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EVALUATION OF DRINKING WATER QUALITY CONSUMED IN SOME URBAN CONDOMINIUMS IN KELANA JAYA BEFORE AND AFTER USING MICRO- FILTERED WATER DISPENSERS (MWD)

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ABSTRACT
Based on results and analysis, the values of ten parameters namely; Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Turbidity, Nitrate, Nitrite, Chlorine, Fluoride, pH and coliforms bacteria in the study stations were influenced by evaluate water quality during the three months of study periods. Hence, this research aimed to assess and evaluate the 8 drinking water condominium stations at Kelana Jaya area, Selangor, Malaysia. The average value of nitrate, turbidity, chlorine, fluoride was higher of tap water in some condominiums especially ST3, ST4, ST5, ST6 and ST7. The highest value of this physicochemical parameters at stations ST5 (pH 8.6, nitrate 0.16 mg/L, turbidity 1.5 NTU, chlorine 1.2 mg/L, and fluoride 1.65 mg/L) and ST6 (pH 8.5, nitrate 0.15 mg/L, turbidity 1.6 NTU, chlorine 1.95 mg/L and fluoride 1.73 mg/L) which slightly higher than drinking water standard. With same aim of this investigation to determine the level of total viable counts and fecal coliform bacteria of taps waters before using filters which indicate that there were 3 stations have higher value ST3 (before 563 and after 5 CFU/100 mL), ST5 (before 579 and after 7 CFU/100 mL) and ST6 (before 582 and after 15 CFU/100 mL) respectively. The house filter in most physicochemical parameters is more accurate than commercial filter (WFS) but for total viable counts and fecal coliform bacteria found that commercial filter is more effective and accurate than housefilter.

Keywords: *Drinking water; DO; BOD; COD; water quality.*

NTRODUCTION

Water is an essential resource that sustains life on earth, changes in the natural quality and distribution of water have ecological impacts that can sometimes be devastating (Said, *et al*., 2014). Surfaces and ground water resources have played an important function throughout the history in the development of human civilization. About one third of the drinking water requirement of the world is obtained from surface sources like rivers, canals and lakes (Muhammad, *et al*., 2013).

Recently, Malaysian is facing a lot of environmental issues regarding water pollution (Al-Mahdi, *et al*., 2019; Lai, *et al*., 2017). Rivers and lakes play a major role in assimilation or carrying off the municipal and industrial wastewater, run-off from agricultural land and other pollutant dis-charge. The major pollutants in Malaysian's rivers lakes and groundwater are Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolving Oxygen (DO), Ammoniacal Nitrogen (NH_3-N), Suspended Solids (SS), Heavy Metals and Microbial contaminations. High BOD is contributed largely by untreated or partially treated sewage from manufacturing and agro-based industries (Abdullah, *et al*., 2016; Rahmanian, *et al*., 2015).

On the other hand, the main contaminants of the marine and coastal waters in the country are mainly suspended solids, heavy metals, coliforms bacteria, oil and grease, whilst for ground water are solid waste landfills, radioactive land-fill, etc, which released from human activities and wastewater sewage (Azlan, *et al*., 2012).

This research was mainly focused on the evaluation of drinking water quality consumed in some urban condominiums in Kelana jaya, before and after using micro-filtered water dispensers (MWD). The source of the drinking water samples is municipality water which connected with different types of filters. That may affect the different

characteristic of water quality parameters such as Physico-Chemical and bacteriological. The quality parameters in this study was investigated about the total viable count, total coliform count, residual free chlorine, nitrate ion, nitrite ion, dissolving oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (CO-D), turbidity and pH before and after using different types of water filters in some condominiums in Kelana Jays, Selangor, Malaysia.

MATERIALS AND METHODS

This study with all biological and physiochemical parameters of water samples carried out at environment department laboratory at UPM University, Selangor, Malaysia. Water samples collected from 8 stations (Sterling 1, Mahkota 2, Zenith Residences 3, Tiara Kelana 4, Kel-ana Puteri 5, Kelana D'Putera 6, Suria Dama-nsara 7 and Eve Suite 8 condominiums at Kelana Jaya area, Selangor, Malaysia by random sampling methods. Tap water, public commercial filter and house private filter water with two filters were used for samples collected. The water samples in sterile container from 8 stations then start the research process.

Sixteen house water filters (two houses water sample from each condominium), then sixteen taps water (two taps water from each house in each condominium) and eight commercial filter water from each condominium. The house filter used in this study types Global Double Water Filter, SKU, Malaysia and the commercial water filter types SPLASSHY Vending Machine Model SUS 304, Stainless steel body, Malaysia.

The total water sample analysis from all those 8 stations were 40 water samples. Each station collected 16 tape water and house filters water from same units as before and after filters used to evaluate the physicochemical as pear a drinking water quality index (WQI), which consists of nine parameters such as namely; Dissolved Oxygen (DO), Biochemical Oxygen Demand (B-OD), Chemical Oxygen Demand (COD), turbidity, Nitrate, Nitrite, Chlorine, Fluoride and pH then biological properties of the water samples.

Data analysis by statistical method*:* After it has been collecting samples and analyzing the samples in the laboratory there is a need to analysis it mathematically and statistically in order to estimate the missing data, serial dependence, mistake percentage during the process and many other benefits. In fact, analysis of the data statistically for the water samples provides a clear picture of the situation of the water body that can be useful especially for the water management. Microsoft Excel software program is using due to analyze the gathered data statistically. Graphs were used in order to show the variation in the data which recorded.

The study was approved by the Lincoln medical college ethics committee (Lincoln University College ethics committee) and the ethics University review board and followed the guidelines of the Malaysia declaration. The researcher was informed also in written form and signed an agreement of consent for participation in the study.

RESULTS

1. Physicochemical parameters: All physic-chemical parameters average of this investigation study of 8 sampling stations as tap water before using hose or commercial filters were recorded in Table 1 and Figure 1. The dissolved oxygen average out of 8 stations was between minimum 6.35 mg/L at station 6 and maximum 8.5mg/L at station 8. The tap water average of DO 8.5 mg/L but after using house filter slightly increase to 8.55mg /L and decrease while using commercial filter to 8.40 mg/L

The biochemical oxygen demand (BOD) range was between minimum 0.152 mg/L at stat-ion 8 and maximum 2.52 mg/L at station 6. The mean value of biochemical oxygen demand from tap water was 1.13 mg/L. However, the value was reduced after using the house filter, which was 0.067 mg/L and 0.033 mg/L for the commercial water filter.

For chemical oxygen demand (COD) average range was between minimum 2.21 mg/L at stat-ion 1 and maximum 4.4 mg/L at station 7. Chemical Oxygen Demand (COD) of the water in this study was record in the tape water (before using any filter), both filters didn't show any value of COD as shown in Table 2 and Figure 2, which mean that the water from both filters is acceptable or fall within the standards of WHO (2014) and Ministry of Health Malaysia (2014).

Average of pH was between minimum 8.1 at station 1 and 8 and maximum 8.6 at station 5. According to WHO standards pH of water should be 6.5 to 8.5. However, in this study, the pH and turbidity values were ranged between 8.1 to 8.6 and 0.667 to 1.6 NTU respectively. Both of the parameters did not exceed the standard limit; however, these were falling in basic or alkaline range. All the tested water samples of pH and turbidity were within the limit of acceptable standard of drinking water of 6.5-9 for pH and 5 NTU for turbidity, according to WHO, (2014) and Ministry of Health Malaysia (2014).

The WHO allows maximum permissible limit of nitrate in drinking water is 10 mg/l. The concentration of nitrate in the tap water ranges from

0.0106 to 0.19mg/L, and after using the filter the nitrate concentration reduced to reach 0.0024mg /L in house filter and 0.004mg/L in commercial filters. For nitrate range were between minimum 0.0106 mg/L at station 8 and maximum 0.19 mg /L at station 4 and for nitrite mini-mum 0.0055 mg/L at station 1 and maximum 0.02 mg/L at station 5.

Nitrites (NO^-) mean concentration level among all the water samples ranged around 0.012 mg/L, but house filter reduces to 0.0024 mg/L and after using commercial filter the value reduces more 0.0008mg/L. All the water samples had their NO^- level within WHO acceptable standard which is 1mg/ L.

The chlorine average out of 8 stations was between minimum 1.05 mg/L at station 8 and maximum 1.25 mg/L at station 6. For fluoride mini-mum 1.172mg /L at station 8 and maximum 1.95mg/L at station 5. The free residual chlorine concentration for all the water samples varied around 1.95mg/L. The concentration reduces after using the house filter to 0.532mg/L and slightly reduce after using commercial filter with 1.064mg/L. The level of concentration of fluoride of the water samples ranged value around 1.46mg/L. The concentration of chlorine was reduced after using house filter to 0.521mg/L and more reduce after using commercial filter water to 0.477 mg/L as shown in table 1 and figure 1. All value for all sample within the acceptable WHO (2014) guideline value of 1.5 mg/L.

Table-1: The average value of physico-chemical parameters of water in all sampling station 2.

ST no.	DO (mg/L)	BOD (mg/L)	COD (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Turbidity NTU	Chlorine (mg/L)	Fluoride (mg/L)	pH
ST1	7.65	0.167	2.21	0.015	0.0055	0.678	1.08	1.185	8.1
ST2	7.50	0.215	3.2	0.04	0.007	0.718	1.1	1.21	8.2
ST3	6.75	1.52	4.2	0.15	0.014	1.05	1.15	1.35	8.5
ST4	7.40	0.55	3.3	0.19	0.01	0.95	1.11	1.46	8.4
ST5	6.50	2.50	4.3	0.16	0.02	1.5	1.2	1.95	8.6
ST6	6.35	2.52	4.1	0.05	0.019	1.6	1.25	1.73	8.5
ST7	6.50	1.45	4.4	0.17	0.017	1.2	1.24	1.62	8.4
ST8	8.50	0.152	2.23	0.0106	0.0057	0.667	1.05	1.172	8.1

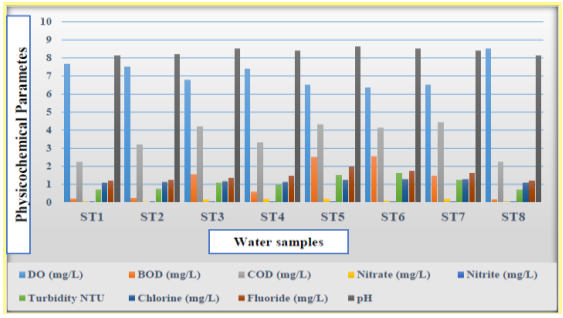

Figure 1: The value of physiochemical parameters of water in all sampling station 2.

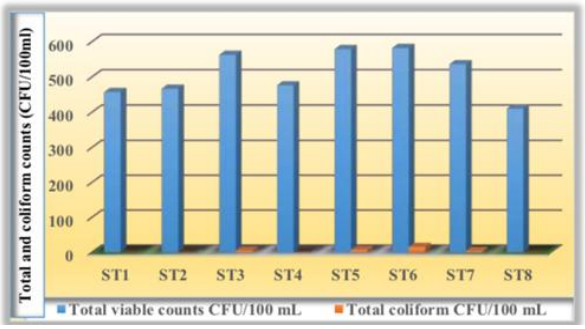

Figure 2: The average of total viable counts and total coliform of all sampling station.

2. Microbiological analysis of water Samples: Results of the bacteriological analysis of the water samples in this study illustrated in Tables 2, 3 and Figure 2. The total viable counts for water samples before using the filter was ranged from 410 CFU/ 100 mL to 582 CFU/100mL, stat-ions 8 and station 6 respectively.

Table 2: The average value of total viable counts and total coliform of all sampling stations.

ST no.	Total viable counts (±STDEV) CFU/100 mL	Total coliform (±STDEV) CFU/100 mL
ST1	457	0
ST2	467	0
ST3	563	5
ST4	476	0
ST5	579	7
ST6	582	15
ST7	536	4
ST8	410	0

The most probable number (MPN) for presumptive total coliform count of the water samples ranged from 0 to 15 MPN per 100mL. However, after using the filters, total viable counts were reduced to 36 CFU per 100 ml for the house filter and only 30 CFU per 100 ml for the commercial filter. Moreover, the MPN for presumptive total coliform count was Nil in both filters as in Table 3 and Figure 3.

Table-3: Total viable counts of bacteria in the water samples.

Sample	Total microbial count (±STDEV) cfu/100 mL	Total coliform (±STDEV) cfu/100 mL
Tap water	582 (±289)	15
Using house filter	36 (±289)	Nil
Using commercial filter	30 (±289)	Nil

The results in previous figure show that both of filters didn't show any coliform bacteria compared to the raw water source which show a range of coliform of 0 to 15 CFU/100mL. The EPA maximum contaminant level (MCL) for coliform bacteria in drinking water is zero total coliform per 100 mL of water.

According to EPA standard, every water sample that has coliform must be analyzed for either fecal coliforms or *E. coli* with a view to ascertaining contamination with human or animal waste and possibly pathogenic bacteria or organism may be present.

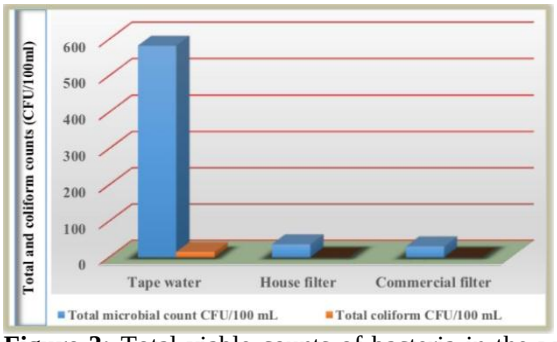

Figure 3: Total viable counts of bacteria in the water samples.

However, both filters that been tested in this study didn't show any coliform bacteria, which mean that water from the two types of filter is acceptable according to the EPA and WHO guidelines.

DISCUSSION

In an attempt to simplify the extensive amount of data collected in this study coherent to the physic-chemical and microbiological parameters listed in the NWQS, (2014) and WHO, (2014), an indexing system was introduced. The purpose of a drinking WQI is to summarize large amounts of water quality data for a specific drinking water of Kelana Jaya area condominiums, Selangor, Malaysia in into simple terms. This makes it easily understandable for communities in the quality of drinking water and for municipality management which agree by Zurahanim, *et al*., (2020).

According to drinking water quality standards of WHO, (2014) and Ministry of Health Malaysia, (2014), the level of COD and BOD for drinking water should be Nil, these study results show that the water from the two tested filters is acceptable or fall within the standards of WHO (2014) Ministry of Health Malaysia, (2014) and NWQS, (2014). The range of water quality of this study is similar to the water quality of Nicholson, *et al*., (2016) and Muhammad, *et al*., (2013). These results show that the water from the two tested filters is acceptable and fall within the standards of WHO, (2014) Ministry of Health Malaysia, (2014) and EPA (2013) for nitrate and nitrile. The chlorite in the water for the average time of storage of water in the household (typically 4-24 hours) of our result was similar to result of Masoumi, *et al*., (2013). Most of the fluoride tested samples were slightly more than the acceptable WHO (2014) guideline value of 1.5mg/l Sources of microbial contamination include surface runoff, pasture and other land areas where animal wastes are deposited from human activities. Additional sources include discharge from septic tanks, sewage treatment facilities and natural soil and plant bacteria (EPA, 2013). Accor-ding to EPA standard, every house water sample which coming from the municipal water supply that has coliform must be analyzed for either fecal coliforms or *E. coli* (EPA, 2013) with a view to ascertaining contamination with human or animal waste and possibly pathogenic bacteria or organism may be present (EPA, 2013). WHO in (2014) permissible limits for coliform, fecal coliform and *E. coli* is 0 MPN/ 100mL. Current study agrees with Halloch, (2011), Most of the results which recorded in nature (imprecise), there are at least two reasons that an index may fail to accurately communicate water quality information. Certain chemical parameters, which may be carcinogenic, are also not included in the WQI (NWQS, 2014).

CONCLUSION

Based on results and analysis, the values of nine parameters namely; Dissolved Oxygen (D-O), Bio-chemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Turbidity, Nitrate, Nitrite, Chlorine, Fluoride and pH and coliforms in the study stations were influenced by evaluate water quality during the three months of study periods. Hence, this research aimed to assess and evaluate the 8 drinking water condominium stations at Kelana Jaya area, Selangor, Malaysia. The average value of nitrate, turbidity, chlorine, fluoride and were higher of taps water in some condominiums especially ST3, ST4, ST-5 and ST7. The highest value of this physico-chemical parameters was at stations ST5 (pH 8.6, nitrate 0.16 mg/L, turbidity 1.5 NTU, chlorine 1.2 mg/L and fluoride 1.95mg /L) and ST6 (pH 8.5, nitrate 0.05mg/L, turbidity 1.6 NTU, chlorine 1.25mg/L and fluoride 1.73mg /L) which slightly higher for standard drinking water.

With same aim of this investigation to determine level total viable counts and fecal coliform bacteria of taps waters before using filters which indicate that there were 3 stations have higher value ST3 (563 and 5 CFU/100 mL), ST5 (579 and 7CFU/100mL) and ST6 (582 and 15CFU/100 mL) respectively. The house filter in most physico-chemical parameters is more accurate than commercial filter but for total viable counts and fecal coliform bacteria found that commercial filter is more effective and accurate than house filter.

In both the drinking water INWQS and WQI were good water quality benchmarking tools, albeit with certain limitations. More importantly is the effective utilization of these tools by the respo-

nsible agencies and parties involved in watershed management. The authorities must be aware of the implications and limitations of bench-marking using the drinking water INWQS and WQI, so that drinking water quality preservation efforts can be executed seamlessly.

Water is the second essential factor for life after oxygen. If this essential factor is not available some organism dies early, some from resistance stage, while some other dies late. Human beings are not excluded from this marvelous factor. Peoples obtain their drinking water from surface and underground sources. However, both surface and ground water sources could become contaminated, by biological and chemical pollutants arising from point and non-point sources. Using water filter is an important thing to prevent or reduce of water pollution. Present study results had shown that mostly physicochemical and micrbiological parameters of drinking water before and after using two filter systems were found within the permissible limits of WHO. Presence of coliform bacteria in the raw water indicates that water source is facially polluted from different biological sources and can use COD and BOD ratio to determine the types of pollution. The main cause of problem is maybe the old water distribution network, inside the condominium, leakage in pipeline, bad sanitary condition and improper management of waste disposal. The poor sanitary condition in Peshawar city is mainly responsible for this change in water quality, because old pipes and leakages in pipes provide way to waste water and other pollutant contaminates the drinking water and alters their quality. The results indicate that drinking water from both filters are having Nil coliform bacterial contamination. In addition, all the tested physicochemical parameter was within the standards of Malaysian ministry of health, EPA and WHO for drinking water, which indicates that water from these filters is suitable for human drinking. Water filter is good method and it can be used to prevent or reduce physicochemical and bacteriological pollutions which make the water suitable for drinking.

Conflict of interest- None

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