# MICROBIOLOGICAL EXAMINATION OF COLUMN WATER IN TERENGGANU

## (Kualiti Mikrobiologi Turus Air Di Terengganu, Malaysia)

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**Abstract**

The microbiological quality of rural column water at Terengganu was determined. Coliform (*E.coli*), algae, fungi and total count of bacteria were used indicators for the hygienic quality of the Kuala Terengganu water. Membrane filter method and direct count method were applied for the purpose of detection and enumeration. Conclusions relative to the water quality status, as well as the possible reasons for water quality problems are presented in this paper. Obtained results indicated that the water quality status of Kuala Terengganu area cannot cope up with the Malaysia Ministry of Health or World Health Organization standards. Generally the water quality depends on its microbiological conditions. On the other hand, the presence of the micro-organisms in some column water showed that some of the ground water Kuala Terengganu is polluted.

**Keywords:** microorganism, *E. coli*, fungi, algae, total count.

**Abstrak**

Kajian ini telah dilakukan bagi mengetahui kualiti turus air (column water) di Terengganu. Kualiti mikrobiologi dinilai berasaskan pengiraan koloni *E. coli*, alga dan fungi. Kaedah penapisan membran dan kaedah pengiraan terus digunakan bagi tujuan pengesanan dan penilaian. Kertas kerja ini memaparkan keputusan kajian dan perbincangan terhadap faktor-faktor yang menyumbang kepada tahap kualiti air yang diperolehi. Keseluruhannya, hasil kajian menunjukkan kualiti air di Kuala Terengganu tidak mematuhi piawaian Kementerian Kesihatan Malaysia atau Pertubuhan Kesihatan Sedunia (WHO). Kandungan mikrobiologi menunjukkan kebanyakan air bawah tanah di Kuala Terengganu mengalami pencemaran.

**Kata kunci:** mikroorganisma, *E.coli*, fungi, alga, bilangan total

## Introduction

For ages, column water represents an important source of clean water. To this date, column is still used widely as the sole supply of water for daily basic necessities especially in the municipal area of the undeveloped country [1]. Column water originates from the preserved ground water in the form of aquifer or in the stone cleft [2]. Since column water is extensively utilized as a drinking water, it is important to ensure that the water is safe for human digestion and free from any bacteria. Column water is private water systems which are highly vulnerable to bacterial contamination, but usually have no governmental oversight [3]. Thus, columns used for drinking water should be inspected and tested for the occurrence of pathogenic bacteria regularly, in addition to other water quality parameters. The level of microorganism in the water is a sign of the water safety and indicates the hygienic status [4]. The availability of microorganism in the water supply could be a deathful treats towards human and therefore their presence in the water must be evaluated and assessed in order to make sure that the water meets the standard quality of safe drinking water for human health and welfare as authorized by the World Health Organization [5]. Good quality water is a basic factor in guaranteeing public health, the protection of the environment and sustainable development. In this research, we will examine the intensity level of the microorganism including coliform, algae and fungi in the rural column water in Terengganu. Detection and enumeration of bacterial concentration were determined using membrane filter and direct count methods. Based on these obtained results, the safety and cleanability level of this water was then evaluated and assessed whether it fulfils the standard requirements for human consumption approved by the Malaysia Ministry of Health.

## Methodology

### Materials

The composition of Endo dev Agar comprises of meat extract, peptone, lactose, sodium chloride, sodium sulphite, basic fuchsine and agar. The pH was then adjusted to 7.3 (± 0.2 approx.) using either sodium hydroxide or hydrochloric acid. Nutrient agar was prepared using gelatin peptone, meat extract and agar according to the method standardized by APHA. The final pH of nutrient agar is 7.0 (± 0.2 approx.). While the formulation of Potato Dextrose Agar (pH 5.6 ± 0.2 approx.) consists of potato extract, glucose and agar. The unit for these agar is g/L. All reagent grade solutions were used without any further purification.

### Apparatus and procedure

### Sampling aspects

Sampling was conducted in the state of Terengganu Darul Iman, Malaysia in seven districts: Kemaman, Dungun, Marang, Kuala Terengganu, Hulu Terengganu, Setiu and Besut. Four samples were collected from Kuala Terengganu area and two samples each were collected from other districts. The collected samples were preserved carefully to ensure that it was free from any contamination.

Two sampling points were chosen from each district. The lists are as follows: Kemaman (Kampung Baharu and Esso Petrol Station), Dungun (Kampung Kemenyer and Kampung Pasir), Hulu Terengganu (Kampung Bukit Gemuroh and Kampung Nibong), Marang (Kampung Lubok Perah and Wakaf Tapai), Setiu (Kampung Guntung Luar and Kampung Tembila), and Besut (Kampong Batu Bunga and Kampung Pasir Akar). For Kuala Terengganu region, Tanjung, Pantai Tok Jembal, Mengabang Telipot 1 and Mengabang Telipot 2 were selected. In the first step, the inner surface of the metal bucket was sterilised using methylated spirit. The bucket was then lowered into the well and prior to that, it is important to ensure that the rope does not touch the interior side of the bucket as well as there is no contact between the bucket and the wall of the well. After filling the bucket with water, it was pulled up and then poured into bottle. The bottle was then covered with the protective sheet.

In the second step, 47mm, 0.4µm, sterilized grid membrane filter (cellulose nitrate membrane filter) was used to filter the collected water sample under partial vacuum. Several petri dish containing agar medium were prepared prior to water collection. A piece of filter paper is then placed on the top of the agar. Funnel was rinsed three times by 30mL sterilized water. 100mL of water sample is used for every run. For the heavily polluted water, it was previously diluted 3 to 5 times. The water sample in the funnel was tipped onto the filter paper. The petri dishes was kept in the box containing moistened paper towels and then incubated at 44.5±0.5 $^{o}$C for 24 hours. Colonies were counted using stereoscopic microscope (10–15x magnification) and the average count per square was multiplied by 100 times reciprocally to give total colonies per millilitre.

### Sample preparation

All samples were thoroughly mixed or diluted rapidly by a mechanical shaker. Appropriate volumes of these shacked samples were then filtered through the membrane filter with pore diameter of 0.45 or 0.8µm. The filter papers were incubated at 15 $^{o}$C for 5 days in humid atmosphere and colonies were counted using a binocular dissecting microscope at a magnification of 10x.

### Total Count of Bacteria – Membrane Filter Method

Appropriate volume of water sample was filtered through a sterile (47mm dia. and 0.45µm pore size) grid membrane filter under partial vacuum system. Filter paper that was cut into small disc is then laid on the top of the nutrient agar in the petri dishes that were prepared previously. Funnel was rinsed three times by 30mL sterilized water. 100mL of water sample is used for every run. For the heavily polluted water, it was previously diluted 3 to 5 times. The water sample in the funnel was tipped onto the filter paper. Dishes were placed in a closed box containing moistened paper towels and incubated at 35±0.5 $^{o}$C for 24 hours. Colonies were counted by viable count or using stereoscopic microscope.

## Results and Discussion

From the numerous count of total bacteria, it is clearly reveals that, the column water in East Coast Malaysia is highly intensified with microorganism. This conditions is due to no treatment was made (such as chlorination or other disinfection) prior to the water usage. Based on the observation, not all columns examined contains *E.coli*. *E.coli* only exists in the column water from certain places due to the fact that, it is a thermo tolerant species which is faecal origin and therefore its survival depends on weather. Another factor that determines the presence of *E.coli* is the sources of pollution such as sanitary landfills, animal feed lots, industrial waste dumped and storage places for fertilizers as well as fowls.

In Kampung Baharu, total count of bacteria was too abundant but after fourth dilution, the counted bacteria is 58 CFU (Table 1). The nearby animal feedlots, and heavy rain few days before the sampling takes place might be the reasons for the lofty amount of bacteria. In Dungun district, the overall count of bacteria for Kampung Kemenyer was greater than Kampung Pasir as stated in the Table-1 although the sample water comes from the same source. The bacteria contents in the column were influenced much by the environment. From the results, we can see that the bacterial content in column water of Kampung Kemenyer is high as compare to the Kampung Pasir even though Kampung Pasir located nearer to the feed lots. Heavy rain the days before might be the cause for this low count as the bacterial has been washed out from the soil.

Table 1: Obtained Results of Total Count (Bacteria, *E. Coli* and Fungi) of Kemaman and Dungun District

| | Bacteria (CFU/mL) | | | | E. coli (CFU/mL) | | | | Fungi (CFU/mL) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Blank | S1 | S4 | S5 | Blank | S1 | S2 | S3 | Blank | S1 | S2 | S3 |
| Kpg. Baharu | 0 | TNTC | 58 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 4 | 4 |
| Esso | 0 | TNTC | 64 | 5 | 0 | 0 | 0 | 0 | 0 | 13 | 10 | 3 |
| Kpg. Kemenyer | 0 | TNTC | 70 | 9 | 0 | 2 | 1 | 0 | 0 | 25 | 23 | 19 |
| Kpg. Pasir | 0 | TNTC | 63 | 3 | 0 | 0 | 0 | 0 | 0 | 20 | 17 | 3 |

Table 2: Obtained Results of Total Count (Bacteria, *E. Coli* and Fungi) of Kuala Terengganu District

| | Bacteria (CFU/mL) | | | | E. Coli (CFU/mL) | | | | Fungi (CFU/mL) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Blank | S1 | S4 | S5 | Blank | S1 | S2 | S3 | Blank | S1 | S2 | S3 |
| Tanjung | 0 | TNTC | 0 | 0 | 0 | 7 | 1 | 0 | 0 | 0 | 0 | 0 |
| Pantai Tok Jembal | 0 | TNTC | 13 | 7 | 0 | TNTC | 48 | 2 | 0 | TNTC | 50 | 0 |
| Mengabang Telipot | 0 | 4 | 1 | 1 | 0 | 118 | 4 | 0 | 0 | 145 | 37 | 13 |
| Mengabang Telipot | 0 | TNTC | 137 | 46 | 0 | 49 | 4 | 0 | 0 | 34 | 15 | 5 |

While for fungi, the total count was only about 20 CFU (Table 2) since fungi can endure moist condition but it does not able to resist wet climate. The quantity of *E.coli* which is the bacterial of concern by most wastewater engineer is high in Pantai Tok Jembal owing to the municipal waste from the nearby cows rearing farms. The results for fungi contents in Pantai Tok Jembal showed that the column water has very high fungi growth. *E. coli* and fungi can grow very well in this place due to the contamination by faeces of animals and rubbish surrounding the area. Mengabang Telipot 1 has higher amount of *E. coli* than Mengabang Telipot 2 although the distance of the sampling areas were not far. Since the column examined in Mengabang Telipot 2 owned by individual, proper care and handling has been made, thus the column was not highly polluted. Surrounding chickens in Mengabang Telipot 1 might explain the high reading of bacterial level. But for fungi, both Mengabang Telipot 1 and 2 has a very low content of fungi.

Tanjung has a very low amount *E. coli* because it is located near to Kuala Terengganu Main Bus Station which produced a lot of hazardous chemical particles which reduce the *E. coli* growth. No fungi is found to grow in column water in Tanjung because the chemicals such as benzene, carbon, sulphur dioxide, sulphur, lead and a lot more release by the buses has contaminate and inhibited the growth of fungi in the column water. As usual the bacteria count of column water without dilution showed a "too numerous too counts". After fourth dilution Kampung Bukit Gemuroh was 10 CFU while Kampung Nibong was 13 CFU. Kampung Nibong leads in *E. coli* contents compared to Kampung Bukit Gemuroh (Table-3). This is due to the flood in Kampung Nibong when the sampling was conducted. The column water of Kampung Nibong was highly contaminated with the wastes from rivers, roads and farms as well as the animal feed lots during flooding. The total bacterial count in Marang district was very concentrated (Table-3) since sampling was conducted in rainy day at Kampung Lubok Perah and Wakaf Tapai. *E. coli* from the soil enter the column water due to the rain flow. *E. coli* appears due to the presence of small organisms faeces like squirrel, birds, and others. Wakaf Tapai of fungi growth was higher than Kampung Bukit Perah.

Table 3: Result for Total Count of Bacteria, *E. Coli* and Fungi in the District of Hulu Terengganu and Marang

| | Bacteria (CFU/mL) | | | | E. Coli (CFU/mL) | | | | Fungi (CFU/mL) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Blank | S1 | S4 | S5 | Blank | S1 | S2 | S3 | Blank | S1 | S2 | S3 |
| Kpg. Bt. Gemuroh | 0 | TNTC | 10 | 1 | 0 | 78 | 7 | 1 | 0 | 73 | 0 | 0 |
| Kpg. Nibong | 0 | TNTC | 13 | 3 | 0 | TNTC | 68 | 19 | 0 | TNTC | 6 | 0 |
| Kpg. Lubok Perah | 0 | TNTC | 0 | 0 | 0 | 11 | 2 | 3 | 0 | 33 | 0 | 1 |
| Wakaf Tapai | 0 | TNTC | 2 | 1 | 0 | 35 | 2 | 0 | 0 | 61 | 1 | 0 |

The obtained result of bacteria counts for Kampung Guntung Luar and Kampung Tembila is shown in Table-4 and it states that the amount of bacteria for Kampung Guntung Luar was high compared to Kampung Tembila. This is because from the surveillance, wells in Kampung Guntung Luar was not properly managed compared to Kampung Tembila. For the fungi growth the results is vice versa. The pumping system used in Kampung Tembila has lead to the growth of fungi due to lack of cleaning of the pump pipelines. Kampung Guntung Luar has lesser fungi growth as the water is collected directly using bucket. The result for bacterial count for Kampung Pasir Aka and Kampung Bukit Naga is shown in Table-4. Both Kampung Bukit Bunga and Kampung Pasir Akar situated near to animal feed lots. Additionally, both of them are open wells. Raining on the sampling day causes the animal feed lots to be washed out into the well. So, the expectation of high *E.coli* amount was right.

Table 4: Result for Total Count of Bacteria, *E. Coli* and Fungi in the District of Setiu and Besut

| | Bacteria (CFU/mL) | | | | E. Coli (CFU/mL) | | | | Fungi (CFU/mL) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Blank | S1 | S4 | S5 | Blank | S1 | S2 | S3 | Blank | S1 | S2 | S3 |
| Kpg. Guntung Luar | 0 | TNTC | 2 | 1 | 0 | TNTC | 39 | 2 | 0 | 29 | 0 | 0 |
| Kpg. Tembila | 0 | TNTC | 8 | 19 | 0 | 75 | 2 | 1 | 0 | 69 | 1 | 0 |
| Kpg. Bt. Bunga | 0 | TNTC | 0 | 0 | 0 | TNTC | 6 | 0 | 0 | 54 | 0 | 0 |
| Kpg. Pasir Aka | 0 | TNTC | 8 | 4 | 0 | TNTC | 38 | 9 | 0 | 67 | 0 | 0 |

## Conclusions

From the obtained results, it shown that the microbiological expectation of the column water in Kuala Terengganu is positive. This reflects that the column water, which is untreated contains microorganism that might be pathogenic and cause a bad impacts to human health. These results also indicate the poor quality of column water in Kuala

Terengganu area and it is not complementary with the standard of drinking water required by World Health Organization (WHO).

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