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ABSTRACT

Sungai Pusu is a river that flows through the campus of the International Islamic University Malaysia (IIUM), Gombak. This river could have been affected by pollution and urbanization making the water to be cloudy in appearance. The massive deterioration of the river was identified caused by housing construction at the upstream. There is also waste dumping area located near tributary of Sungai Pusu which may lead to leachate seeping into the river. The location within university area with lots of residents makes the river exposed to daily pollution. This study was carried out with samples taken from 8 stations within the campus to determine the bacterial distribution and the physicochemical parameters at the Sungai Pusu, Gombak. Physicochemical parameters (temperature, specific conductivity, dissolved oxygen and pH) were analyzed by using Hydrolab (Data Sonde 4A). Temperature range was found from 30°C to 34°C, pH range from 7.67 to 8.42, dissolved oxygen ranged from 2.80mg/l to 4.88mg/l, and specific conductance ranged from 0.041ms/cm to 0.134ms/cm. High bacterial colony (cfu mL-1) was observed at Station 8 (39,272 cfu mL-1) followed by Station 5 (30,311 cfu mL-1) while, the lowest bacterial colony was found at Station 6 (2,005 cfu mL-1). This study provides an overview on the distribution of the bacterial varied with physicochemical parameters throughout the river which might be due to the human intervention and natural

KEYWORDS

Sungai Pusu, River monitoring, Bacterial community, Physicochemicalparameters.

1. INTRODUCTION

Rivers link between terrestrial, freshwater and coastal marine systems in an open transport. They pump in freshwater to wetlands and lake and pump out freshwater to the sea. The most obvious characteristic of river ecosystems is the unidirectional flow driven by gravity. Based on a study, river ecosystems link the terrestrial and aquatic habitats through both hydrological and nutrient cycles [1]. Rivers are also often the endpoint for many of our industrial and urban pollutions and runoffs. During rains, chemical fertilizer and animal waste peppering residential areas and agricultural lands is swept into local streams, rivers, and other bodies of water. River also acts as a medium of disease transmission to human and animal as a whole. Therefore, proper monitoring of river water is highly needed as to maintain its standard approved quality.

Based on a research, microorganisms always change in response to environment thus allowing them to become useful biological indicator as they react at a faster rate towards foreign environmental condition [1-3]. Bacterial communities study is governed by bacterial diversity in an ecosystem that influenced by abiotic and biotic factors. According to a study, abiotic factors include physical and chemical factors such as temperature, salinity, oxygen level and pH whereas biotic factors include plasmids, phages and transposons that affect the characteristics of bacteria genetically [4]. The environmental parameters such as surrounding temperature, pH, specific conductivity and dissolved oxygen are said to influence the size, composition and viability of bacteria [5,6]. This study aims to determine the physicochemical parameters that influences the distribution of bacteria in Sungai Pusu Gombak. Study on the bacterial distribution and physicochemical parameters is of paramount important in order to understand the dynamic relationship formed [7].

2. EXPERIMENTAL METHOD

2.1 Sampling sites

The water sample was collected from Sungai Pusu, Gombak within IIUM campus. Eight sampling sites were randomly selected to represent the river Pusu which runs through IIUM campus as indicated in Table 1:

Station	Coordinate
Station 1	N 03° 15‘ 38.0“ E 101° 44‘ 22.4“
Station 2	N 03° 15‘ 20.6“ E 101° 44‘ 11.5“
Station 3	N 03° 15‘ 06.7“ E 101° 44‘ 01.1“
Station 4	N 03° 15‘ 03.9“ E 101° 43‘ 59.5“
Station 5	N 03° 15‘ 02.4“ E 101° 43‘ 49.7“
Station 6	N 03° 15‘ 18.3“ E 101° 44‘ 29.6“
Station 7	N 03° 15‘ 11.1“ E 101° 44‘ 71.8“
Station 8	N 03 ° 14‘ 59.9“ E 101° 44‘ 10.7“

2.2 Physicochemical Parameters Study

Physicochemical parameters of the water at the sampling locations were recorded using Hydrolab (DataSonde 4A). The parameters recorded were temperature, specific conductivity, dissolved oxygen level, and pH of the water.

2.3 Water Sample Collection

Water samples were collected using water sampler from each station at the water surface. The sterilized sampling bottles were used to ensure no contamination of exogenous substances. The water samples were kept inside the ice chest to preserve the bacterial composition before being further processed in the laboratory.

2.4 Bacterial Enumeration

Bacterial isolation from water sample was conducted using serial dilution technique. From each dilution (10^{-1} to 10^{-3}), 200µl samples was pipetted out

and spread on Luria Bertani (LB) Agar. Three replicates were collected for each sampling stations. All the plates were incubated at 37°C for 24 hours. After 24 hours, the colony forming unit (CFU/ml) was calculated. All the colonies were subculture on individual LB agar plate.

3. RESULTS AND DISCUSSION

3.1 Physicochemical parameters

Physicochemical parameter is crucial as it helps to describe the river water characteristics in depth. The parameters being discussed include temperature of the sampling water, specific conductivity, dissolved oxygen and pH (Table 2).

Station 6 showed the highest temperature (34.28 °C) meanwhile station 3 showed the lowest temperature (30.01°C) among all the eight stations. The temperature of the water can be influenced by the depth of the river itself. As stated by a researcher, water bodies such as rivers and lakes will exhibit vertical rise in temperature as the upper part will be warmth by the sun while the deeper water will not be affected by the sun and thus remain cooler [8]. Station 6 is an ankle-deep area making it warmest compared to other stations. In addition, Station 6 sampling site located near to waste dumping area making the river water to be warmer. This finding was supported by a researcher [9]. According to their study on water quality, they observed that heat from wastewater can lead to increase of water temperature in urban area. Station 3 has shown the coolest temperature as the sample was taken at deeper region of the river (0.4m).

Station 7 and Station 8 showed the highest specific conductance (0.134mS/cm) while Station 1 shows the lowest specific conductance (0.041mS/cm). Station 7, located near residential construction site and Station 8, located near cafetaria and student center have high specific conductance. which may due to high pollution level from urbanization activity. This finding agrees with the findings of a researcher, as they stated that specific conductance can be used to estimate level of pollution [10]. Station 1 located at the border of IIUM campus which not yet passed through busy area, thus, shows the lowest specific conductance.

Dissolved oxygen showed highest reading at Station 1 (4.88mg/l) and lowest at Station 4 (2.80mg/l). Dissolved oxygen level is affected by level of contamination of that area. High amount of contaminant will be broken down by aerobic bacteria thus producing low dissolved oxygen level. Station 1 located at the river inlet to IIUM campus, may not yet been contaminated with human activity therefore consists of high dissolved oxygen, whereas Station 4 located at the center of International Islamic University, Gombak making it rich in contaminant thus having a low dissolved oxygen level.

Station 8 showed pH 8.42, which is highest compared to other stations while station 1 has pH of 7.67. Station 1 has standard pH and be considered as less polluted area. World health organization (WHO) has stated a pH standard for water quality is at the range of 6.5 to 9.5 [11].

Table 2: Physicochemical parameters of Sungai Pusu

STATIONS	WATER QUALITY PARAMETERS				
	Temp (°C)	SpC (ms/cm)	Dissolved Oxygen (mg/l)	pH	Depth (m)
1	30.56	0.041	4.88	7.67	-
2	31.73	0.076	4.78	7.82	0.1
3	30.01	0.094	3.31	7.83	0.4
4	31.15	0.093	2.8	8.21	0.1
5	32.50	0.124	2.86	8.32	-
6	34.28	0.052	4.84	7.84	-
7	30.48	0.134	4.8	8.24	-
8	31.42	0.134	3.34	8.42	-

3.2 Bacterial Enumeration

In order to determine the distribution of bacteria in each station, colony forming unit was measured on LB media. The result shows different amount of bacterial colony was obtained from each sampling station (Table 2). Station 8 showed the highest number of colony forming unit (39,272 cfu mL^{-1}) while Station 6 has the smallest number of CFU (2,005 cfu mL^{-1}). This shows that the pattern of bacterial number does not increase or decrease depending on the flow pattern of the river. However, it depending on the environmental conditions at particular sites as suggested in Baas Becking hypothesis which stated that local community composition at a given site is only controlled by environmental variation (for example, nutrient concentration, grazing pressure) and not by the spatial distribution of sites [12]. Station 8 located at the later part of the river has the highest CFU value. This might due to the activities that contribute to additional nutrient into the river compared to Station 7 which located at the beginning of the tributary. The same patent was observed in Station 2 which has the lowest CFU value. The location of station 2 at the early part of the river that run through IIUM campusreceived less nutrient from activities in the campus. However, the high number of bacterial colony does not indicate the high bacterial diversity in the Sungai Pusu.

Table 3: CFU reading for overall bacteria

Stations	cfu mL^{-1}
1	14,361
2	12,255
3	17,600
4	25,716
5	30,311
6	2,005
7	14,483
8	39,272

3.3 Correlation between physicochemical parameters and bacterial distribution

All eight stations showed temperature ranging from 30.01°C to 34.28°C. Temperature higher than 34°C reduce the CFU to 2,005 cfu mL^{-1} (Station 6) while lowest temperature of 30°C (Station 3) may still sustain growth (17,600 cfu mL^{-1}). From the result, it can be concluded that higher number of bacteria cells can be obtained at station with temperature within 30°C to 33°C (Figure 1). According to a research, this might be due to presence of various types of bacteria with different optimum temperature at each site and other factors that influence the numbers of bacterial cell [13].

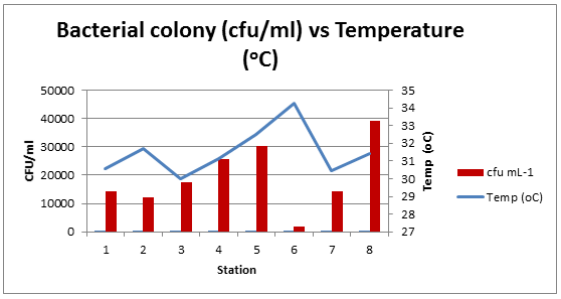

Figure 1: Relationship between the number of bacterial colony (CFU/ml) and temperature of the sampling stations.

Station 8 has high SpC (0.134ms/cm) with high CFU value (39,272 cfu mL^{-1}) while Station 1 has lowest SpC (0.041ms/cm) with low CFU value (14,361 cfu mL^{-1}). SpC is crucial as it helps to assimilate Dissolved Organic Compound (DOC) that later can be used by microbes as food, thus increased in CFU value (Figure 2) [14].

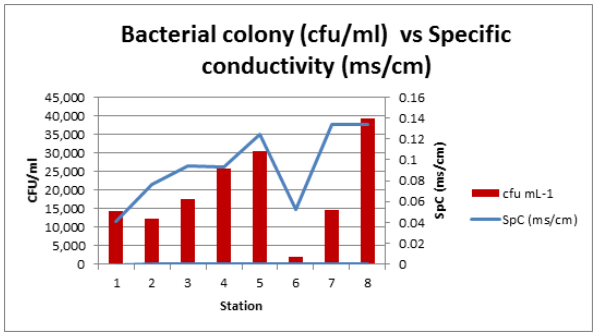

Figure 2: Relationship between the number of bacterial colony (CFU/ml) and specific conductivity of the sampling stations

In an ecosystem, bacterial will use the DO for them to respire and live. Therefore, high number of bacteria leads to low amount of DO available. Station 6 with high amount of oxygen has low CFU values. This is because only small number of oxygen is used as fewer microbes are presence at the station. Station 4, 5 and 8 show the good examples of high CFU with low DO condition as microbes used the DO for their daily activity (Figure 3)

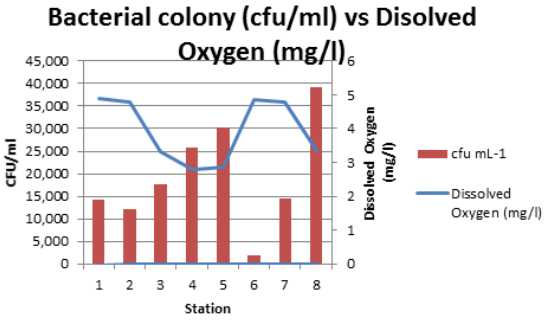

Figure 3: Relationship between the number of bacterial colony (CFU/ml) and dissolved oxygen of the sampling stations

pH ranges from 8.2 and 8.5 are most ideal for bacterial distribution as high cfu numbers were obtained. According to a researcher, the optimum pH for microbes to sustain growth ranges from 6.5 to 8 [15]. This fact is in line with the result obtained for Stations 4, 5 and 8 (Figure 4). However, the pH 7.84 at station 6 shows low CFU compared to station 2 and 3 that have almost same pH values (7.83 and 7.83, respectively). This might be due to the effect of other factors that may have influence the number of bacterial colony in station 6.

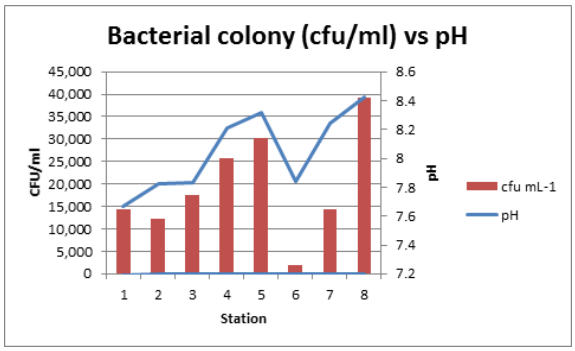

Figure 4: Relationship between the number of bacterial colony (CFU/ml) and pH of the sampling stations

4. CONCLUSION

Distribution of bacteria in Sungai Pusu that run through IIUM campus is not influenced by individual physicochemical parameter but rather the combination of many factors. The higher bacterial colony was obtained at the station near active human activities which may lead to release of nutrient into the river that promotes the bacterial growth. This was also indicated by higher dissolved oxygen level in those station. However the higher number of bacterial colony might not indicate the higher diversity of the bacteria as it can be from few dominant species as specific nutrient usually supports less diversity of bacteria. Furthermore, the colony may only obtained from culturable bacterial strains which not give actual representation of the bacterial composition in the river. Further non-culturable based bacterial identification study is needed to determine the bacterial community structure in the environment.

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