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The Coliform Bacteria in the Wastewater Ponds of Doha City, Qatar

Roda F. Al-Thani
Department of Biological Sciences, Faculty of Science,
University of Qatar, P.O.BOX 2713, Doha, Qatar

بكتيريا القولون في برك مياه الصرف فى مدينة الدوحة

روضة فهد آل ثاني
قسم العلوم البيولوجية، كلية العلوم ، جامعة قطر، ص.ب. ٢٧١٣، الدوحة، قطر

الدراسات الميكروبيولوجية لمياه الصرف الصحي والرواسب في بركة أبو هامور (مياه صرف صحي غير معالجة) وفي بركة أبو نخلة (مياه صرف صحي معالجة) وهما بركتان خارج الدوحة. بينت أن بكتيريا القولون تتواجد في الأولى أكثر منها في الثانية وهي بكتيريا من نوع الايشريشية القولونية وتتواجد في أطراف البركتين من جميع الجهات خاصة في المناطق التي تصب فيها المياه. وكذلك تتواجد البكتيريا التالية في أطراف بركة أبو هامور وليس في بركة أبو نخلة:

Escherichia coli, Salmonella spp., Oritus spp.,
Chromobacterium violaceum, Klebsiella pneumonis, Aeromona
Hydrophilia, Pseudomonas aeruginosa.

كما تتواجد أنواع البكتيريا التالية:

Streptomyces, Bacillus and Macrococcus sp.

في الرواسب في كل من بركة أبو نخلة وبركة أبو هامور.

Key words: *Coliform bacteria, Escherishia coli, Gam staining, Serial Dilution Technique (SDT), Wastewater.*

ABSTRACT

The microbiological study of the wastewater and its sediment around Abu-Hamour pond (untreated wastewater pond) and Abu-Nakhla pond (treated wastewater pond), located on the outskirts of Doha City, revealed that coliform bacteria were prominently present in the former than in the latter one. *E.coli.* was

present in the coastal wastewater in all sites around both ponds. Yet, *E. coli.* was present in wet soils around theses ponds primarily near the discharge sites where new water is constantly poured in. Also the following bacteria were prominently present in the coastal waters of Abu-Hamour pond than in Abu-Nakhla pond: *Escherishia coli*, *Salmonella* spp., *Oritus* spp., *Chromobacterium violaceum*, *Klebsiella pneumonis*, *Aeromona hydrophilia*, *Pseudomonas aeruginosa.* Moreover, *Streptomyces*, *Bacillus* and *Macrococcus sp.* were more prominent in the sediment around Abu-Hamour pond than Abu-Nakhla pond.

Introduction

The wastewater cycling and re-use represent a major alternative to the freshwater supply particularly in countries where water scarcity is a limiting factor to human activities which needs more water for agricultural, industrial as well as other uses [1-3]. The threat imposed to human health by contamination of water supplies with sewage is a prime concern of every one worldwide [4]. The enteric diseases such as cholera, typhoid fever and bacillary dysentery could reach an epidemic status when water supplies are not properly protected or treated. Wastewater is a liquid effluent derived from domestic sewage or industrial sources, which for reasons of public health and for recreational, economic, and aesthetic considerations, can not be disposed and merely by discarding them untreated into seas, lakes or streams [5]. The occurrence of fecal indicator bacterial isolates in drinking water, in contact with wastewater, is a world wide problem which has recently received considerable attention [6-10].

The total and fecal coliforms (TC and FC) are commonly used as indicators of fecal contamination of waters [11] due to the fact that they are predominant in faces of human and warm-blooded animals and can be easily isolated and characterized as high counts indicates heavy pollution, whilst the low counts represent moderate pollution [12-13]. Full examination of water quality embodies four lines of investigation; these are topographical, chemical, biological and bacteriological, each is essential and yields information not otherwise obtainable. Nevertheless, bacteriological examination is the most sensitive means of detecting fecal contaminants and therefore, indicates any dangerous pollution, which may pose a high risk to public health [14].

Qatar is an arid country, which has few water resources and its growing population needs more water for domestic, agricultural as well as industrial uses. Most of the water supplied to the public through the water network and distributed bottles. As yet, there is no definitive evidence available on the wastewater re-use and or cycling in Qatar. Therefore, the aim of the present work is to evaluate the microbiological quality of wastewaters with and whitout treatment in Qatar.The comparison of results with the Qatari and International Standards for water quality is another aim of the study.

Materials and Methods

Sampling Program

On the absence of the drainage system in Qatar, as yet, half of the wastewater is being treated primarily and then dumped in Abu-Nakhla pond, whilst the other half is being dumped in Abu-Hamour pond without any treatment. Both ponds are located south west of Doha city.and the locations of ten sampling sites around the pools (five sites for each) are shown in Figure 1. Water samples were collected every month during the period of October 2000- September 2001. The water samples were collected in sterile plastic bottles from the shallow waters (10-15 cm deep) around the edges of the ponds. Soils were collected from the muddy soil around the edge of the ponds. Samples were kept in ice-box on return to the laboratory.

Bacteriological Assay

Total coliform were determined using the serial dilution Technique (SDT) by plating the sub-samples on either EMB or EA media. For further purification and and identification of the bacterial isolates, Lactose fermentation test (Durham tube), IMVIC test and gram staining were also used. For further diagnosis of the pathogenic bacteria, samples were analyzed by Vitek instrument made by Biomerieux in the microbiology laboratory at Hamad Hospital, Doha City.

Results and Discussion

Total Coliform

The results of total coliform of the wastewater's from all sites are given in Table1 and 2. It has become clear that total coliform in the untreated wastewater (Abu-Hamour) is highly polluted all around the year and thus the temporal and spatial distribution of the total coliform is sporadic and represent a direct threat to the general health of human and the wildlife in Qatar. In contrast, however, total coliform in the treated wastewater (Abu-Nakhla) is very much similar to that of Abu-Hamour and apparently there is no difference between the treated and the untreated wastewater. Moreover, coliform bacteria were even most common in KN site (a site near-by the discharge pipeline coming directly from the water treatment plants, which makes treatment ineffective. The data obtained in this work is comparable to those reported for other parts of the world [1, 13, 15 – 17].

Characterization of Bacterial Isolates

The most predominant isolates were found to be: *E. coli*, *Salmonella* spp., *Oritus* spp., *C. violaceum*, *K. pneumonis*, *A. hydrophilia*, *P. aeruginosa*. The less frequently prevailed bacteria were the

gram positive ones commonly found in sediment around the wastewater ponds; such as: *Streptomyces*, *Bacillus* and *Macrococcus*. The detection of both *P. aerogenosa* and *E.coli* in the vast majority of the sites studied is comparable to that reported from different waters associated with fecal pollution around the world [13, 16, 18].

The degree of hazardous effect of these ponds upon people and wildlife is not known yet. However, treated wastewater is presently used in Qatar to water green area and gardens, in addition to growing fodder plants (alfalfa) [3]. Moreover, Abu-Nakhla pond, which receives treated wastewater is also rich in fishes and birds and frogs , a status which, perhaps, may well provacate the threat to the health risk by increasing possibilities of diseases cycling and transmission to and from the human. Cattle like camel, sheep and goats were seen occasionally around the ponds and intermittently drinking from these ponds. A monitoring system for these ponds is thus recommended and that highly-polluted pond of Abu-Hamour should be entirely avoided and find its way to treatments in order to save people and wildlife from the hazardous effects of pathogens.

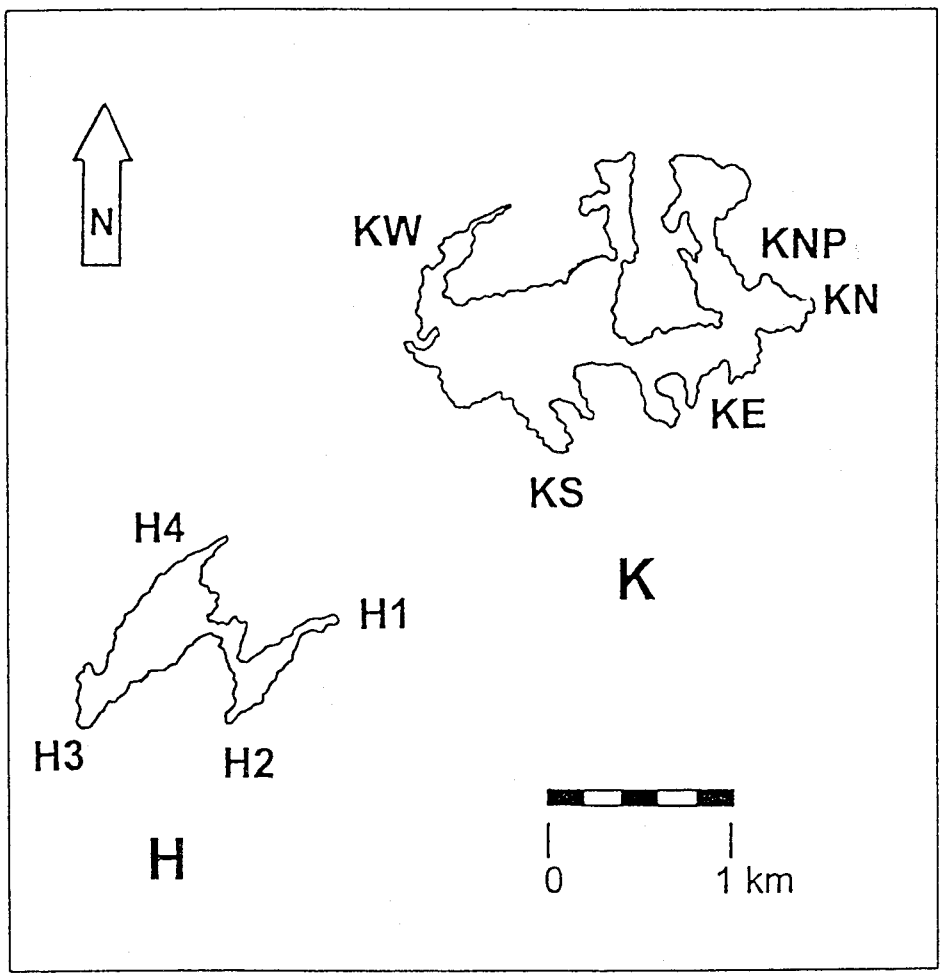

Figure 1. Maps of Abu-Hamour (H) and Abu-Nakhla (K) wastewater ponds showing sampling points. KNP, KN, KE, Ks and KW respectively represent the northeastern wastewater discharge pipeline, northeastern, eastern, southern and western shores. H1, H2, H3 and H4 respectively represent the northeastern wastewater discharge shore, southeast, southwest and northwest shores.

Table 1. Coliform bacteria found in water samples collected from Abu-Hamour (H) and Abu-Nakhla (K) wastewater ponds. + present, - absent.

Months	Abu-Hamour Pond				Abu-Nakhla Pond				
	H1	H2	H3	H4	KNP	KN	KE	KS	KW
October 2000	+	+	+	+	+	++	++	++	+
November 2000	+	+	++	+	+	+	+	++	+
December 2000	+	+	+	+	+	+	+	+	+
January 2001	++	+	+	+	+	+	+	+	+
February 2001	++	+	_	+	+	+	_	+	+
March 2001	+	+	+	+	+	+	+	+	+
April 2001	+	++	+	+	+	+	+	+	+
May 2001	++	+	+	+	+	+	+	+	+
June 2001	+	+	+	+	+	+	+	+	+
July 2001	++	_	+	++	+	+	+	+	+
August 2001	++	+	+	+	++	+	+	+	++
September 2001	+	+	+	++	_	+	_	+	+

Table 2. Coliform bacteria found in soil samples collected from the edges of Abu-Hamour (H) and Abu-Nakhla (K) wastewater ponds. + present, - absent.

Months	Abu-Hamour Pond				Abu-Nakhla Pond				
	H1	H2	H3	H4	KNP	KN	KE	KS	KW
October 2000	+	–	–	–	–	+	–	–	–
November 2000	–	–	–	–	–	–	–	–	–
December 2000	+	–	–	–	–	+	–	–	–
January 2001	++	–	–	–	–	+	+	–	–
February 2001	+	–	–	–	–	+	–	–	–
March 2001	+	–	–	–	–	+	–	–	–
April 2001	–	–	–	–	–	+	–	–	–
May 2001	–	–	–	–	–	+	–	+	–
June 2001	+	–	–	–	–	+	–	–	+
July 2001	–	–	–	–	–	+	+	–	–
August 2001	–	–	–	–	–	–	+	–	+
September 2001	++	–	–	–	–	+	–	+	+

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