still a debate on the efficiency of filtration system to comply with the regulations as water that physically looks colourless, odourless, and even tasteless which are not sufficient to determine that the water is safe for consumption [9].

Most of the water quality problems are related to bacteriological contamination or other microbiological contamination, and a number of very serious problems may occur due to pollution of water sources by chemicals. Although no general recommendations can be used in other areas or no appropriate universal parameter selection is given, some other important indicator parameters may provide useful guidelines in assessing water quality [10].

Pollutants in water can affect the quality of water and then human health too. Potential sources of water pollution are geological conditions, industrial and agricultural activities, and water treatment plants. Water pollution is also classified as microorganisms, inorganic material, organic substances, radionuclide, and disinfection. Nonorganic chemicals hold most of them as pollutants in drinking water. Inorganic chemicals are also part of heavy metals such as lead (Pb), arsenic (As), magnesium (Mg), nickel (Ni), copper (Cu), and zinc (Zn). The heavy metals as described above are materials that get attention because they can cause health problems [3].

Escherichia coli is part of a coliform group. *E. coli* is rod-shaped and Gram-negative bacteria found in human intestines and hot-blooded animals where they are dominant anaerobic organisms (living organisms without oxygen or presence of oxygen) although they are only a small component of the amount of microflora [11]. Coliforms detection is widely used as a way to measure the efficacy of hygiene programs where the presence of coliforms shows an increased risk of significant pathogenic presence [12]. In fact, the drinking water should be examined in terms of microbiological and physicochemical quality [9].

This study was carried out to determine the physicochemical and microbiological quality of treated water from paid water filter machines. This study also determined the efficacy of treated water from water filtration machines for safe drinking water. Finally, the study was implemented to evaluate the level of consumption of treated water from some paid water filters by the consumers of *Bandar Baru Bangi*.

2. Materials and Methods

The criteria of selecting sampling points were based on the population density and the number of water filter machines available. The treated water was sampled in *Bandar Baru Bangi*, *Selangor*. Table 1 shows the selected 15 paid water filters which were based on the sampling point/availability of the machines within 10 km radius from the Universiti Kebangsaan Malaysia, *Bangi*. The treated water samples were collected for up to 1 liter per sampling point aseptically from 15 different water filter machines within the stipulated areas.

2.1. Sample Collection. The samples were collected aseptically in sterile 1 liter polyethylene (PE) bottles, which were washed with sterile deionized water [3]. Prior to the sampling, the tap mouth where the filtered water flows were wiped with alcohol wipes and flamed using a portable lighter, the water from the filtration units were run for 30–60 seconds, before being transferred into the sampling bottles. The bottles were kept in a polystyrene box containing ice packs before being transported back to the food microbiology laboratory in the UKM [9].

2.2. Physicochemical Analysis

2.2.1. pH Values. The pH of the treated water was determined using the calibrated pH meter (HANNA HI-991301 High Range). Calibration was carried out using pH 4, 7, and 10 buffer solution prior to the analysis [3, 13]. This analysis was conducted in triplicates to obtain the average of pH value ($n = 3$).

2.2.2. Turbidity. The turbidity of the treated water was determined using the spectrophotometer [14]. The samples were poured into the sample holder and left for several

Table 1: The selected 15 paid water filters located in *Bandar Baru Bangi*, Selangor, Malaysia.

Sample code	Location
A	*Sg. Ramal, Kajang*
B	*Sg. Ramal, Kajang*
C	Section 8, *Bandar Baru Bangi*
D	Section 8, *Bandar Baru Bangi*
E	Section 8, *Bandar Baru Bangi*
F	Section 16, *Bandar Baru Bangi*
G	Section 16, *Bandar Baru Bangi*
H	Section 16, *Bandar Baru Bangi*
I	Section 16, *Bandar Baru Bangi*
J	Section 3, *Bandar Baru Bangi*
K	Section 3, *Bandar Baru Bangi*
L	Section 15, *Bandar Baru Bangi*
M	Section 15, *Bandar Baru Bangi*
N	Section 15, *Bandar Baru Bangi*
O	Section 3, *Bandar Baru Bangi*

minutes (<2 min) prior to the reading [15, 16]. This analysis was conducted in triplicates to obtain the average turbidity value ($n = 3$).

2.2.3. Total Dissolved Solid. The total dissolved solid content of the treated water was measured using the high-range total dissolved solid (TDS) meter (HANNA, HI-991301). This analysis was conducted in triplicates to obtain the average dissolved solid content ($n = 3$).

2.2.4. Conductivity. The conductivity values were determined in accordance to the United States Environmental Protection Agency [14] method. The readings were taken by using the electric conductivity meter (HANNA, HI-991301) [17]. This analysis was implemented in triplicates to obtain the average conductivity values ($n = 3$).

2.2.5. Mineral Content. The mineral content was determined in accordance to the American Public Health Organization [18] method. The inductively coupled plasma mass spectrometry (ICP-MS) (PerkinElmer Elan 9000) was used for the analysis with precalibration metal standards cocktails [19]. This analysis was performed in duplicates to obtain the average mineral content ($n = 2$).

2.2.6. Dissolved Oxygen. The dissolved oxygen was determined in accordance to the United States Environmental Protection Agency [14]. The water sample was poured into the incubation bottles (300 mL) to measure the dissolved oxygen content of the treated water using dissolved oxygen meter (YSI 5100). The reading was taken in triplicates for each sampling performed ($n = 3$).

2.3. Microbiological Analysis

2.3.1. Total Colony Count. Yeast extract agar (YEA, Oxoid or Merck) was used with approximately 15–20 mL for each petri dish via the pour plate method [20]. YEA was aseptically poured into every 1 mL of the treated water sample in a petri dish. The petri dishes were incubated at 22°C for 72 hours and at 37°C for 24 hours. The plates containing 25–250 colonies were counted, and the colony counts were determined in log cfu/mL using the method of ISO 6222: 1999 standard [21].

2.3.2. Total Coliforms (Coliforms and Escherichia coli). A total of 100 mL of the treated water samples from the paid water filtration machines was poured onto a sterile membrane filter using a membrane filtration technique. Then, the membrane filters were placed aseptically on top of the Brilliance *E. coli* and coliform agar (Oxoid). The petri dishes were then incubated upside down at 37°C for 24 hours [20]. This analysis was repeated twice for each sample ($n = 2$). Petri dishes containing 15–150 colonies of coliforms and *E. coli* were calculated in cfu/100 mL according to the APHA [18] method.

2.4. Statistical Analysis. The data were presented as mean ± standard deviation (SD) of mean. Statistical comparisons were performed using Fisher's test. Values of $p < 0.05$ were considered statistically significant.

3. Results and Discussion

3.1. pH Values. The pH value of drinking water is an indispensable index for determining its acidity and alkalinity. The pH values often have no direct effect on human health [22]. The value of alkalinity in water shows the natural salts present in the water. The source of alkalinity is a mineral that dissolves in water from the soil. Various ionic sepsis that contribute to alkalinity include bicarbonate, hydroxide, phosphate, borate, and organic acids. These factors are the characteristics of water resources and natural processes occurring at any time [23–25].

The pH value does not have any direct side-effects on health. However, a lower value which is below 4 will produce a sour taste in the water while higher values which are above 8.5 will produce alkaline taste [26]. The Food Act [27] recommends a safe pH range of 6.5 to 8.5. The recommended pH value for drinking water standard according to the Ministry of Health Malaysia (MOH) is 6.5 to 9.0. Based on Figure 1, the total pH range of the treated water samples was between 6.50 and 7.15 where this range indicated that the pH values of the samples were within the recommended standard range. The water samples tested in this study were within the range of safe standard. Water in the acidic range can inhibit bacterial growth such as *E. coli* due to the presence of chlorine [6]. Based on this study, the samples of the treated water are conclusively safe to drink. Based on ANOVA test, there was a significant difference ($p < 0.05$) for the pH values of all the treated water samples from the paid filtering machines.

3.2. Turbidity. Turbidity is an expression of the optical properties of water that causes light to be dispersed and

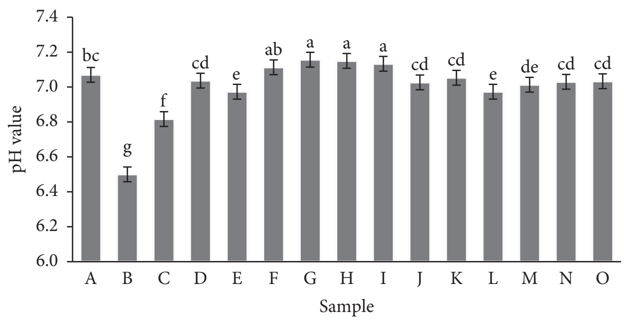

Figure 1: pH values for 15 samples of treated water. A-B: *Sg. Ramal*; C-E: Section 8, *Bandar Baru Bangi*; F-I: Section 16, *Bandar Baru Bangi*; J, K, and O Section 3, *Bandar Baru Bangi*; L-N: Section 15, *Bandar Baru Bangi*. All results are expressed in mean ± SD. [a-g]Values for the samples which have different letters are significantly different ($p < 0.05$).

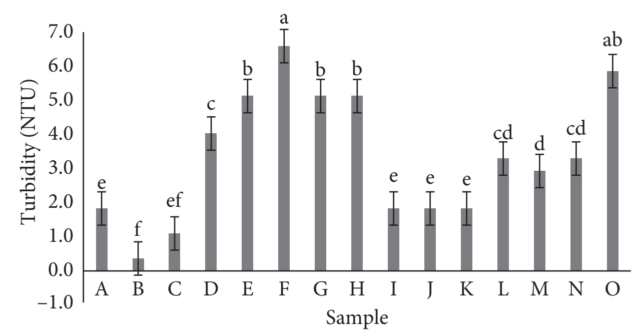

Figure 2: The turbidity for 15 samples of treated water. A-B: *Sg. Ramal*; C-E: Section 8, *Bandar Baru Bangi*; F-I: Section 16, *Bandar Baru Bangi*; J, K, and O Section 3, *Bandar Baru Bangi*; L-N: Section 15, *Bandar Baru Bangi*. All results are expressed in mean ± SD. [a-f]Values for the samples which have different letters are significantly different ($p < 0.05$).

measured by determining the level of light scattering by the particles present in the drinking water sample [28]. The turbidity of drinking water is a measure of the immaturity of the water, commonly used as a proxy measure for the risks of pollution from microorganisms and the effectiveness of public drinking water treatments [29].

Figure 2 shows the turbidity values for the 15 samples of the drinking water that were studied. Sample B (*Sg. Ramal, Kajang*) had the lowest turbidity level of 0.33 ± 0.58 NTU, and each sample had reached the standard set by the Ministry of Health (MOH) where each had a turbidity level of less than 5 NTU except for sample F (Section 16, *Bandar Baru Bangi*), whose turbidity value was 6 NTU.

3.3. Total Dissolved Solid. The amount of total dissolved solids (TDSs) is a term used to describe inorganic salts and some organic matter found in aqueous solution. The main elements are usually calcium, magnesium, sodium, carbonate potassium, chloride, sulfate, and nitrate [6]. Figure 3 shows that the sample O has the highest TDS value and approximates the TDS volume of industrial mineral water (C3). Sample N had the lowest TDS amongst the 15 treated water samples. According to the Ministry of Health Malaysia [30], the amount of TDS allowed for drinking water is 500 mg/L. It can be seen that all of the treated water samples from the water filters complied with the standard because of the amount of their TDS being less than 500 mg/L. Such TDS contents might be due to the filtration process carried out by the water filter machines.

3.4. Conductivity. According to USEPA [14], ions operate electricity because of their positive and negative charges. When electrolytes are dissolved in water, they break into positively (cations) and negatively charged particles (anions). Because the dissolved substance splits in water, the concentration of each positive and negative charge remains the same. This means that although the conductivity of water increases with added ions, the electricity remains neutral [14].

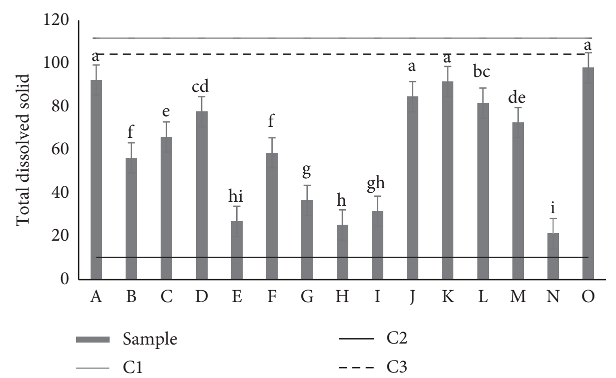

Figure 3: Total dissolved solid for 15 samples of treated water. A-B: *Sg. Ramal*; C-E: Section 8, *Bandar Baru Bangi*; F-I: Section 16, *Bandar Baru Bangi*; J, K, and O Section 3, *Bandar Baru Bangi*; L-N: Section 15, *Bandar Baru Bangi*. C1: household mineral water (Cuckoo); C2: distilled water; C3: commercial mineral water bottle.

Figure 4 shows the conductivity of the 15 treated water samples around *Bandar Baru Bangi, Selangor*. The typical conductivity on the reverse osmosis water (RO) is between 1 and 100 μS/cm, depending on the conductivity of the supply water. Normally, conductivity is measured by an online sensor [31]. Conductivity values for samples E, G, H, I, and N were less than 100 μS/cm, while the remaining 10 more samples had higher conductivity values.

3.5. Mineral Content. The determination of the mineral content in natural water and the environment is growing for the benefit of pollution studies [32]. Some heavy metals are toxic in high amounts such as iron (Fe), lead (Pb), and nitrite (Ni) that will invade the human central nervous system. Most heavy metals that are naturally formed are considered harmless to human health as they only exist in very low amounts [33]. Pollutions by heavy metals will not only damage crops but will also disrupt the quality of the environment such as drinking water that will endanger humans' health and other living beings'. Environmental pollution

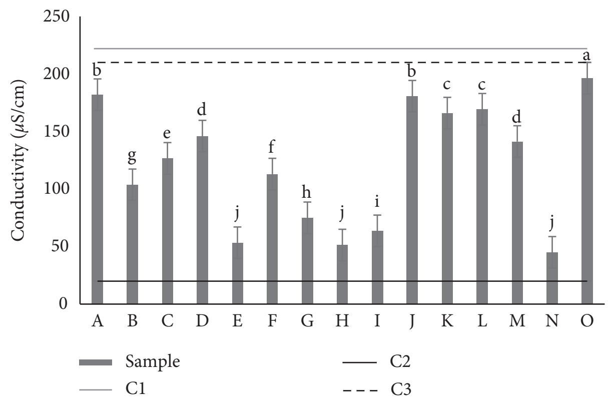

Figure 4: The ion conductivity values for 15 samples of treated water. A-B: *Sg. Ramal*; C-E: Section 8, *Bandar Baru Bangi*; F-I: Section 16, *Bandar Baru Bangi*; J, K, and O Section 3, *Bandar Baru Bangi*; L-N: Section 15, *Bandar Baru Bangi*. C1: household mineral water (Cuckoo); C2: distilled water; C3: commercial mineral water bottle.

caused by heavy metals results in a long period of time and the process is only one way [34].

The results of the mineral analysis carried out are shown in Table 2. The range of values obtained was 0.0003 to 0.0048 mg/L for copper, 0.22 to 1.21 mg/L for magnesium, 0.0025 to 0.0182 mg/L for aluminium, and 0.0003 to 0.0016 mg/L for arsenic. Iron ranged from 0.0114 to 0.1086 mg/L, zinc ranged from 0.0057 to 0.0848 mg/L, while chromium determined in the water samples had values between 0.0002 and 0.0010 mg/L. Plumbum and cadmium were not detected in the mineral analysis of the treated water samples.

3.6. Dissolved Oxygen. According to the World Health Organization [6], the amount of dissolved oxygen in water depends on physical and chemical properties (particularly temperature and salinity). The dissolved oxygen in water by solely physical processes is proportional to the partial pressure of the gas in contact with water. It depends on the temperature and concentration of dissolved salts, especially chloride [35]. Figure 5 shows the dissolved oxygen for 15 treated water samples from the paid water filters. The dissolved oxygen value of sample A was the highest at 8.2 mg/L, and there was a significant difference ($p < 0.05$) with the dissolved oxygen value of sample N. Sample N had a low soluble oxygen value of 7.6 mg/L. A significant difference ($p < 0.05$) could be from the dissolved oxygen value of each sample. Generally, the dissolved oxygen saturation concentration decreases when temperature and salinity increase. In drinking water, at the temperatures of 5°C, 10°C, and 20°C, the dissolved oxygen saturated concentrations are 12.8, 11.3, and 9.1 mg/L [6], respectively. Each sample in this study was discovered to have complied with the WHO-defined standard for having a dissolved oxygen value of less than 9.1 mg/L [6].

3.7. Determination of Total Colony Counts. The results of the total colony count compared to the standard set by the Industrial Guide to Good Hygiene Practice by Automatic Vending Association of Britain [36] showed that the maximum standard for the colony count for the paid water filter machine sample was <4.0 log cfu/mL at 37°C, whereas for the temperature of 22°C, it was <3.0 log cfu/mL. Figures 6 and 7 show the total colony count of the 15 hot spots sampling at the incubation temperature of 37°C and 22°C, respectively. According to the National Health Medical Research Council [37], no guidelines have been set for the heterotrophic plate count (HPC) in drinking water, but the sudden rise in colonies shows the early signs of pollution in the soil. Detected colonies are not specific because such microorganisms include bacteria, yeasts, and fungi. The HPC bacteria are both anaerobic bacteria and facultative anaerobes such as *Alcaligenes*, *Acinetobacter*, *Flavobacterium*, and *Pseudomonas* [37]. The bacterial group is usually not associated with a specific disease but may cause diseases such as gastroenteritis and infections of body systems [38].

However, when compared to the standardized values set by IGGHP [36], for the drinking water of the paid water filtration machines, it was discovered that the overall results for all the treated water samples were at the specified level. The treated water for the 15 samples of the paid water filtration machines was safe to drink because it had a total colony count that was less than 4 log cfu/mL for the incubation temperature of 37°C and less than 3 log cfu/mL for the incubation temperature of 22°C.

3.8. Number of Coliforms. According to the Food Act [27], the number of coliforms in treated water should be less than 4 cfu/100 mL, while the Ministry of Health Malaysia [30] states that drinking water is safe if the total number of coliforms is 0 MPN/100 mL. As the present study used membrane filtration method, samples C, D, H, and I (Table 3) were discovered to have exceeded 4 cfu/100 mL and they did not comply with the prescribed Food Act [27] to provide safe water for drinking. Coliform numbers were classified as all facultative anaerobic, Gram-negative, non-spore formers, oxidase-negative bacteria, and rod-shaped by lactose fermentation and gas within 48 hours at 35°C or positive β-galactosidase Enterobacteriaceae [18]. The

Table 2: The mineral content for 15 samples of treated water.

Sample	Mineral content (mg/L)								
	Copper (Cu)	Magnesium (Mg)	Aluminium (Al)	Arsenic (As)	Iron (Fe)	Zinc (Zn)	Lead (Pb)	Chromium (Cr)	Cadmium (Cd)
A	0.0003 ± 0.00	1.1659 ± 0.01	0.0065 ± 0.00	0.0016 ± 0.00	0.0414 ± 0.00	0.0034 ± 0.00	ND	0.0020 ± 0.00	ND
B	0.0008 ± 0.00	0.8322 ± 0.04	0.0025 ± 0.00	0.0008 ± 0.00	0.0225 ± 0.00	0.0057 ± 0.00	ND	0.0002 ± 0.00	ND
C	0.0048 ± 0.00	0.8361 ± 0.02	0.0061 ± 0.00	0.0008 ± 0.00	0.0225 ± 0.00	0.0848 ± 0.00	ND	0.0006 ± 0.00	ND
D	0.0004 ± 0.00	0.9609 ± 0.02	0.0103 ± 0.00	0.0009 ± 0.00	0.0284 ± 0.00	0.0334 ± 0.00	ND	0.0003 ± 0.00	ND
E	0.0003 ± 0.00	0.2886 ± 0.00	0.0053 ± 0.00	0.0003 ± 0.00	0.0145 ± 0.00	0.0154 ± 0.00	ND	0.0007 ± 0.00	ND
F	0.0003 ± 0.00	0.7490 ± 0.03	0.0061 ± 0.00	0.0005 ± 0.00	0.0277 ± 0.00	0.0119 ± 0.00	ND	0.0004 ± 0.00	ND
G	0.0003 ± 0.00	0.3935 ± 0.02	0.0099 ± 0.00	0.0004 ± 0.00	0.0199 ± 0.00	0.0071 ± 0.00	ND	0.0006 ± 0.00	ND
H	0.0013 ± 0.00	0.2390 ± 0.01	0.0091 ± 0.00	0.0002 ± 0.00	0.0145 ± 0.00	0.0058 ± 0.00	ND	0.0003 ± 0.00	ND
I	0.0028 ± 0.00	0.3313 ± 0.01	0.0106 ± 0.00	0.0003 ± 0.00	0.0155 ± 0.00	0.0076 ± 0.00	ND	0.0002 ± 0.00	ND
J	0.0005 ± 0.00	1.0925 ± 0.01	0.0059 ± 0.00	0.0011 ± 0.00	0.0380 ± 0.00	0.0125 ± 0.00	ND	0.0010 ± 0.00	ND
K	0.0003 ± 0.00	1.2155 ± 0.05	0.0109 ± 0.00	0.0009 ± 0.00	0.0373 ± 0.00	0.0060 ± 0.00	ND	0.0006 ± 0.00	ND
L	0.0005 ± 0.00	1.0836 ± 0.03	0.0059 ± 0.00	0.0008 ± 0.00	0.0353 ± 0.00	0.0254 ± 0.00	ND	0.0005 ± 0.00	ND
M	0.0011 ± 0.00	1.0694 ± 0.05	0.0182 ± 0.00	0.0007 ± 0.00	0.0329 ± 0.00	0.0281 ± 0.00	ND	0.0003 ± 0.00	ND
N	0.0005 ± 0.00	0.2101 ± 0.00	0.0061 ± 0.00	0.0002 ± 0.00	0.1086 ± 0.00	0.0217 ± 0.00	ND	0.0002 ± 0.00	ND
O	0.0003 ± 0.00	0.2200 ± 0.00	0.0090 ± 0.00	0.0003 ± 0.00	0.0114 ± 0.00	0.0207 ± 0.00	ND	0.0002 ± 0.00	ND

ND—not detected. All results are expressed in mean ± SD in triplicates ($n = 3$).

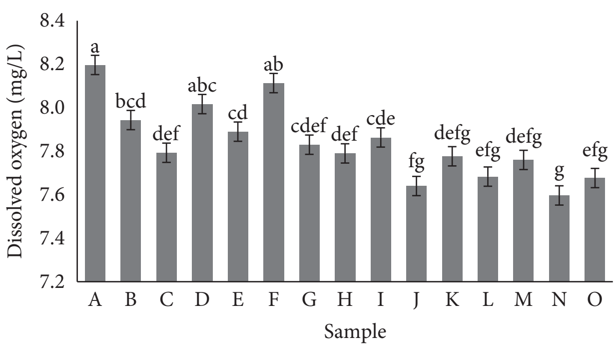

Figure 5: Dissolved oxygen for 15 samples of treated water. A-B: *Sg. Ramal*; C-E: Section 8, *Bandar Baru Bangi*; F-I: Section 16, *Bandar Baru Bangi*; J, K, and O Section 3, *Bandar Baru Bangi*; L-N: Section 15, *Bandar Baru Bangi*. [a-g]Values for the samples which have different letters are significantly different ($p < 0.05$).

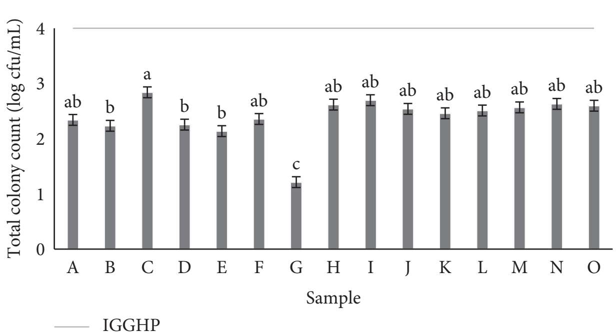

Figure 6: Total colony count at 37°C for 15 samples of treated water. A-B: *Sg. Ramal*; C-E: Section 8, *Bandar Baru Bangi*; F-I: Section 16, *Bandar Baru Bangi*; J, K, and O Section 3, *Bandar Baru Bangi*; L-N: Section 15, *Bandar Baru Bangi*. All results are expressed in mean ± SD. [a-c]Values for the samples which have different letters are significantly different ($p < 0.05$).

number of coliforms is generally considered as a dirt pollution indicator as most coliforms are capable of developing in the environment and water distribution

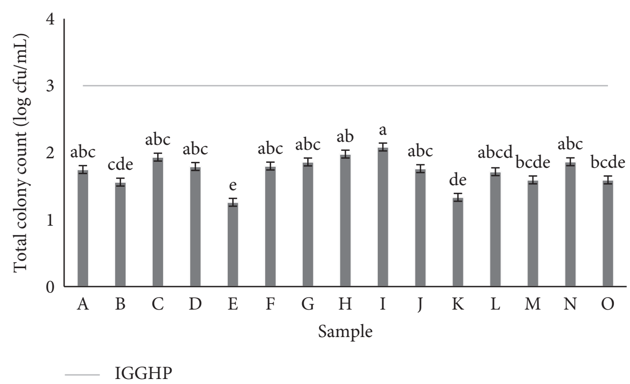

Figure 7: Total colony count at 22°C for 15 samples of treated water. A-B: *Sg. Ramal*; C-E: Section 8, *Bandar Baru Bangi*; F-I: Section 16, *Bandar Baru Bangi*; J, K, and O Section 3, *Bandar Baru Bangi*; L-N: Section 15, *Bandar Baru Bangi*. All results are expressed in mean ± SD. [a-e]Values for the samples which have different letters are significantly different ($p < 0.05$).

systems [39]. Even though there is small amount of coliforms presence in the drinking water, it is still considered to be harmful, and this is also indicates the deterioration of microbiological quality of the drinking water. The presence of coliforms in treated water samples usually indicates ineffective treatment and disinfection. According to Hunter and Burge [40], *E. coli* only survives in water within 42 days. Coliforms are often used as a microbiological indicator, but *E. coli* is more specifically used to determine water quality levels [41].

Based on Table 4, the *E. coli* were not present in any of the treated water samples for all the 15 sampling points. It can be concluded that all of the water samples were at the standard level set by EC 80/777/EEC [19, 42]. According to the standards, *E. coli* cannot be present in any of the samples tested. *E. coli* is part of a coliform group and is a rod-shaped and Gram-negative bacterium found in human intestines and hot-blooded animals where it is a dominant anaerobe

Table 3: The amount of coliforms for 15 samples of treated drinking water.

Sample	Sampling mean ($n = 3$) cfu/100 mL (cfu/mL)	*Comply with standards [27]
A	2.4 ± 0.35 (0.024)	Yes
B	2.2 ± 0.76 (0.022)	Yes
C	5.4 ± 1.50 (0.054)	No
D	5.1 ± 0.84 (0.051)	No
E	2.8 ± 1.04 (0.028)	Yes
F	1.3 ± 0.33 (0.013)	Yes
G	2.4 ± 0.51 (0.024)	Yes
H	4.3 ± 0.67 (0.043)	No
I	4.4 ± 1.00 (0.044)	No
J	1.3 ± 0.33 (0.013)	Yes
K	2.2 ± 1.01 (0.022)	Yes
L	2.3 ± 0.67 (0.023)	Yes
M	2.2 ± 1.26 (0.022)	Yes
N	3.1 ± 0.69 (0.031)	Yes
O	2.4 ± 0.51 (0.024)	Yes

*<4 cfu/100 mL. A-B: *Sg. Ramal*; C-E: Section 8, *Bandar Baru Bangi*; F-I: Section 16, *Bandar Baru Bangi*; J, K, and O: Section 3, *Bandar Baru Bangi*; L-N: Section 15, *Bandar Baru Bangi*. All results are expressed in mean ± SD.

Table 4: *Escherichia coli* total for 15 samples of treated drinking water.

Sample	Sampling mean ($n = 3$) cfu/100 mL (cfu/mL)	*Comply with standards [27]
A	0	Yes
B	0	Yes
D	0	Yes
E	0	Yes
F	0	Yes
G	0	Yes
H	0	Yes
I	0	Yes
J	0	Yes
K	0	Yes
L	0	Yes
M	0	Yes
N	0	Yes
O	0	Yes

*<0 cfu/100 mL. A-B: *Sg. Ramal*; C-E: Section 8, *Bandar Baru Bangi*; F-I: Section 16, *Bandar Baru Bangi*; J, K, and O: Section 3, *Bandar Baru Bangi*; L-N: Section 15, *Bandar Baru Bangi*.

(living organism without the presence of oxygen). However, it is only a small component of the amount of microflora [11]. Coliform detection is widely used as a way to measure the efficacy of hygiene programs where the presence of coliforms shows an increased risk of significant pathogenic presence [12].

3.9. Questionnaire. The majority of the respondents used the treated water from these paid filter machines for 2 to 4 times a week, 46.7% (14 respondents), 23.3% (7 respondents) used less than 2 times a week, and 30.0% (9 respondents) used more than 4 times a week. It also discovered that 43.3% of the respondents used the treated water from the 1.5 L paid water filteration machines and 23.3% (7 respondents) used the treated water from the paid filteration machines which were above 2.0 L. This indicates that the consumption of water from the pay-tap water machines by most *Bandar Baru Bangi* residents is quite high in a day. The preferential consideration when using treated water from a pay-filter machine was as follows: firstly, the machine being readily available with 66.6% (20 respondents) revealing this, and secondly, water quality with only a few respondents, 6.7% (2 persons) reporting this. The results also showed that 100% of the respondents ($n = 30$) were satisfied with the colour, taste, and smell of the treated water provided. A total of 100% of the respondents perceived the water provided by the paid filtering machines was safe to drink. A total of 10.0% (3 respondents) revealed that they had experienced throat discomfort after consuming the treated water from the paid water filters. This indicates that the majority of the subjects basically do not experience any health problems arising from the treated water provided by the paid water filter machines. The filtered water is a major source of safe and reliable drinking water [9].

4. Conclusions

Based on the physicochemical parameter tests, it can be concluded that the pH and mineral contents of the treated water samples are in a safe range according to the standards and are also at a safe level to drink. For total dissolved solids and conductivity, the treated water from the paid water filter machines is also within a safe range to drink. For the microbiological parameters, the total colony counts for all the 15 samples of the treated water show that the water is safe for use as the colony counts are at a safe level which is <4 log cfu/mL. Although the total colony counts for all the samples generally show that the water is safe to drink, further microbiological analysis conducted showed that 4 out of the 15 water filtered samples contained coliforms that exceeded 4 cfu/100 mL, which were samples C, D, H, and I. All of the treated water samples were discovered not to contain *E. coli*, and this shows that the samples comply with the standards. Overall, it can be concluded that most respondents are less concerned with the safety and hygienic aspects of drinking water although a few respondents reported having experienced throat discomfort, which might be a possible sign of water-borne disease. However, a further confirmation test is needed to confirm water-borne disease. The treated water from filtration water system should be monitored and maintained in accordance with the schedule of the filter used so that the quality of the water consumed is guaranteed in terms of safety.

Data Availability

The data used to support this study are provided within the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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