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An Assessment of Potable Water Quality at Kolej Kediaman Kampus Pagoh, Universiti Tun Hussein Onn Malaysia

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Abstract: Water quality is an essential requirement of human life and activities associated with industry, agriculture, and others, and it considers one of the most delicate parts of the environment. This study was carried out to determine the University Tun Hussein Onn Malaysia Pagoh Campus Student Residential College 1 (A1), 2 (A14) and 3 (A17) water quality to ensure the level of water hardness parameter met the usable standard at the supply point of the pipe. This study was carried out based on the responses from students that the water quality of the hostel is affecting them which can lead to some health issues such as hair loss, and skin becoming dry and itchy when consuming the hostel's water. There were five parameters namely pH, Temperature, Hardness, Manganese, and Chemical Oxygen Demand (COD) were employed in this study to determine the water quality. To measure these parameters the researcher conducted laboratory testing to gather exact data that can be very easy to analyse and comply with Malaysian Drinking Water Quality Standard (MDWQS). This research will carry out by using the most advanced DR 6000 UV-VIS lab spectrophotometer HACH method to quantitative analysis of water quality parameters. For the measured temperature parameters, the range was 27.26 °C to 32.38 °C, pH 7.1 to 7.6, hardness 20.3 mg/l to 39.7 mg/l, manganese 0.2 mg/l to 1.0 mg/l, and lastly, for COD, the range was 10 mg/l to 25 mg/l, respectively. The values of each parameter were found to be within the safe limits set by (MDWQS) except for the manganese level. This study is to provide benefits to university students which included those from different states, so they can use the Hostel's water without any inconvenience and without affecting their health during their study period.

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Keywords: Potable Water quality, Drinking Water, Water Hardness Level

1. Introduction

In this respect, water quality can be defined as the chemical, physical and biological characteristics of water, usually with respect to its suitability for the designated use. Water can be used for recreation, drinking, agriculture, or industry. Water quality standards are put in place to ensure the suitability of efficient use of water for a designated purpose [1]. Water quality standards are put in place to ensure the suitability of efficient use of water for a designated purpose. Water quality analysis is to measure the required parameters of water, following the standards method, to check whether it is in accordance with the standard [2].

In order to swiftly learn how the water quality affected our UTHM Hostel students in Pagoh and what issues they were experiencing, this study conducted a questionnaire survey. The poll found that most pupils agree that after drinking the hostel's water for a while, they may have health problems including hair loss and dry, itchy skin due to the hostel's water quality. The amount of dissolved calcium and magnesium in the water is the simplest way to define water hardness. Calcium and magnesium are the main dissolved minerals in hard water. The last time student washed their hands, might have felt the effects of hard water. This might have noticed a film of residue on hands after using soap to wash them, depending on how hard the water is. "Soap scum" is created in hard water when soap reacts with the water's comparatively high calcium content. If use hard water, you will need to use more soap or detergent to get things clean, whether it is in hands, hair, or laundry [3]. Calcium and magnesium compounds, as well as several other metals, are the main contributors to hardness. According to general rules, water is categorized as soft if the calcium carbonate content is less than 60 mg/L (milligrams per liter moderately hard if it is between 61 and 120 mg/L, hard if it is between 121 and 180 mg/L, and extremely hard if it is more than 180 mg/l [3].

According to the WHO's Geneva Conference, hard water has no known detrimental effects on health. Additionally, very hard water could make a significant additional contribution to the total intake of calcium and magnesium [4]. The impacts of the salts dissolved in hard water, particularly calcium, and magnesium, are chiefly responsible for their negative health effects. A change in bowel movements (diarrhea) could result in an increase in magnesium salt intake. It may be laxative to drink water that contains high concentrations of both sulfated magnesium (around 250 mg/l each) [4].

2. Materials and methods

The material and methods section will be describing all the information required to obtain the results of this study.

2.1 Water sample collection and preservation

For the purpose of collecting a water sample, the researcher used tap water from each residential college block, which is designated as blocks A1, A14, and A17, respectively, according to the residential college's colleges 1, 2, and 3. Additionally, the researcher collected water samples in polyethylene bottles, which had to be carefully cleaned and rinsed with distilled water to remove any impurities. The samples are then allowed to thaw to room temperature before analysis, and the previously indicated measurement for the chosen parameter is taken [5]. Finally, a month's worth of parameter measurements are carried out. The equipment being used must also be washed and cleaned with distilled water before usage.

2.2 Preparation for laboratory testing

Water was examined in a lab to ascertain its properties. After that, it was examined and compared with the Malaysian Drinking Water Standard (MDWQS)

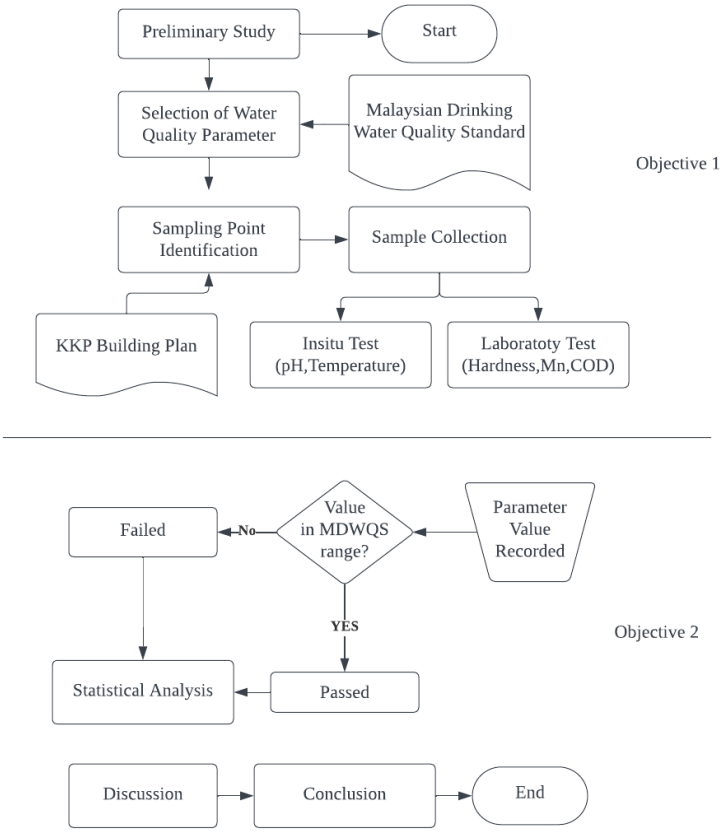

Figure 1: Shows the research method and several procedures to conduct the analysis have been selected shown in the overview of the methodology

2.3 Determination of physical and chemical drinking water parameters

Water quality parameters are used to measure the quality of water, physical parameters are related to the physical characteristics of water. In this study, the researcher determines the temperature of the water has an impact on several characteristics of water quality, including odors, chemical reactions, solubility, palatability, and viscosity. Thus, the temperature of the water affects biological oxygen requirement, sedimentation, and chlorination [6]. Next, pH is one of the first measurements this study should make when evaluating the quality of water. A straightforward pH sensor or test kit can be used to determine the pH of water, which will reveal how basic or acidic the water is. There will always be more hydrogen ions in acidic water [6]. These are some chemical aspects of water quality that could me to determine water hardness levels. When water has a significant mineral content, hardness develops. Dissolved minerals in water could cause scale deposits on hot water pipes if do not take care of them. You can have trouble making a lather with the soap you're using if you take a shower in water with a lot of minerals in it. Magnesium and calcium ions, which can enter water from rock and soil, are the principal causes of hardness in water. Most of the time, groundwater is harder than surface water. A colorimeter or test strip can be used to determine the hardness of the water [6]. The levels of manganese in groundwater from natural leaching processes can vary widely depending upon the types of rock and

minerals present at the water table. Typically, manganese concentrations from natural processes are low but can range up to 0.1 mg/l or higher [7]. Accordingly, Chemical oxygen demand (COD) is the quantity of dissolved oxygen required for the oxidation of chemical organic compounds, such as petroleum, in water. The short-term effects of wastewater effluents on the oxygen content of receiving waters are estimated using COD [8].

2.4 Water quality standard

According to the Malaysian Drinking Water Quality Standard (MDWQS) that the Ministry of Health provided for this study the researcher checked the water samples [9]. Knowing whether there are any poisonous or harmful elements in the tap water in the research region is crucial.

3. Results and Discussion

The results and discussion section will provide the results of laboratory analysis for parameter characterization of physical and chemical parameters by using DR6000 Spectrophotometer and pH meter for descriptive analysis, pH, temperature, hardness, manganese, and COD testing.

3.1 The relationship of hardness, manganese, and COD

There is no clear relationship between water hardness, COD, and manganese. On the other hand, large quantities of organic matter (which can be revealed by high COD levels) might exacerbate issues with manganese in water and contribute to water hardness [10]. Water hardness, COD, and manganese have a connection to water quality analysis, as explained in the sentence below: Water hardness, which is correlated with mineral content and can affect flavor, scale growth, and detergent efficiency, is different from COD, which is a marker of organic pollution and can influence aquatic life and water quality. On the other hand, manganese is a mineral found in water that, in excessive concentrations, can alter taste and aroma, create stains, and even cause health issues [11].

3.1.1 The hardness level of water

Figure 2 to Figure 5 shows data from the hardness analysis of water samples for three residential colleges. According to the MDWQS, there are limits that need to be followed for hardness produces a few problems that may be detrimental to both the plumbing system's health and quality of life. Table 1 shows the hardness analysis of water samples for three KKKP on (Week 1) below.

Table 1: Hardness analysis of water samples for Three KKKP (Week 1)

	101	102	501	502	Tank
KKP 1 (A1)	28.7 mg/l	29.9 mg/l	20.6 mg/l	27.4 mg/l	39.7 mg/l
KKP 2 (A 14)	26.8 mg/l	27.6 mg/l	21.8 mg/l	24.5 mg/l	38.4 mg/l
KKP 3 (A 17)	23.7 mg/l	25.8 mg/l	26.4 mg/l	28.7 mg/l	35.6 mg/l

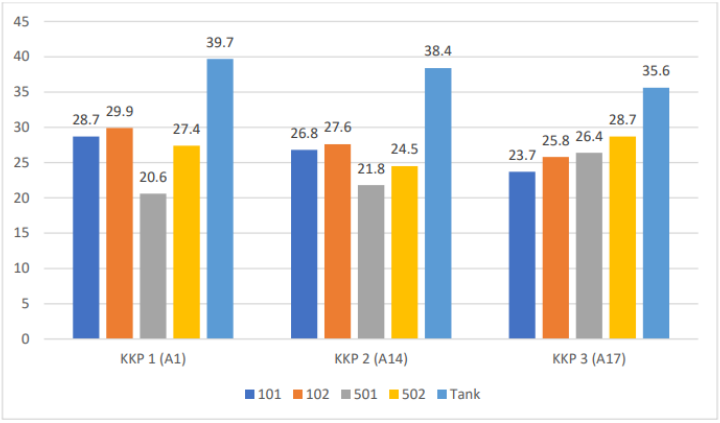

Figure 2: Hardness Analysis of Water Samples for Three KKP (week 1)

Based on Figure 2, the hardness level at the tank is the highest value at 39.7 mg/l as the water sample took it straight from the water tank. Therefore, the minimum hardness level of water was 20.6 mg/l as per the data above. Table 2 shows the Hardness analysis of water samples for three KKKP on (Week 2) below.

Table 2: Hardness analysis of water samples for three KKP (Week 2)

	101	102	501	502	Tank
KKP 1 (A1)	23.9 mg/l	22.2 mg/l	20.3 mg/l	20.5 mg/l	37.4 mg/l
KKP 2 (A 14)	24.6 mg/l	23.5 mg/l	22.4 mg/l	22.3 mg/l	39.6 mg/l
KKP 3 (A 17)	21.8 mg/l	21.4 mg/l	23.5 mg/l	22.2 mg/l	38.8 mg/l

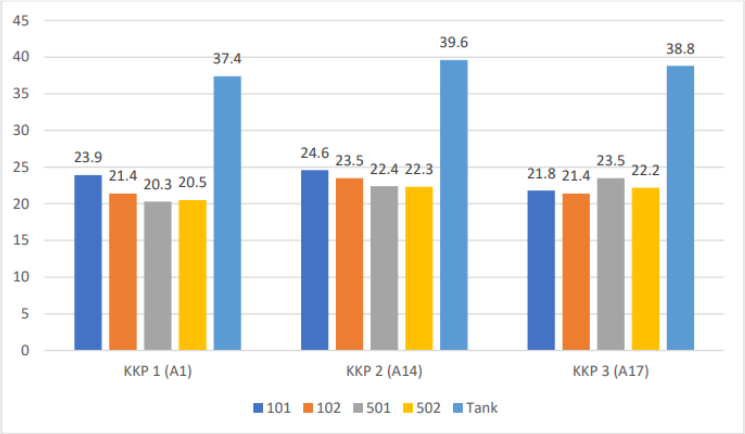

Figure 3: Hardness Analysis of Water Samples for Three KKP (week 2)

Based on Figure 3, the hardness level at the tank is the highest value at 39.6 mg/l as the water sample took it straight from the water tank. Therefore, the minimum hardness level of water was 20.3 mg/l as per the data above. Table 3 shows the Hardness analysis of the water sample for three KKKP on (Week 3) below.

Table 3: Hardness analysis of water samples for three KKP (Week 3)

	101	102	501	502	Tank
KKP 1 (A1)	21.3 mg/l	22.8 mg/l	23.4 mg/l	24.3 mg/l	38.4 mg/l
KKP 2 (A 14)	22.7 mg/l	22.4 mg/l	20.6 mg/l	21.8 mg/l	39.6 mg/l
KKP 3 (A 17)	20.8 mg/l	20.3 mg/l	21.3 mg/l	21.9 mg/l	38.7 mg/l

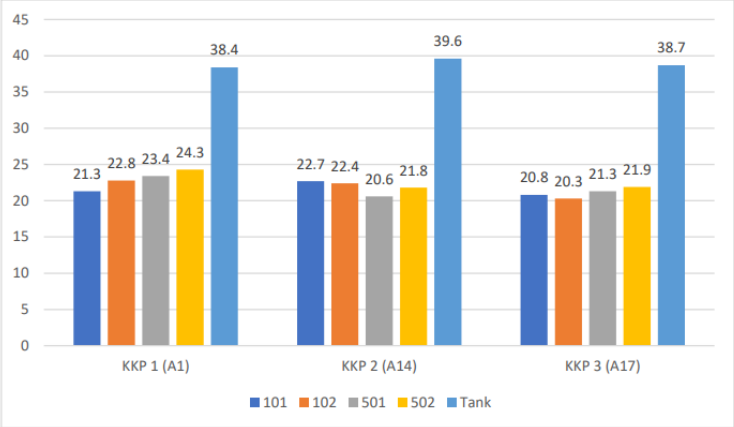

Figure 4: Hardness analysis of water samples for three KKP (week 3)

Based on Figure 4, the hardness level at the tank is the highest value at 39.6 mg/l as the water sample took it straight from the water tank. Therefore, the minimum hardness level of water was 20.3 mg/l as per the data above. Table 4 shows the Hardness analysis of water samples for three KKKP on (Week 4) below.

Table 4 Hardness Analysis of Water Samples for Three KKP (Week 4)

	101	102	501	502	Tank
KKP 1 (A1)	23.7 mg/l	23.5 mg/l	21.7 mg/l	23.5 mg/l	38.6 mg/l
KKP 2 (A 14)	20.8 mg/l	20.4 mg/l	22.4 mg/l	22.7 mg/l	37.4 mg/l
KKP 3 (A 17)	21.7 mg/l	23.6 mg/l	26.8 mg/l	26.4 mg/l	38.3 mg/l

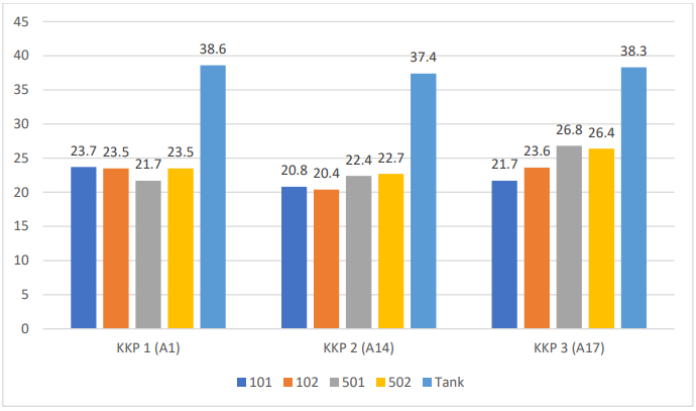

Figure 5: Hardness Analysis of Water Samples for Three KKP (week 4)

Based on Figure 4.12, the hardness level at the tank is the highest value at 38.6 mg/l as the water sample took it straight from the water tank. Therefore, the minimum hardness level of water was 20.4 mg/l as per the data above.

3.1.2 The manganese level of water

Figure 6 to Figure 10 show data from the manganese analysis of water samples for three residential colleges. According to the MDWQS, there are limits that need to be followed to cause the water to turn brown or rusty, stain clothing, sinks, and faucets, and have an unpleasant taste or odor. Table 5 shows the Manganese analysis of water samples for three KKKP on (Week 1) below.

Table 5: Manganese Analysis of Water Samples for Three KKP (Week 1)

	101	102	501	502	Tank
KKP 1 (A1)	0.9 mg/l	0.6 mg/l	0.7 mg/l	0.9 mg/l	0.2 mg/l
KKP 2 (A 14)	1.0 mg/l	0.8 mg/l	0.6 mg/l	0.8 mg/l	0.3 mg/l
KKP 3 (A 17)	0.9 mg/l	0.7 mg/l	0.5 mg/l	0.7 mg/l	0.4 mg/l

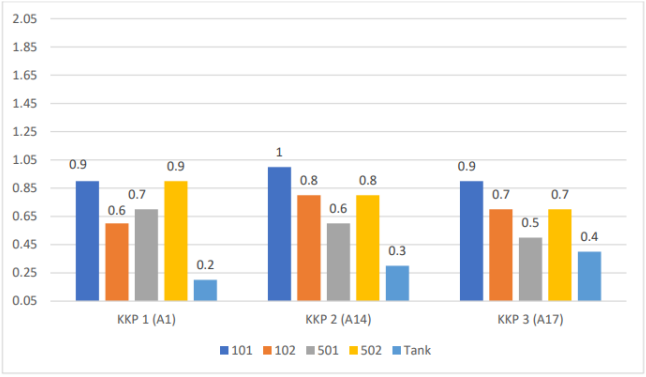

Figure 6: Manganese Analysis of Water Samples for Three KKP (week 1)

Based on Figure 6, the manganese level at the tank is the highest value with 1.0 mg/l as the water sample took it from the tap water 101 (A14). Therefore, the minimum manganese level of water was 0.2 mg/l as per the data above. Table 6 shows the Manganese analysis of water samples for three KKKP on (Week 2) below.

Table 6: Manganese analysis of water samples for three KKP (Week 2)

	101	102	501	502	Tank
KKP 1 (A1)	0.8 mg/l	0.6 mg/l	0.9 mg/l	0.7 mg/l	0.3 mg/l
KKP 2 (A 14)	0.9 mg/l	0.7 mg/l	0.8 mg/l	0.8 mg/l	0.2 mg/l
KKP 3 (A 17)	0.7 mg/l	0.8 mg/l	0.7 mg/l	1.0 mg/l	0.5 mg/l

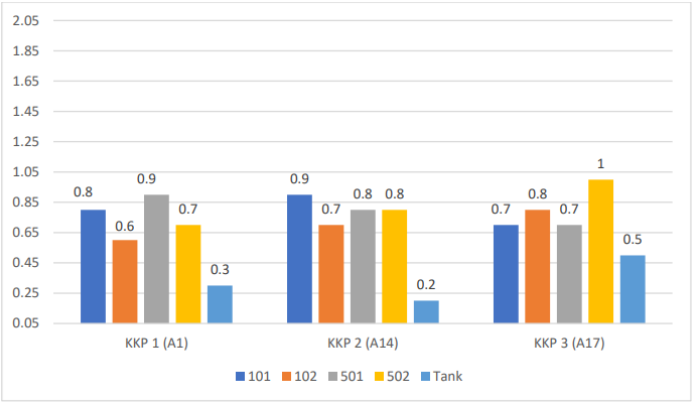

Figure 7: Manganese analysis of water samples for three KKP (week 2)

Based on Figure 7, the manganese level at the tank is the highest value with 1.0 mg/l as the water sample took it from the tap water 502 (A17). Therefore, the minimum manganese level of water was 0.2 mg/l as per the data above. Table 7 shows the Manganese analysis of water samples for three KKKP on (Week 3) below.

Table 7: Manganese Analysis of Water Samples for Three KKP (Week 3)

	101	102	501	502	Tank
KKP 1 (A1)	0.9 mg/l	0.8 mg/l	0.7 mg/l	0.8 mg/l	0.2 mg/l
KKP 2 (A 14)	0.7 mg/l	0.6 mg/l	0.9 mg/l	0.6 mg/l	0.4 mg/l
KKP 3 (A 17)	0.8 mg/l	0.9 mg/l	0.8 mg/l	0.7 mg/l	0.3 mg/l

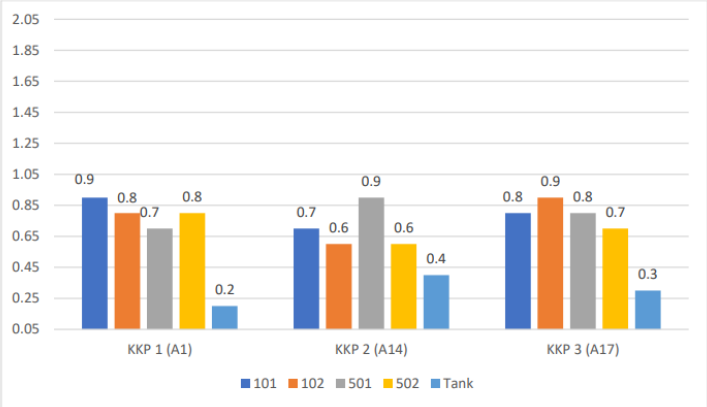

Figure 8: Manganese Analysis of Water Samples for Three KKP (week 3)

Based on Figure 8, the manganese level at the tank is the highest value with 0.9 mg/l as the water sample took it from the tap water. Therefore, the minimum manganese level of water was 0.2 mg/l as per the data above. Table 8 shows the Manganese analysis of water samples for three KKKP on (Week 4) below.

Table 8: Manganese Analysis of Water Samples for Three KKP (Week 4)

	101	102	501	502	Tank
KKP 1 (A1)	0.7 mg/l	0.8 mg/l	0.7 mg/l	0.9 mg/l	0.2 mg/l
KKP 2 (A 14)	0.9 mg/l	0.7 mg/l	0.9 mg/l	0.8 mg/l	0.3 mg/l
KKP 3 (A 17)	0.8 mg/l	0.8 mg/l	0.7 mg/l	0.6 mg/l	0.5 mg/l

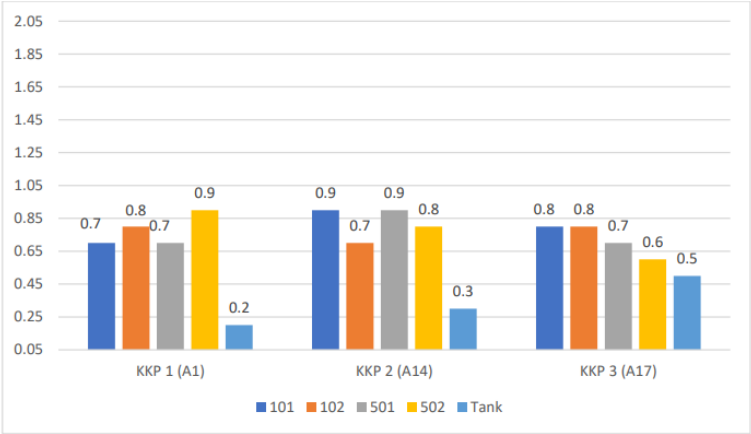

Figure 9: Manganese Analysis of Water Samples for Three KKP (week 4)

Based on Figure 9, the manganese level at the tank is the highest value with 0.9 mg/l as the water sample took it from the tap water. Therefore, the minimum manganese level of water was 0.2 mg/l as per the data above.

3.1.3 The Chemical Oxygen Demand (COD) of water

Figures 10 to Figure 14 show data from the COD analysis of water samples for three residential colleges. According to MDWQS, there are limits that need to be followed for COD. COD is the measure of the capacity of water to consume oxygen during the decomposition of organic matter in the water. In the words, it is the amount of oxygen that is needed to oxidize the organic matter present in a quantity of water. Table 9 shows the COD analysis of water samples for three KKKP on (Week 1) below.

Table 9: COD analysis of water samples for three KKP (Week 1)

	101	102	501	502	Tank
KKP 1 (A1)	13 mg/l	11 mg/l	14 mg/l	16 mg/l	20 mg/l
KKP 2 (A 14)	17 mg/l	12 mg/l	10 mg/l	15 mg/l	21 mg/l
KKP 3 (A 17)	14 mg/l	13 mg/l	19 mg/l	14 mg/l	22 mg/l

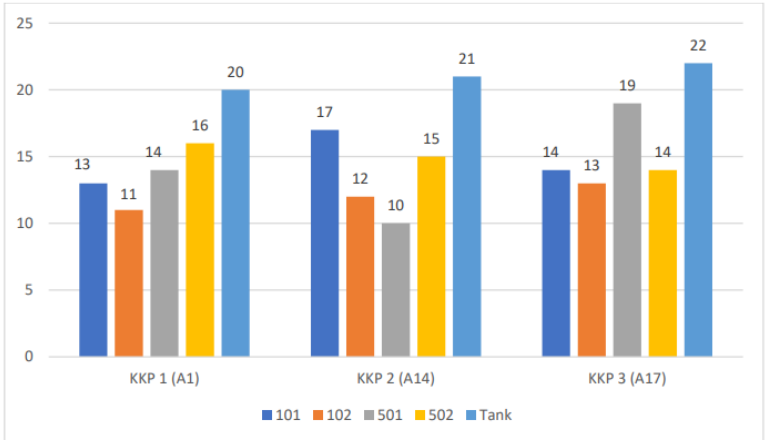

Figure 10 COD Analysis of Water Samples for Three KKP (week 1)

Based on Figure 10, the COD level at the tank is the highest value with 22 mg/l as the water sample took it from the tap water. Therefore, the minimum COD level of water was 10 mg/l as per the data above. Table 10 shows the COD analysis of water samples for three KKKP on (Week 2) below.

Table 10: COD Analysis of Water Samples for Three KKP (Week 2)

	101	102	501	502	Tank
KKP 1 (A1)	17 mg/l	19 mg/l	16 mg/l	14 mg/l	25 mg/l
KKP 2 (A 14)	11 mg/l	17 mg/l	14 mg/l	17 mg/l	20 mg/l
KKP 3 (A 17)	16 mg/l	18 mg/l	17 mg/l	18 mg/l	24 mg/l

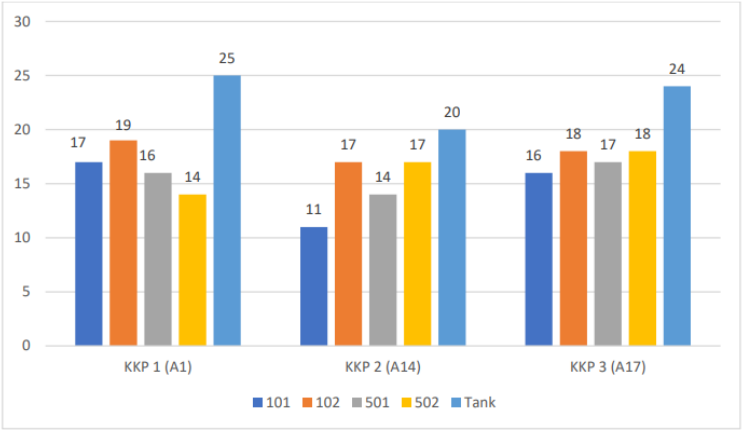

Figure 11: COD Analysis of Water Samples for Three KKP (week 2)

Based on Figure 11, the COD level at the tank is the highest value with 25 mg/l as the water sample took it from the tap water. Therefore, the minimum COD level of water was 11 mg/l as per the data above. Table 11 shows the COD analysis of water samples for three KKKP on (Week 3) below.

Table 11: COD Analysis of Water Samples for Three KKP (Week 3)

	101	102	501	502	Tank
KKP 1 (A1)	16 mg/l	17 mg/l	19 mg/l	18 mg/l	24 mg/l
KKP 2 (A 14)	17mg/l	18 mg/l	18 mg/l	17 mg/l	22 mg/l
KKP 3 (A 17)	18 mg/l	16 mg/l	17 mg/l	18 mg/l	21 mg/l

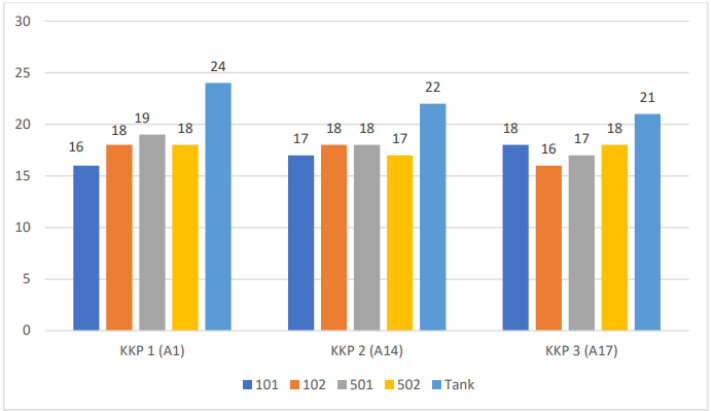

Figure 12: COD Analysis of Water Samples for Three KKP (week 3)

Based on Figure 12, the COD level at the tank is the highest value with 24 mg/l as the water sample took it from the tap water. Therefore, the minimum COD level of water was 16 mg/l as per the data above. Table 12 shows the COD analysis of water samples for three KKKP on (Week 14) below.

Table 12: COD Analysis of Water Samples for Three KKP (Week 4)

	101	102	501	502	Tank
KKP 1 (A1)	17 mg/l	19 mg/l	18mg/l	15 mg/l	21 mg/l
KKP 2 (A 14)	18 mg/l	16 mg/l	15 mg/l	19 mg/l	25 mg/l
KKP 3 (A 17)	16 mg/l	17 mg/l	19 mg/l	18 mg/l	20 mg/l

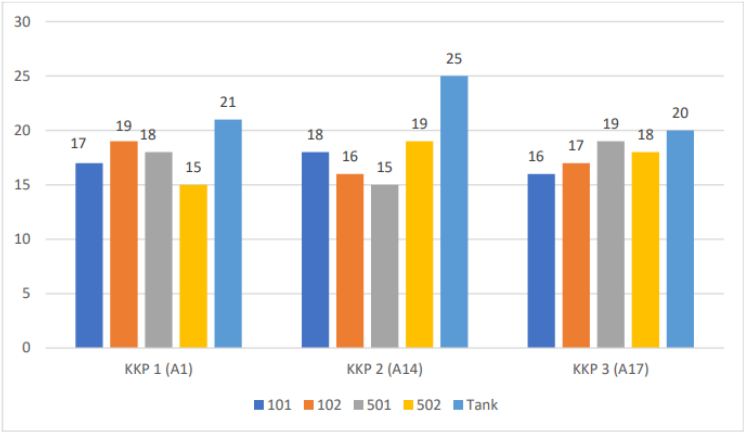

Figure 13: COD Analysis of Water Samples for Three KKP (week 4)

Based on Figure 13, the COD level at the tank is the highest value with 25 mg/l as the water sample took it from the tap water. Therefore, the minimum COD level of water was 15 mg/l as per the data above.

3.1.2 Discussion

In summary, water hardness, COD, and manganese are all important parameters to consider when analyzing water quality. Water hardness can affect the taste of water and indicate other water quality issues, while COD can indicate the presence of pollutants and assess the effectiveness of water treatment processes. Manganese can cause discoloration and staining but can be removed using treatment methods. Based on the descriptive data collected through laboratory testing and checked compliance with the Malaysian Drinking Water Quality Standard (MDWQS) the water hardness level was still maintained according to the required standard level [9]. Furthermore, the hardness level in the selected Residential areas was categorized as slightly hard which is can refer to the water hardness scale [12]. Next, For the manganese level, all the descriptive data were more than (0.1mg/l) which is the level exceeding the drinking water quality standard required [9]. According to the study, when the manganese level is higher than the standard requirement and using the water for a long period can pose a potential health issue [13]. Exceeding manganese levels may be related to hard water, iron, bacteria-infected water, or even an arsenic problem. However, there is no proof in the search results that hard water can arise from manganese concentrations over the necessary standard level. Manganese is one of the dissolved minerals that contributes to hard water, but calcium, magnesium, and manganese are other important contributors.

4. Conclusion

In conclusion, this research has achieved the objectives mentioned in Chapter 1 which are to measure the parameters of hardness, pH, temperature, manganese, and COD. The level at the supply point of the pipe in University Tun Hussein Onn Malaysia Pagoh Campus Residential College 1, 2, and 3 and to analyze the (parameters) value according to the Malaysian Drinking Water Quality Standard (MDWQS) in comparison with three selected student's residential college. Based on the descriptive analysis result obtained through experiments, all the parameters (temperature, pH, Hardness, and Chemical Oxygen Demand (COD)) do not exceed the limits stated in (MDWQS. But, the level of manganese only exceeds the standard which makes the water for Residential College 1 (A1), Residential College 2 (A14), and Residential College 3(A 17) not safe to use and will affect consumers' health.

Acknowledgment

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