

Water Quality of Hills Water, Supply Water and RO Water Machine at Ulu Yam Selangor

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Abstract. The rapid development resulted in the deterioration of the quality of drinking water in Malaysia. Recognizing the importance of water quality, new alternatives for drinking water such as mineral water processing from reverse osmosis (RO) machine become more popular. Hence, the demand for mineral water, natural spring water or water from the hills or mountains rose lately. More consumers believed the quality of these spring water better than other source of drinking water. However, the quality of all the drinking water sources is to meet the required quality standard. Therefore, this paper aims to measure the quality of the waters from hills, from RO machine and the water supply in Ulu Yam, Selangor Batang Kali, Malaysia. The water quality was determined based on following parameters: ammoniacal nitrogen (NH₃), iron (Fe), turbidity (NTU) and pH. The results show that the water from hills has better quality compared to water supply and water from RO machine. The value of NH₃ ranged from 0.03 mg/L- 0.67 mg/L; Fe was from 0.03mg/L – 0.12 mg/L, turbidity at 0.42 NTU – 0.88 NTU and pH is at 6.60 – 0.71. Based on the studied parameters, all three types of water are fit for drinking and have met the required national drinking water quality standard.

Keywords: Water quality standard, hills water, supply water, RO water machine.

1. Introduction

Water is a natural resource that is vital for life. Sufficient clean water is essential for our healthy living as well as the health of the environment. Malaysia is blessed with rich water resources and receives an average annual rainfall of 3000 mm that contributes to an estimated annual water resource of some 900 billion mm³. All Malaysians have the right of access to safe, adequate and affordable water supply. One of the water related problems in Malaysia is the demand for drinking water that is rapidly rising due to equally increasing population [1]The current demand for drinking water is about 11 billion m³, which is predicted to increase to about 18 billion m³ in the year 2050 [2]. About 99% of Malaysia's raw water supply are derived from surface water sources primarily rivers and stream that originate and flow from the highlands, whereas, the 1% is from groundwater source [3]. The majority of the potable water is tapped from the rivers, which are fed by the rain [4]. In view of the drinking water problem, the security and sustainability of water resources and to ensure adequate and safe water supply for all are crucial task for the authority [5].

However, water quality deterioration on an ongoing basis will have an impact on human health. Despite the enforcement of the Environmental Quality Act (EQA) in 1974, the water quality of Malaysian inland water (especially rivers) is following a deteriorating trend [4]. According to [4], reductions of good quality raw water is reflected in the increasing number of polluted and slightly polluted rivers. Land use changes is a leading cause of river pollution problems in Selangor State. The quality degradation of the Selangor River will still be



expected in the years to come since pollutant loads are not envisaged to be handled effectively [6]. Therefore, monitoring the drinking water quality is significantly important because the possibility of the water source for drinking (from the river and ground water) becoming polluted is very high.

1.1 Water Quality Evaluation

Water quality is divided into three main categories: physical, chemical and biological [7]. Physical measurement involves turbidity, color, odor, and taste. Normally physical parameters are recommended for use in monitoring water quality for small communities. In most cases the physical properties of drinking water are easily measured even by ordinary people [8]. Chemical parameters include the organic and inorganic forms of metals and nutrients. Measurement of ammonia nitrogen ($\text{NH}_3\text{-N}$) and Iron (Fe) are used for chemical parameters. Meanwhile, inorganic parameters were measured by pH, iron, sulfate and chloride. The biological parameters include total and fecal coliform, heterotrophic plate count (HPC) and E. coli counts.

A Water Quality Index (WQI) developed to indicate overall water quality conditions based on water quality variables considered: dissolved oxygen, specific conductivity, turbidity, total phosphorus, and fecal coliform [9]. The WQI provides a useful way to predict changes and trends in the water quality by considering multiple parameters [10]. National Drinking Water Quality Standards as shown in **Table 1** was formulated in 2000 based on World Health Organisation (WHO) guideline. This standard was used as the water quality benchmarks of treated water and raw water which is either obtained from a water treatment plant or raw water in Malaysia [11].

Geographical locations may affect the quality of portable water, which its mineral contents are very dependent on the mineral compositions of the soil and pollutants such as heavy metal (Azlan et al. 2012). Further research should be done to identify the contents of water quality from difference water sourced. Study of spring water are critical for everyday use for water is safe and does not cause any health problems for the long term or short term. Therefore, objectives of this study to identify the contents of water quality based on the experimental parameters of spring water, tap water and water RO machine for drinking water and measure the water quality based on Malaysian drinking water quality standards. Spring water security are critical for safety use purpose and contaminated spring water could cause health problems for the long term or short term.

Meanwhile, RO water machine is reverse osmosis membrane process cellophane, it's like separating the purified water from contaminated water. RO is when pressure is applied to the side, while the membrane to force water into the area, the dirt is pushed from the side and swept out. RO also can act as an ultra-filters remove particles such as certain microorganisms that may be too large to pass through the pores of the membrane. Even RO drinking water has undergone a filtration before purchasing by customer but the water. Water characteristics profile developed based on the result of this study. The water characteristics consist; Ammoniacal Nitrogen (NH_3), Iron (Fe), Turbidity (NTU) and pH.

Turbidity occurs when pollutants such as clay, silt, organic matter, microorganisms and domestic or industrial wastewater mixed with water. Basically, turbidity can be seen with the naked eye and can be measured by the ability of light to penetrate into the water. Turbidity indicates the amount of particles suspended in water [14]. The turbidity meter is used with reference to the turbidity standard. Ammoniacal Nitrogen ($\text{NH}_3\text{-N}$) is identified as one of the main pollutants to render many of the rivers polluted but it was not considered in the EQA as a monitoring parameter until the new regulations published in 2009 [4]. Ammoniacal nitrogen (NH_3) is a parameter that determines the quality of water based on the growth of algae that contribute to the eutrophication process.

Table 1. National Drinking Water Standard (KKM, 2009).

PARAMETER	RECOMMENDED RAW WATER QUALITY	DRINKING WATER QUALITY STANDARDS
	Acceptable Value (mg/litre (unless otherwise stated))	Maximum Acceptable Value (mg/litre (unless otherwise stated))
Total Coliform	5000 MPN / 100 ml	0 in 100 ml
E.coli	5000 MPN / 100 m	0 in 100 m
Turbidity	1000 NTU	5 NTU
Color	300 TCU	15 TCU
pH	5.5 - 9.0	6.5 - 9.0
Free Residual Chlorine	-	0.2 - 5.0
Combined Chlorine	-	Not Less Than 1.0
Temperature	-	-
Clostridium perfringens (including spores)	-	Absent
Coliform bacteria	-	-
Colony count 22 ²	-	-
Conductivity	-	-
Enterococci	-	-
Odour	-	-
Taste	-	-
Oxidisability	-	-
Total Dissolved Solids	1500	1000
Chloride	250	250
Ammonia	1.5	1.5
Nitrat	10	10
Ferum/Iron	1.0	0.3
Fluoride	1.5	0.4 - 0.6
Hardness	500	500
Aluminium	-	0.2
Manganese	0.2	0.1
Chemical Oxygen Demand	10	-
Anionic Detergent MBAS	1.0	1.0
Biological Oxygen Demand	6	-

2. Methodology

2.1 Water Sampling

The water for spring water collected from water flow from the hill in Ulu Yam as shown in Figure-1. Water from the top of the hill flows out through the provided pipes. This area located on a hill bordering between Hulu Selangor and Gombak district, about 16 kilometers from Kuala Lumpur. There are four outlet pipes that drain water from the hill. Water samples were collected 6 different times. The second area is the RO machine water around Ulu Yam. There are two RO machines in the area. Water samples were also taken at 6 different times. The final field for the study was tap water supplied in Ulu Yam resident area.

2.2 Water Analysis.

There are four laboratory tests conducted at Laboratory of Environmental, Faculty of Civil and Environmental Engineering (FKAAS) which is turbidity, Ammoniacal Nitrogen (NH₃), Iron (Fe) and pH. Ammoniacal Nitrogen test was done to check on water odor. Figure-2 shown the Ammoniacal Nitrogen test set. Spectrophotometer DR6000 machine used to analysis Ammoniacal Nitrogen, Iron and Turbidity. Four different apparatus were used, which are Hach DR 5000, Hach DR2100, DO meter and pH meter



Figure-1. Collecting water sample at hill area Ulu Yam, Selangor



Figure 2. Ammoniacal Nitrogen test set.

3. Result and discussion

The result obtained from turbidity analysis are shown in Figure-3. As can be seen from the graph, the water samples water hill (0.42 NTU) turbidity value is lower than RO water sample (0.88 NTU) and supply water (0.76 NTU). The turbidity of RO water samples RO is the highest since the machine is not well maintained in accordance with the schedule set. However, all the value are still under safe limits for consumption of less than 1000.00 NTU.

Figure-4 provides the value of Ammoniacal Nitrogen (NH_3) recorded for each of sample and the standard value NH_3 for the Ministry of Health (MOH) raw and treated water. Comparing the results, it can see that the value of Ammoniacal Nitrogen (NH_3) reading for RO water samples (0.67 mg/L) slightly higher compare to treated supply water (0.21 mg/L) and hill water (0.03 mg/L). These findings indicate the growth of algae in RO water samples are high. Meanwhile, the NH_3 reading for hill water samples are very low show of the least algae growth in hill water. This experimental evidence showed

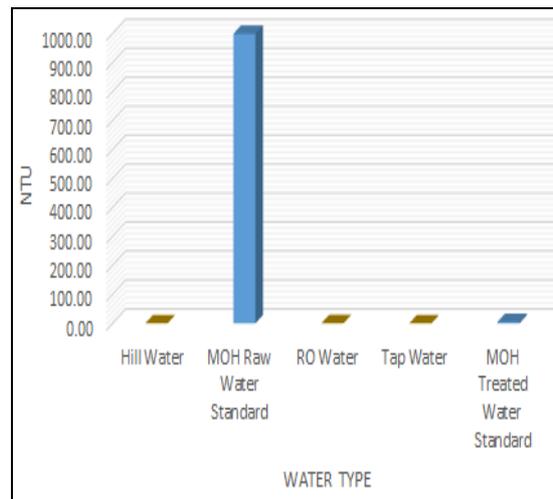


Figure 3. Turbidity (NTU) graph for water sample.

the occurrence of algae growth will be given the odor to the water. Therefore, experimental evident of less odor in hill water indicate there almost none of algae growth in hill water.

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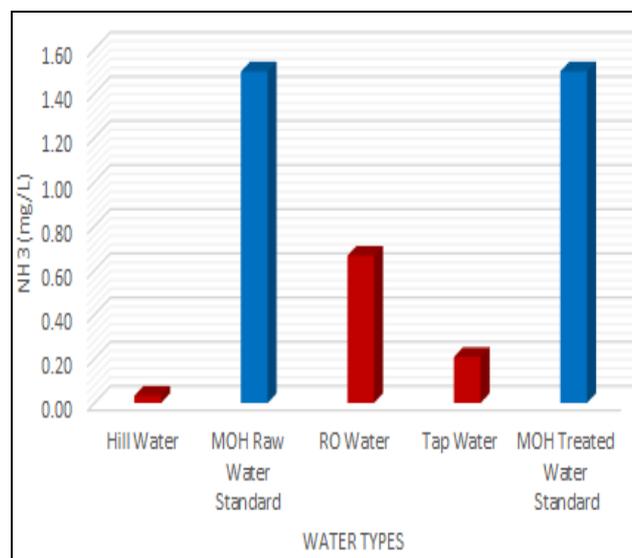


Figure 4. Results of Ammoniacal Nitrogen.

The result obtained from the Fe analysis shown in Figure-5. From the graph in figure 7, it is apparent that the hills water (0.03mg/L) has the lowest of Fe reading compared to supply water (0.08mg/L) and RO water (0.12mg/L). Overall, the value of Fe for all the water sample still under MOH standard. Meanwhile, Figure-6 illustrated the pH reading for the water samples. The pH value was recorded from the supply water is 7.01 or neutral. pH analysis indicate that tap water is free of alkaline and acid due to well treated before distribution to

the consumer. pH value for hill water (6.76) and RO water (6.60) are almost neutral. The low pH reading of RO water is due to the process of osmosis occurs when the water is filtered repeatedly may cause lime content on the water is reduced from neutral.

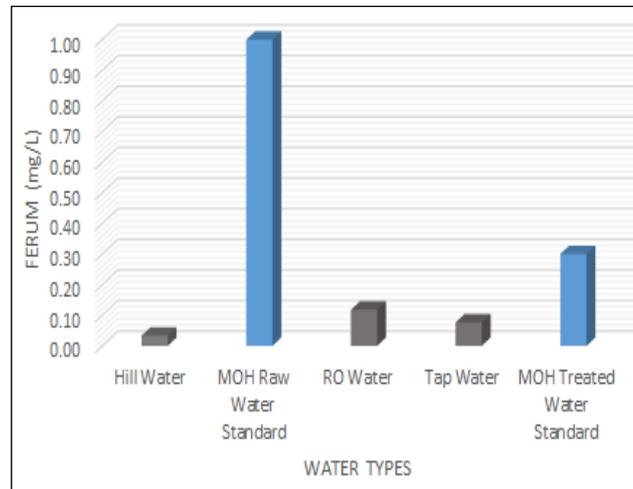


Figure 5. Result of Fe reading for each water sample.

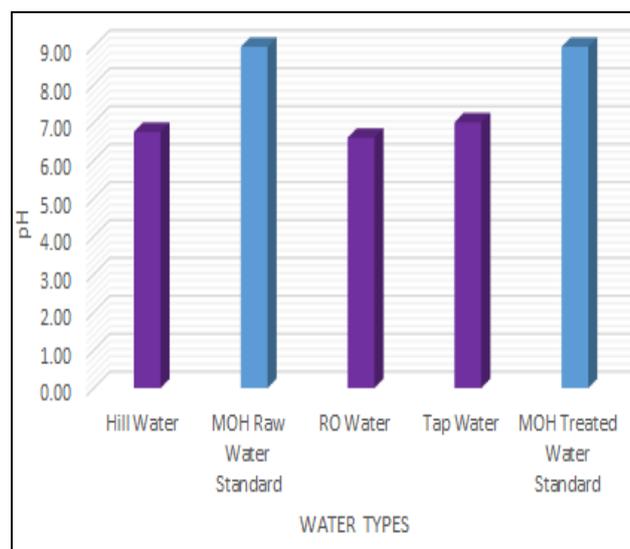


Figure 6. pH result of water samples.

Based on value for all the parameters, the hills water is best drinking water quality compared to supply water and RO water machine. The hill water has the lowest value of NTU, NH_3 and Fe and almost neutral for pH reading. Surprisingly NH_3 was found in tap water. This may occur because at that time the area experienced water rationing. Water flow through the pipe only once for every two days and give the odor to the water in the pipe. Meanwhile, the value of iron come from existing corrosion of underground pipes. RO water machine are still at a satisfactory level by the quality of treated drinking water to drink according to the standards for Drinking Water Quality of the Ministry of Health. However, the NH_3 values for RO water is the highest compared to hill water and tap water sample. Environmental conditions of the machines are less clean possibility cause of odor in the water. The iron content in the RO water high due to corrosion of the supply pipe that may have been long and not be replaced. This study support previous research that geographical location greatly influenced the in water sample content (Azlan et al. 2012). In general, it seems that the results indicate all the water sources are safe for drinking because it still under MOH standard.

Water quality criteria should be more stringent to ensure water security. Although overall the samples of water in Ulu Yam is clean but still need control measures to be conducted as to avoid from water deterioration. Serious care should be a concern for tap water because the water is a major source of locals for everyday use. Running regular maintenance need for the existing pipe for making sure the piping system are clean and run properly. For turbidity control, the maintenance of the area around the pipe or piping system should be reviewed. This is because the turbidity can occur when there is a problem of leaking pipes. In addition, the screening machine for reverse osmosis systems also needs to be maintained so that the pH value is not affected. RO machine water is unfavorable in terms of mineral content in which all the minerals have been filtered by the machine.

Every day, more and more people come to get hill water either for drinking or daily use. Therefore, periodic reviews are proposed from time to time so that all consumers can know the quality of the water either is drinkable or not. Our government, especially the Department of Irrigation and Drainage is responsible for ensuring that the consumer drinks the water is safe and high quality. Legal action could be imposed on offenders who taking out the trash in the vicinity of hill water or anything to irresponsible in maintaining water RO machine. In addition, carry out awareness programs to educate the people about water quality and management at many levels, such as school and selected community. Expected from this program is for knowledge enhancement through engagement and educational outreach programme. So our young generation can start the initiative to conserve water such as hill water will not only in Ulu Yam but elsewhere as well.

4. Conclusions

As the conclusion, overall, the water quality of all the water samples are in good condition and suitable for use as drinking water. This can be proved by the average amount was recorded for all samples where water still according to the standards of the drinking water quality index by the Ministry of Health (MOH). Poor quality of drinking water will give the negative effect on local residents. Contaminated water can also be a source of various diseases to people in the area. Therefore, drinking water quality assessment is very important and needs to be conducted regularly.

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