ANALYSES OF WATER QUALITY IN WATER SAMPLES FROM NATURAL PONDS IN WARTARYA VILLAGE

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Abstract

Bacteriological analysis was done from May, 2013 to September 2015. A total of 21 water samples were collected from natural ponds from different locations in Wartarya Village, Htan-Ta-Pin Township, Yangon Region. There are seven ponds in Wartarya village. All water samples were found to be contaminated with faecal coliforms and the range of faecal coliforms counts were observed between 4 and 1600 MPN/100ml. The minimum amount of faecal colifons found in the samples was 8 MPN/100ml and the maximum amount was 1600 PMN/100ml in summer. In contrast, the minimum amount of faecal coliforms found in the samples was 4 MPN/100ml and the maximum amount was 50 MPN/100ml in wet season. Some physical parameters of the samples were also recorded. The range of temperature at the sampling sites was from 27˚C to 33˚C, pH from 7.0 to 9.0 and DO from 4 mg/L to 12mg/L. The range of metallic ions such as Fe in the pond waters during summer (May) ranged from 0.22mg/L to 0.26mg/L whereas in the raining season (July) Fe ions varied from 0.27mg/L -0.72mg/L. By contrast, calcium (Ca) varied from 1.20mg/L - 11.46mg/Lin the summer (May) and 0.5mg/L -8.3mg/L during the raining season (July).Lead (Pb) was absent in all pond waters during rainy and summer seasons. All chemical elements present in the water were within the WHO and ICMR permissible limits and thus safe for human consumption. The findings of the current study indicated the presence of acceptable limits of the chemicals, metallic irons concentrations and safety of the waters for drinking and other purposes. However, the studied areas were polluted by faecal coliforms bacteria posing harzard to the populace especially in summer. Hence, the environmental hygiene needs to be improved in Wartarya village. This research highlights that water need to be boiled before drinking or washing.

Keywords: Faecal coliforms , *Escherichia coli* , Physical and chemical parameters and natural ponds

Introduction

Good quality water is essential for all living beings. Besides quality also plays an important role in development of human health. Good quality of water is more essential for the aquatic flora and fauna (Idris and Noor, 2003).

Microorganisms are found everywhere in our environment. They are common in the air, soil and water. There are thousands of species of bacteria on earth (Sadowsky, 2008).

Bacteria are numerous and are a natural component of lakes, rivers and streams. Over 60 genera of bacteria are present in these aquatic systems. Most of these bacteria are harmless to humans. Elevated numbers of these harmless bacteria are associated with increased numbers of harmful bacteria. Consumption of water contaminated with Feces of warm-blooded animals can cause a variety of illnesses (Elizabeth, 2000).

The ever-increasing population has resulted in various types of contamination in most water bodies. The faecal contamination in drinking water sources is a major cause of various water borne infectious diseases, a global problems. The coliform bacteria have been

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internationally used as prime indicator of faecal contamination of water since the beginning of 20^{th} century (Pathak and Gopal, 2005).

Determining the bacterial quality of drinking water is the single most important water quality test. One glass of water containing just a few disease organisms can cause illness. Bacterial contaminants such as *E.coli* and faecal coliform in drinking water represent an acute health risk (Environmental Service, 2010). Total coliforms are a group of bacteria commonly found in the environment. Some coliform bacteria will occur in all ponds, but dangerously high levels may occur in ponds (Anonymous, 2012).

Faecal coliform bacteria are a sub-group of total coliform bacteria. Faecal coliform bacteria are indicators of faecal contamination. Faecal coliform bacteria are found in Feces. The faecal category contains both pathogen (disease causing) and non pathogenic bacteria. An example of one group of faecal coliform bacteria is *Escherichia coli* which was first discovered by Theodor Escherich. *E.coli* is the USEPA (US Environmental Protection Agency) recommended indicator of faecal contamination in fresh water. *E. coli* bacteria originate from the wastes of animals or humans. *E. coli* is the only member of the total coliform group of bacteria. The bacterium *E.coli* is one of the best and most thoroughly studied free-living organisms. Some *E.coli* strains live as harmless commensals in animal intestines. Most *E.coli* actually are important part of a healthy human intestinal tract. Some *E.coli* bacteria are beneficial by producing vitamin K_2 for their host. *E.coli* normally colonizes an infant's gastrointestinal tract within 40 hours of birth. Faecal coliforms and *E.coli* generally do not pose the actual health risk, but the presence of faecal matter, which may carry numerous pathogenic disease causing organisms.

Escherichia coli O_{157}: H_7, may cause illness. Other kinds of *E.coli* are used as markers for water contamination. Faecal coliforms and *E.coli* are used indicators to measure the degree of pollution and sanitary quality of water.

The survival of *Escherichia coli* in natural waters is one of great interest due to the importance of these organisms as indicators of faecal pollution in natural waters (Wcislo and Chrost, 2000).

Escherichia coli in drinking water indicates the water has been contaminated with faecal material that may contain disease causing microorganisms, such as certain bacteria, viruses or parasites. The most common symptoms of waterborne illness include nausea, vomiting and diarrhea. *E. coli* can cause diarrhea, urinary tract infections and other illnesses (Anonymous, 2009).

Faecal coliform density may be conducive to bacterial pathogen regrowth. Faecal coliform analysis remains an effective tool for evaluating potential public health or environmental impact. The presence of any faecal indicators shows that drinking water is potentially unsafe for consumption (Environmental Services, 2003).

Metals are important component of human environment and these may be either beneficial or toxic depending upon their concentration. calcium is naturally present in water. Calcium is a dietary requirement for all organisms apart from some insects and bacteria. Calcium also gives water a better taste. Elementary iron dissolves in water under normal condition. Iron is an essential element in human nutrition. Iron also is an essential trace element in living organisms (WHO, 1996).

A pond used to supply drinking water for humans and animals should be tested for faecal coliforms, *Escherichia coli* and other parameters. Microbiological and Chemical surveillance of drinking water quality is an important of public health management. Thus, the present research was carried out with the aim to assess the pollution of microbial contamination and chemical elements in water of natural ponds in Wartarya Village with the following objectives;

- To investigate occurrence of total faecal coliforms in natural water samples from different study sites
- To isolate and identify *Escherichia coli* as faecal indicator from study area
- To examine their distribution pattern in natural ponds by month
- To analyze some physical parameters of water samples in different sites
- To analyze some metals in parameters of water at different sites.

Materials and Methods

Study area and study site

Water samples were collected in natural ponds from different locations in Wartarya Village, Htan-Ta-Pin Township, Yangon Region. There are seven ponds in the village which are located in different places of the village (Plate 1). Two ponds are in the east, three ponds are in the middle, and two ponds are at the west of the village.

Study period

The study was done from May, 2013 to September, 2015.

Sample collection

A total of twenty-one water samples were collected from natural ponds at different sites in Wartarya Village .Water samples were collected in three successive months at each pond from May to July, 2013. Samples were collected aseptically in sterilized glass bottles with caps from 15 cm (0.5 feet) depth at about 300 cm (10 feet) away from the bank of ponds. Collected samples bottles were transported in an ice box to the Microbiology Laboratory in Department of Zoology, West Yangon University for the laboratory experiments.

Pond 1 (sample collection site 1 in May)

Plate 1: Sampling sites in the study area.

Methods

Determination of faecal coliform bacteria

Faecal coliform bacteria counts were determined by multiple tube method as described by WHO, (1985) and as shown in (Figure 1).

Identification of *Escherichia coli*

Identification of *Escherichia coli* was done as shown in flow chart (Figure 2). The Gram stain was carried out by Bisen and Verma (1998) .

Isolation and identification of *Escherichia coli* and other Gram-negative bacteria

All isolates were gram stained to determine their gram reaction. Physico-chemical tests used to identify the species were as follows: Sugar fermentation test, indole, motility and hydrogen sulphide production (SIM) test, citrate utilization test, urease test, Methyl-Red test, Voges-Proskouer test and catalase test. *Escherichia coli* was identified based on biochemical keys by Bergey's Manual (1975), Cowan and Steel (1975) and Martin (1997).

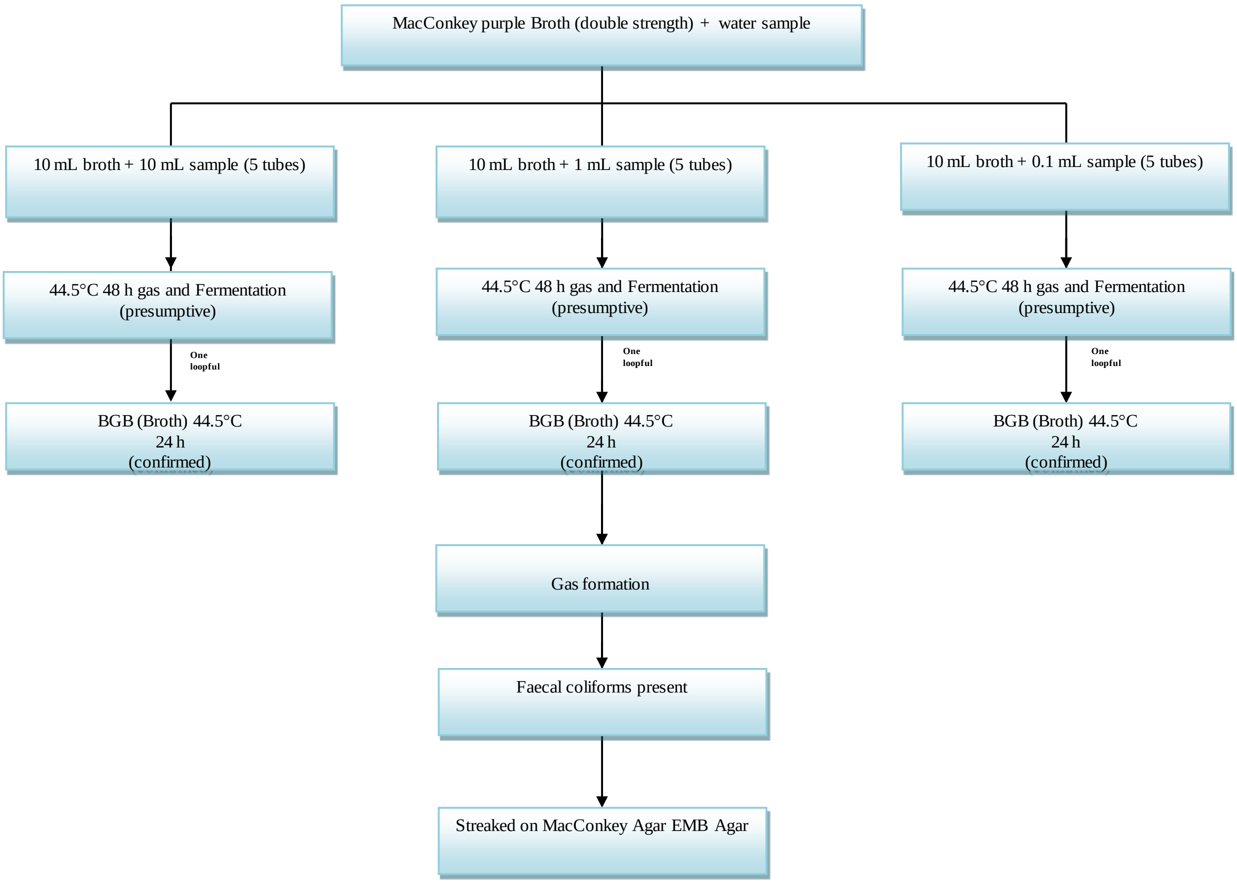


Figure 1 Flow chart for determination of total faecal coliform by multiple tube method (MPN/100 mL) at 44.5°C (WHO, 1985)

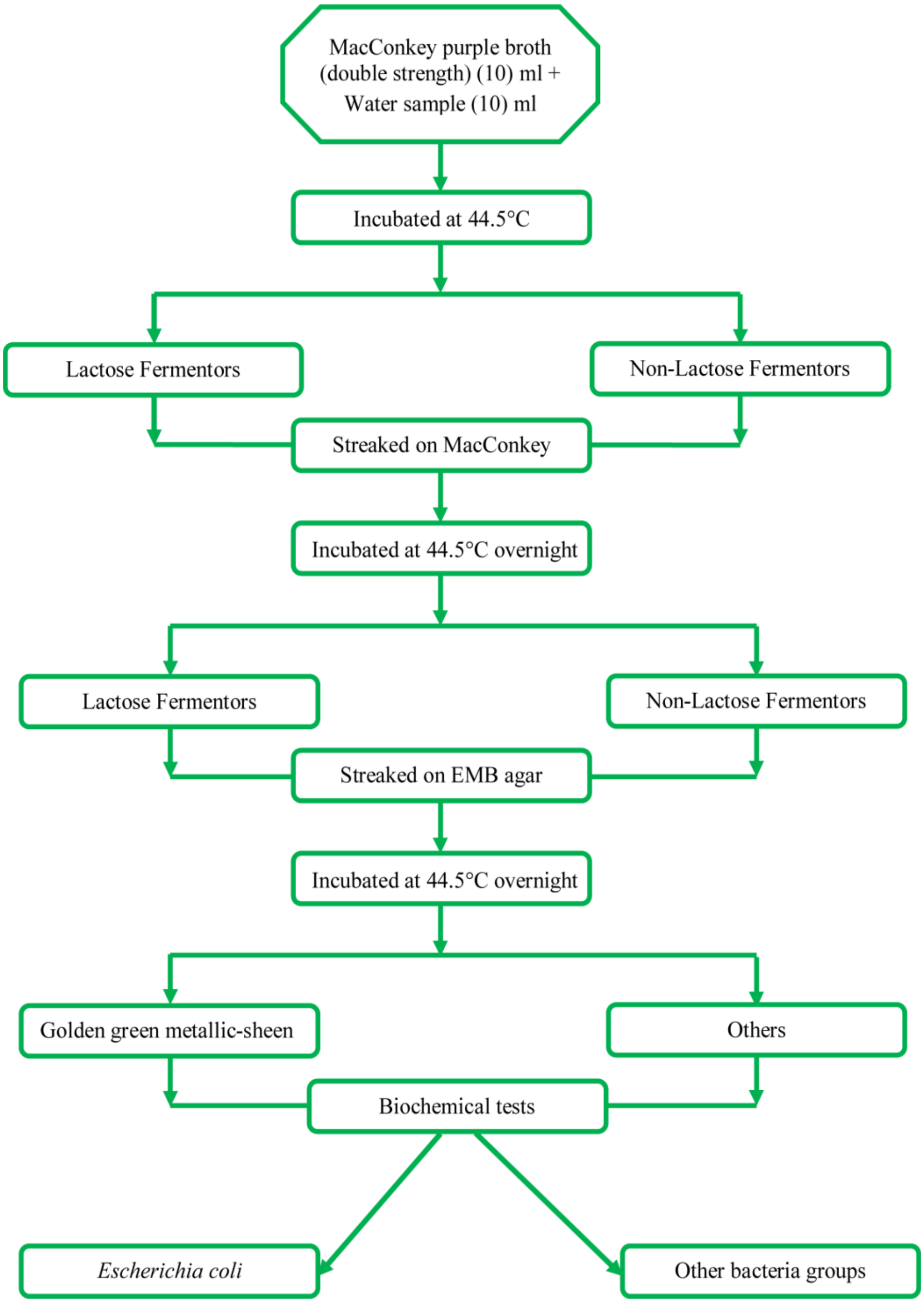


Figure 2 Flow chart for the identification of *Escherichia coli* and other bacterial groups

Measurement of some water physical parameters

Temperature, pH and dissolved oxygen of the water samples were measured as physical parameters as follows:

Temperature

Temperature was measured *in-situ*. A °C thermometer was inserted into the water for 5 minutes. After the 5 minutes, the thermometer was pulled out of the water and the data was recorded.

pH

The values of water pH were measured by pH paper *in situ* .

Dissolved oxygen (DO)

The values of dissolved oxygen were measured by dissolved oxygen kit *in-situ* .

Measurement of some water chemical parameters

Fe, Ca, and Pb of the water samples were measured as chemical parameters. Concentrations of chemical elements were measured by Atomic Absorption Spectrophotometer in Universities' Research Center, University of Yangon.

Results

A total of 21 water samples from different sites of natural ponds in Wartarya Village were tested.

Determination of faecal coliform by multiple tube method

The presence of faecal coliforms in water samples were determined by using double strength MacConkey broth purple. A change in colour from original purple to yellow with the production of gas at 44.5°C for presumptive test (Plate 2).

A loopful of the fermented bacterial culture tube with gas was inoculated into a tube of Brilliant Green Bile Lactose broth and the tubes were then incubated at 44.5°C. The tubes were examined for gas production and the gas tubes were regarded as positive faecal coliform (confirmed test) (Plate 3).

Presumptive faecal coliform (Fc) counts detected in water samples

Presence of faecal coliforms in water samples and their most probable number (MPN) per 100 ml of water samples were determined and the results were shown in Table 2, 3, 4 and 5.

Table 1 shows that 21 samples of natural ponds were found to be contaminated with faecal coliforms 100% and the range of faecal counts were observed between 4 and 1600 MPN/100 ml. Similar range of total faecal coliform count was observed in the samples of ponds 1, 2, 6 and 7. Also they were highest ranged of faecal coliform counts as compare as other different ponds such as pond 3, 4 and 5. The smallest ranged of counts was found in the samples of pond 4.

Table 2 shows that seven samples of natural ponds in May were found to be contaminated with faecal coliforms 100% and the minimum amount of faecal coliforms were found in the samples was 8 MPN/100 ml and the maximum amount was 1600 MPN/100 ml.

Table 3 shows that seven samples of natural ponds in June were found to be contaminated with faecal coliforms 100% and the minimum amount of faecal coliforms were found in the samples was 4 MPN/100 ml and the maximum amount was 30 MPN/100 ml.

Table 4 shows that seven samples of natural ponds in July were found to be contaminated with faecal coliforms 100% and the minimum amount of faecal coliforms were found in the samples was 30 MPN/100 ml and the maximum amount was 50 MPN/100 ml.

Identification of *Escherichia coli*

Escherichia coli isolated were Gram-negative and cells were typically rod-shaped (Plate 4) and about 2.0 µm long and 0.5 µm in width. Each colony of *E.coli* was a circular raised, smooth, dry and rose pink coloured on MacConkey agar (Plate 5). Each colony of *E.coli* was circular, smooth and had golden green metallic-sheen on EMB agar (Plate 6).

Identification of other Gram-negative rods

Each colony of other Gram-negative bacteria (rods) were circular, pale-purple, purple-pink, deep-purple and deep-pink on EMB agar while Gram-negative bacteria were circular, pale-pink and pink on MacConkey agar . All isolated Gram-negative bacteria were short or long rods under the compound light compound at magnification of × 1000 .

Plate 2 Positive reactions of faecal coliform test (presumptive)

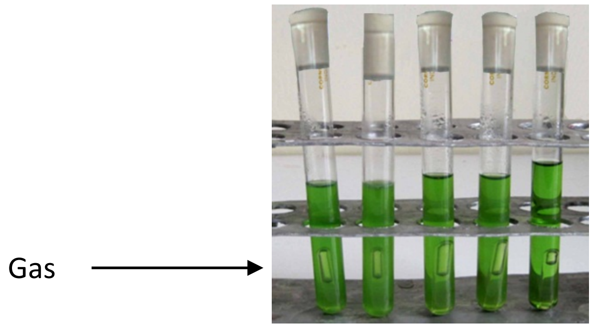


Plate 3 Positive reactions of faecal coliform test (confirmed)

Incidence of *Escherichia coli* and other Gram-negative rods

A total of 21 water samples were collected at different sites from natural ponds. In 11 out of 21 colonies, 52.38% were observed to be contaminated with *Escherichia coli*. Similarly, in 10 out of 21 colonies, 47.62% were observed to be contaminated with other Gram-negative rods bacteria (Table 6). Based on the data there was no significant difference between occurrence of *E.coli* and other Gram-negative rods ($\chi^2 = 0.22$, df = 1, $p > 0.05$).

Table 7 shows that a total of 11 isolate colonies of *Escherichia coli* in samples. The present study shows that the number of *E.coli* colonies obtained in May was 6, in June was 3 and in July was 2. Other Gram-negative colonies observed were 1 isolate number in May, 4 in June and 5 in July (Table 7). Figure 3 shows that colonies of *Escherichia coli* were observed 85.71%, 42.86% and 28.57% in May, June and July respectively. Whereas other Gram-negative rods bacteria were observed 14.29%, 57.14% and 71.43% in May, June and July respectively. There was significantly highest loading of *E.coli* in May ($\chi^2 = 21.496$, df = 2, $p < 0.01$).

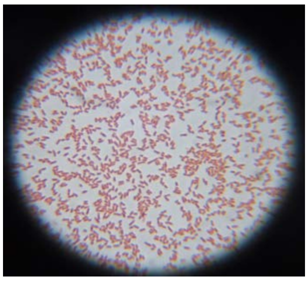


Plate 4 Cell morphology of *Escherichia coli* (× 1000 magnification)

Plate 5 *Escherichia coli* colonies on MacConkey agar

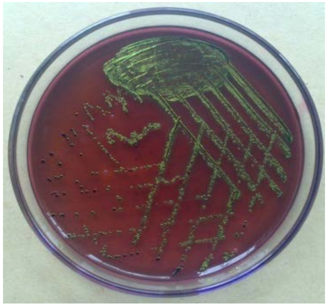
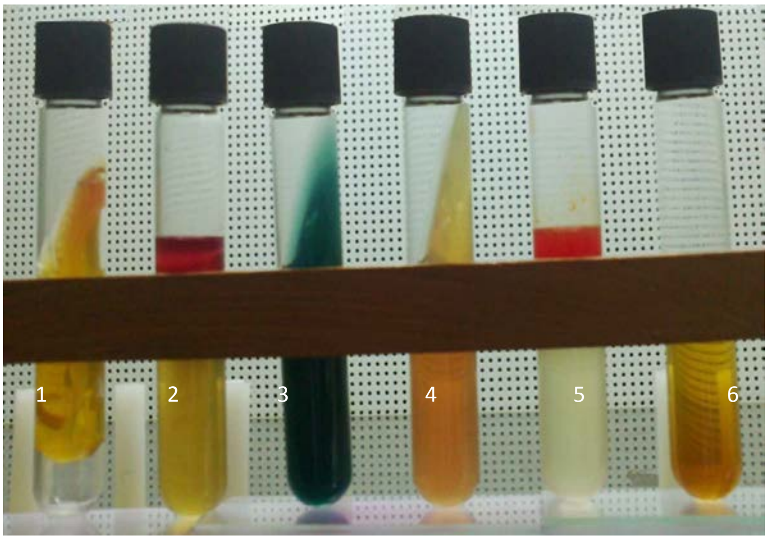


Plate 6 *Escherichia coli* colonies on EMB Agar



Biochemical Test results
1 = Triple Sugar Iron Agar, 2 = Sulphide Indole Motility Agar
3 = Simon's Citrate, 4 = Urease Agar,
5 = Methyl Red, 6 = Voges-Proskauer

Plate7 Biochemical reactions for *Escherichia coli* isolates

Biochemical tests for identification of *E.coli*

A total of 21 colonies were examined for identification by biochemical tests. At the present study showed that 11 colonies of *E.coli* were determined. Confirmation of *Escherichia coli* were done by some biochemical tests Table 5and Plate 7.

Some physical parameters of water samples in natural ponds

The range of temperature observed for the whole study period was from 27°C to 33°C, pH from 7.0 to 9.0 and dissolved oxygen (DO) from 4 mg/l to 12 mg/l Table 8.

The present result observed the mean value of water temperature was 32.57°C, pH was 7.57 and dissolved oxygen (DO) was 6 mg/l in May Table 9.

According to June results, the mean value of water temperature was 28.28°C, pH was 7.92 and dissolved oxygen (DO) was 6 mg/l Table 10.

In July shows that the mean water temperature was 27.71°C, the pH value was 7.43 and dissolved oxygen (DO) was 9.28 mg/l Table 11.

Chemical parameters (Fe , Ca, Pb) of natural pond waters

The present study revealed the presence of Fe and Ca and the absence of Pb in the natural ponds water samples. The mean value of Fe concentration was 0.24 mg/l and Ca was 5.75mg/l in summer. The metals of Pb could not be detected in all ponds (Table 12). Fe concentration ranged from the lowest of 0.22mg/l at pond 4 to the highest of 0.26mg/l at pond 1 in summer. Ca concentration ranged from the lowest of 1.20mg/l at pond 4 to the highest of 20.56 mg/l at pond 2 in summer. The mean value of Fe concentration was 0.84 mg/l and Ca was 20.59mg/l during the month of rainy July. Metals of Pb could not be detected in all ponds during the rainy months too. (Table13). Fe concentration ranged from the lowest 0.27mg/l at pond 6 to the highest of 2.94 mg/l at pond 5 in rainy (July).However, the metals of Fe were surprisingly absent in pond 2 in rainy (July). Ca concentration was the lowest of 0.59mg/l at pond 2 in rainy (July).

Table 1 Presumptive total faecal coliforms counts in some water samples (N=21) from natural ponds for the whole study period

Sr. No	Sites	Number of Water Samples contaminated with faecal coliforms/total number of samples tested	Range of faecal colifom counts (MPN/100 ml)
I	Pond-1	3/3	30 - >1600
II	Pond-2	3/3	30 - >1600
III	Pond-3	3/3	8 - 30
IV	Pond-4	3/3	4 - 30
V	Pond-5	3/3	23 - 50
VI	Pond-6	3/3	30 - > 1600
VII	Pond-7	3/3	30 - > 1600
	Total	21/21 (100%)	4 - > 1600

MPN = Most Probable Number of Cells per 100 ml of water

Table 2 Presumptive total faecal coliforms counts in some water samples (N=7) from natural ponds in May

Sr. No	**Sites**	**Number of Water Samples contaminated with faecal coliforms/total number of samples tested**	**Range of faecal colifom counts (MPN/100 ml)**
I	Pond-1	1/1	>1600 **
II	Pond-2	1/1	>1600 **
III	Pond-3	1/1	8 *
IV	Pond-4	1/1	23
V	Pond-5	1/1	50
VI	Pond-6	1/1	>1600 **
VII	Pond-7	1/1	>1600 **
	Total	7/7 (100%)	

MPN = Most Probable Number of cells per 100 ml of water
** = Maximum count, * = Minimum count

Table 3 Presumptive total faecal coliforms counts in water samples (N=7) from natural ponds in June

Sr. No	Sites	Number of Water Samples contaminated with faecal coliforms/total number of samples tested	Range of faecal colifom counts (MPN/100 ml)
I	Pond-1	1/1	30 **
II	Pond-2	1/1	30 **
III	Pond-3	1/1	8
IV	Pond-4	1/1	4*
V	Pond-5	1/1	23
VI	Pond-6	1/1	30 **
VII	Pond-7	1/1	30 **
	Total	7/7 (100%)	

MPN = Most Probable Number of cells per 100 ml of water
** = Maximum count, * = Minimum count

Table 4 Presumptive total faecal coliforms counts in water samples (N=7) from natural ponds in July

Sr. No	**Sites**	**Number of Water Samples contaminated with faecal coliforms/total number of samples tested**	**Range of faecal colifom counts (MPN/100 ml)**
I	Pond-1	1/1	30 *
II	Pond-2	1/1	30 *
III	Pond-3	1/1	30 *
IV	Pond-4	1/1	30 *
V	Pond-5	1/1	30 *
VI	Pond-6	1/1	50 **
VII	Pond-7	1/1	30 *
	Total	7/7 (100%)	

MPN = Most Probable Number of cells per 100 ml of water
** = Maximum count, * = Minimum count

Table 5 Biochemical characteristics of all isolated *Escherichia coli* from pond water

Bacterial isolates	IMVIC				TSI			SIM			Urcase	Catalase
	Indole	MR	VP	Citrate utilization	H_2S	Slant	Butt	Indole	H_2S	Motility		
Escherichia coli N= 11	+	+	-	-	-	A	AG	+	-	+	-	+

+ = positive
- = negative
A = Acid
G = Gas
H_2S = Hydrogen Sulphite production
MR =Methyl red test
VP =Voges-Proskauer test
SIM =Sulphite, Indole, Motility test
TSI = Triple Sugar iron test

Table 6 Occurrence of *Escherichia coli* and other Gram-negative rods (% of total) in water samples (N = 21) from natural ponds

Bacteria	Number of colonies obtained	Percentage (%)
Escherichia coli	11	52.38
Other Gram-negative rods	10	47.62
Total	**21**	**100**

Table 7 Isolated number of bacteria colonies in natural ponds in different months

Bacteria	Number of colonies			Total colonies
	May	June	July	
Escherichia coli	6	3	2	11
Other Gram-negative bacteria	1	4	5	10
Total	**7**	**7**	**7**	**21**

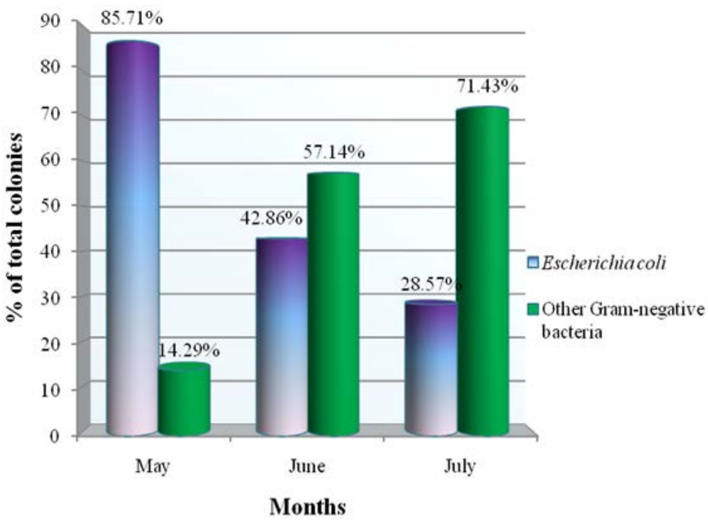


Figure 3 Distribution of *Escherichia coli* colonies and other Gram-negative bacteria colonies (percent of total) in natural ponds at different time in Wartarya Village.

Table 8 Some physical parameters of water samples in natural ponds in different months in Wartarya Village

Sr.no	Sites	Physical parameters			Months
		Temperature (°C)	pH	Dissolved Oxygen (DO) (mg/l)	
I	Pond - 1	32	8.0	6	May
II	Pond - 2	32	8.0	6	
III	Pond - 3	33	7.0	6	
IV	Pond - 4	33	7.5	7	
V	Pond - 5	32	7.0	4	
VI	Pond - 6	33	7.5	7	
VII	Pond - 7	33	8.0	6	
VIII	Pond - 1	28	8.0	6	June
IX	Pond - 2	29	8 0	5	
X	Pond - 3	28	7.0	6	
XI	Pond - 4	29	8.0	7	
XII	Pond - 5	28	8.0	6	
XIII	Pond - 6	28	7.5	4	
XIV	Pond - 7	28	9.0	8	
XV	Pond - 1	28	7.5	12	July
XVI	Pond - 2	28	8.0	8	
XVII	Pond - 3	29	7.0	6	
XVIII	Pond - 4	28	7.0	8	
XIX	Pond - 5	27	7.5	8	
XX	Pond - 6	27	7.5	11	
XXI	Pond - 7	27	7.5	12	
Mean ± SD		29.52 ± 2.29	7.64 ± 0.50	7.08 ± 2.23	

Table 9 Some physical parameters of water samples in relation to the presence of faecal coliforms, *Escherichia coli* and other Gram-negative bacteria among the samples in May

Sr.no	Sites	Physical parameters			Faecal coliform counts (MPN/100ml)	Number of colonies	
		Temperature (°C)	pH	(DO) (mg/l)		*Escherichia coli*	Other Gram-negative bacteria
I	Pond - 1	32	8.0	6	>1600	1	-
II	Pond - 2	32	8.0	6	>1600	1	-
III	Pond - 3	33	7.0	6	8	1	-
IV	Pond - 4	33	7.5	7	23	1	-
V	Pond - 5	32	7.0	4	50	1	-
VI	Pond - 6	33	7.5	7	>1600	-	1
VII	Pond - 7	33	8.0	6	>1600	1	-
Mean		32.57	7.57	6		6	1

(-) = not isolate

Table 10 Some physical parameters of water samples in relation to the presence of faecal coliforms, *Escherichia coli* and other Gram-negative bacteria among the samples in June

Sr. no	Sites	Physical parameters			Faecal coliform counts (MPN/100ml)	Number of colonies	
		Temperature (°C)	pH	(DO) (mg/l)		*Escherichia coli*	Other Gram-negative bacteria
I	Pond - 1	28	8.0	6	30	-	1
II	Pond - 2	29	8 0	5	30	1	-
III	Pond - 3	28	7.0	6	8	-	1
IV	Pond - 4	29	8.0	7	4	-	1
V	Pond - 5	28	8.0	6	23	1	-
VI	Pond - 6	28	7.5	4	30	-	1
VII	Pond - 7	28	9.0	8	30	1	-
Mean		28.28	7.92	6		3	4

(-) = not isolate

Table 11 Some physical parameters of water samples in relation to the presence of faecal coliforms, *Escherichia coli* and other Gram-negative bacteria among the samples in July

Sr. no	Sites	Physical parameters			Faecal coliform counts (MPN/100ml)	Number of colonies	
		Temperature (°C)	pH	(DO) (mg/l)		*Escherichia coli*	Other Gram-negative bacteria
I	Pond - 1	28	7.5	12	30	-	1
II	Pond - 2	28	8.0	8	30	1	-
III	Pond - 3	29	7.0	6	30	1	-
Iv	Pond - 4	28	7.0	8	30	-	1
V	Pond - 5	27	7.5	8	30	-	1
VI	Pond - 6	27	7.5	11	50	-	1
VII	Pond - 7	27	7.5	12	30	-	1
Mean		27.71	7.4	9.28		2	5

(-) = not isolate

Table 12 Average values of chemicals (mg/L) in water samples from study sites in Summer (May)

Chemicals (mg/l)	Sites							
	Pond 1	Pond 2	Pond 3	Pond 4	Pond 5	Pond 6	Pond 7	Mean
Fe	0.24	0.24	0.25	0.22	0.26	0.25	0.23	0.24
Ca	11.46	20.56	1.20	1.37	1.15	2.87	1.69	5.75
Pb	-	-	-	-	-	-	-	-

Absent = -

Table 13 Average values of chemicals (mg/L) in water samples from study sites in Rainy (July)

Chemicals (mg/l)	Sites							
	Pond 1	Pond 2	Pond 3	Pond 4	Pond 5	Pond 6	Pond 7	Mean
Fe	0.72	-	0.38	0.36	2.94	0.27	1.25	0.84
Ca	3.90	8.3	1.92	1.64	0.59	2.12	2.12	2.94
Pb	-	-	-	-	-	-	-	-

Absent = -

Discussion

In the present study, the water samples from seven natural ponds of Wartarya Village, Yangon Region were analyzed on faecal coliform, *Escherichia coli* and other Gram-negative bacteria, also physical parameters.

The result indicated that all natural ponds from the study area were found to be contaminated with faecal coliforms.

It may be assumed that faecal coliform bacteria are ubiquitous at different sites of natural ponds environs. In the present study area, all ponds except pond 1 were located near human dwellings. Pond 1 is located near the paddy field and cowshed. So, human sewages could enter the pond and contaminated the natural water bodies. Ahmed (2003) stated that faecal coliform bacteria can enter ponds through direct discharge of waste from mammals and birds. Birds can be a significant source of faecal coliform bacteria.

Especially the result observed that the concentration of faecal coliform counts were higher in summer (May). Similarly, number of *Escherichia coli* bacteria was higher in summer (May). It could be due to the level of waters were shallow in ponds during the summer when most of the ponds except pond 3 were added the waters from the Hlaing River and the tube wells. Therefore, the waters from that of ponds may contain higher contamination of faecal coliforms bacteria and *E.coli*.

Due to Steven and David (2007) stated that *E.coli* level appeared to have higher levels in river during May. Therefore, the present results agree with the previous report (Ahmed 2003) stated that faecal coliforms were higher during summer than during winter in ponds. The abundance of normal bacteria coliforms are greater in the warm months than in the cold months of pond water. However, faecal coliform bacteria were observed in low concentration in pond 3 (site 3) in summer (May). It could be due to presence of herb lotus (Kyar) in that pond and not directly added of water from the river and other tube wells.

Because, Gray (2007) stated that lotus could be used as bacterial reductions. In the present result were reduced faecal coliforms and *E.coli* loading in all ponds in June and July. The reason for this might have been due to decrease of water temperature during the wet or rainy season. Ahmed (2003) stated that bacterial load might be increased with an increase in temperature in the pond water.

During study period, the average of water temperature was 29°C ± 2.29. The average of pH and dissolved oxygen (DO) values were 7.64 ± 0.50 and 7.09 mg/L ± 2.23. FEPA (1991) stated that the maximum limit of water temperature was 35°C for all aquatic organisms. And EPA (1997) mentioned that natural normal water has pH between 6.5 and 8.5; DO level is between 4 mg/L to 6 mg/L. Therefore, the condition of water temperature and pH were suitable for the survival and propagation of bacteria and aquatic organisms in the study area. Nevertheless, the report of Pond Management Publication (1855) recommended that most pond waters can hold about 10 to 12 mg/L of oxygen. By comparing with the present record observed that the average of DO value was 7.09 mg/L ± 2.23. DO were low in most of the ponds. It could be due to ponds having no out flow, and land locked system. Therefore, the decaying of organic matters dumped in the ponds that will lead to the reduction of DO in the water bodies.

All the data have shown that the bacteria and aquatic organisms could thrive at these physical parameters conditions in the study sites.

The Saskatchewan Drinking Water Quality Standard (2008) stated that the maximum acceptable concentration for coliform in drinking water is zero organisms detectable per 100 ml. But in the present study area, all ponds were loading with *E.coli* 52.38%.

In the present study area, the metals of Fe were observed in all natural ponds in summer. Moreover Fe was higher in summer than in the rainy season and all these indicate that the possible sources of Fe could have been from the aquatic plants and algae as they could have died, fragment and released Fe into the pond waters in the summer or possibly tube well waters were supplemented into ponds for irrigation purposes during summer. Our studies have demonstrated that all pond waters except the pond number 2 showed substantial amounts of the metal Fe. Moreover the pond 2 appeared to be unique as there were no Fe in this pond water and it was located far away from the muddy clay rice fields. Thus our studies conclusively demonstrate that the metal Fe is carried into the pond 2 water during rainy seasons through the running of the rainy muddy clay waters into some ponds while in others Fe is lacking as the rain water is clean and uncontaminated with muddy clay soil.

In the present study, the concentration of Fe was shown to be far less between 0.22mg/L and 0.26mg/L in summer and between 0.27mg/L and 2.94 mg/L in rainy and in these respects, all natural pond waters were shown to contain far less Fe than other reports and thus the natural pond waters were found to be different, less harder and useful for consumption. However Patel and Romani (2003) stated that the values of Fe concentration in well waters was as high as 5.05mg/L. Moreover the values of Fe recorded in the current study were not higher than acceptable limit of 0.3mg/l(WHO,1988) in summer but not in rainy. The values of Fe were not higher than acceptable limit of 1.0mg/L(ICMR, 1983) except pond 5. It was noted that Fe values were higher in rainy than in summer. It was possible that fertilizers employed in the rice field were brought by rain water into the ponds. However Patel and Romani (2003) confirmed that the values of Fe concentration in fertilizer was 10.51mg/L.

The present study revealed the occurrence of the metals of Ca in all pond waters in summer as well as in the rainy seasons indicating natural occurrence of calcium all the ponds thorough out the year. We report a higher Ca values were in summer than in rainy in some ponds and perhaps evaporation and low level of water in ponds during summer may account for the consequent increase in the concentration of the metals of calcium in all pond waters. Another reason could be due to the level of waters were shallow in ponds during summer. So, most ponds were added water from tube wells and Hlaing river. Moreover our studies have shown that the concentration of Ca was found to be between 1.20 mg/L and 20.56mg/L in summer (May). Similarly, the concentration of Ca is between 0.59m/L and 8.30mg/L in rainy (July) and the values of Ca were thus not higher than acceptable limit of 200mg/L (WHO, 1988). A similar observation was reported by Reginaa and Nabi (2009) who stated that the values of Ca concentration in river water were 42mg/L in May and 36mg/l in July. Patel and Romani (2003) stated the values of Ca concentration in well were 3.0mg/l.

Furthermore our studies have shown the contamination of infectious agents and fecal coliform bacteria in the waters of all natural ponds indicating the possible risks for consumption of the contaminated waters which needs water treatment to make safe drinking waters for human consumption. Moreover our studies have shown that the concentrations of ions / metals present in the water of all ponds were within the acceptable limits and therefore the waters from the natural ponds are safe for human consumption and also useful for other agricultural and domestic purposes.

Nevertheless, the water from all ponds are unsafe to drink due to the people might be develop infections from swallowing contaminated pond water.

Conclusion

The findings of the present work indicated that faceal coliforms and *Escherichia coli* were commonly observed in the water bodies of natural ponds at Wartarya Village both in dry and wet season. In the present study, faecal coliform are dominant in samples. The result proved that faecal coliform are ubiquitous at the Wartarya environs. *E.coli* was found to occur at 52.38% of present investigation. Thus, the water is unsafe to drink.

In particular, the water is required to make a rolling boil for three minutes to kill the bacteria and other organisms. Faecal coliforms and *E.coli* can usually be inhibited in growth or killed by boiling water or by treating with chlorine or washing thoroughly with soap after using with water. But the water does not usually need to be boiled for other household purposes like washing.

In water, faecal coliform bacteria have no taste, smell or colour. They can only be detected through a laboratory test. Hence, the detection of faecal coliform and *E.coli* should be tested per year for faecal pollution and microbiological monitoring of the pond water. However, no pond water related illness had recently been reported in the studied village due to bacteria may be nonpathogenic. So, there is no negative impact on public health in Wartarya Village. Local people could be taking necessary precautions in utilizing the pond waters in Wartarya Village.

These physical parameters indicated that the bacteria and aquatic organisms could thrive well in natural ponds of Wartarya Village. This means natural control of pathogenic bacteria could be occurring in the pond waters through food chains and food webs.

DO were low in most of the ponds, thus dissolved oxygen levels below about 6 mg/l may begin to have detrimental effects on pond life. Hence, the removing of decaying of organic matters should be done annually for all ponds.

The study has demonstrated the occurrences of acceptable levels of Fe and Ca chemical elements in most ponds waters through the year and indicated the usefulness of the water for human consumption, domestic purposes and the waters are safe for the life of aquatic organisms.

The results obtained could be useful to conserve natural ponds and to control occurrence of faecal coliforms bacteria in the ponds and to improve public health in Wartarya Village.

The study further recommends an annual sampling testing and analysis of pond water samples at Wartarya village that for faecal, physical and chemical contaminations.

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