

Influence of water and sewage treatment processes on decreasing water-related diseases in marsh community of Iraq *

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Abstract

Water contaminated by sewage or human excrement presents the greatest danger to public health associated with drinking water, and pathogens present in water are usually greatly outnumbered by normal intestinal bacteria, which are easier to isolate and identify.

The coliform group merits consideration as an indicator of water pollution because these bacteria are always present in the intestinal tracts of humans and other warm-blooded animals and are excreted in large numbers in faecal wastes, so in case of discharging sewage disposals under untreated conditions, coliform group appears as a focus of water contamination.

The present study aimed to confirm the influence of rehabilitation water and sanitation facilities on decreasing human diseases related with water in marsh area.

Samples of drinking water were collected during 2003 and 2004 from containers in villagers of rural area in Al-Kahla`a district, whereas waste water and sewage disposals samples were drained from effluents of sewage treatment plant in Al-Mudatharah locality in Al-Kahla`a district during 2003, 2004 and 2005.

Data of morbidity were collected by mobile clinic composed of 1 physician and 2 assist. Of IMC(International Medical Corps).

Multiple tubes fermentation method was used in present paper, included Measurement of Total plate count, Most probable number of coliform and Most Probable Number of *E.coli*, summarize by Transfer 1 ml of positive tubes from presumptive test of coliform of single strength MacConkey broth by loop full and incubation under 44 C °, the temperature needed to growth of *E.coli*, results record when acid and gas liberate in Durham tube with change of colour to yellow and compare results with Probability table.

Spectrophotometer method was based on a measurement of the amount of light absorbed by a sample at a specific wavelength of light. The amount of light absorbed is directly proportional to the concentration of the absorbing chemical species and therefore can be used to measure concentrations.

Results of our present study shows that diarrheal cases among marsh community children have been decreased from 139 to 49 case after construction new water facility and MPN of *E.coli* decreased from 5.1 colonies per 100ml. water to zero colonies as a result of chlorination. Waste water test which discharged to the river referred to decrease of *E.coli* numbers from >10 colonies per 100 ml. to < 10 colonies per 100ml which led to decrease diarrheal cases from 688 to 250.

Conclusions of present study confirmed that untreated sewage influents consider the main key factor for possibility of spreading *E.Coli* in untreated drinking water which contribute in increasing of morbidity cases among children under years of age.

Key words - Diarrhea, water quality, rehabilitation, sewage treatment plant.

- Full text has been presented in the 1st conference for health and environment of Stony Brook University (unpublished).

Introduction

Marsh Arabs are a population lives in southern areas of Iraq ,they face shortages and lack of safe drinking water, with low sanitation facilities .Due to discharging waste water and sewage disposals directly into the rivers without any treatment processes , marsh residents suffer from decline of community health .

During the next 25 years, the world population is expected to reach eight billions, more than half of them will face water shortages in urban and rural areas.[1],in other side total number of people not served with proper sanitation reached about 40% [2].

Contamination of drinking water by microbial and chemical compounds has the potential of affect health of millions of people in the world tend to severe morbidity and mortality in vulnerable populations most at risk for water-related diseases [3]. Approximately 6000 children die every day from diarrhoeal diseases related to inadequate sanitation and hygiene[4,5]. In 2000 , the town water supply in Ontario was contaminated with *E. coli* 0157:H7 resulting in 2,300 symptomatic residents and seven death attributed to the waterborne diseases outbreak [6].

E. coli is one of the important pathogens which originates from sewage disposals and result in diarrhoeal cases specially among children under five years of age, *Escherichia* and, to a lesser extent, *Klebsiella* and *Enterobacter*, organism most commonly thought of as an indicator of faecal pollution [7].most of the mentioned pathogens originates from waste water and sewage disposals , sewage discharge from centralized, water-borne collection systems are a major components of water pollution all over the world , although the sanitary significance of some coliform strains is questionable, all members of the group may be of faecal origin, and it should be assumed that they are of faecal origin unless it can be proven [8].

The faecal coliform group includes that portion of the total coliform group that is capable of forming gas within 24 hours and this group comprises the genera and because it is relatively specific for faecal contamination, the faecal coliform measurement is preferred for monitoring raw water quality and for indicating the potential presence of pathogens at source [9].

Evaluation of the reliability of indicators is carried by comparison of their incidence and survival in water and treatment processes with that of selected pathogens ,by epidemiological studies on the consumers of water supplies ,by calculation based on the minimal infections dose of pathogens ,and by experiments with human volunteers [10]. water is not a natural medium for coliform organisms, and their presence must at least be regarded as indicative of pollution in its widest sense.

The key to control deterioration of health case of marsh Arabs in southern area of Iraq is realized by establishing new water facilities and developing sanitation systems in addition to establish primary health centres in the deep areas of marsh with moving of mobile clinic teams and promote hygiene campaigns. present study aimed to confirm the relation ship between decline of health rate in the settlements locates down stream of sewage treatment plant with consumption untreated raw water by marsh community in targeted area.

Materials and Methods:-

Sample collection:- Samples of drinking water were collected during 2003 and 2004 from containers of villagers in rural area of Al-Kahla`a district , whereas waste water and sewage disposals samples were drained from effluents of sewage treatment plant in Al-Mudatharah locality in Al-Kahla`a district during 2003,2004 and 2005 .

Data of morbidity :- Data of morbidity were collected by mobile clinic team composed of 1 physician and 2 assist. of IMC(International Medical Corps) , the team has been moved during 2003 and 2004 by weekly field visits to families in the targeted area under the

recommendation of the author of present study (Project officer in water and sanitation Dept of IMC) .

Chemical method for analysis of water and waste water:-

pH - Semi-quantifies H₂O pH using the pH meter.

This method determines the pH of water. It is most applicable to waters with a pH ranging from 4.0 to 9.0. It does not provide information on the disassociated H⁺-ions affecting the sensing electrode.

Turbidity- Measurement of the turbidity using a nephelometer.

Turbidity in water is caused by suspended and colloidal matter and is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted. This method uses a nephelometer to measure turbidity. A nephelometer is a turbidimeter with a scattered-light detector at a 90° angle to the incident beam.

Electric conductivity – EC - Semi-quantifies the amount of soluble salts in H₂O using the conductivity meter. This method semi-quantifies the amounts of soluble salts in the water by measurement of the electrical conductivity (EC) of the water sample. The higher the concentration of salt in a solution, the higher will be the electrical conductance (the reciprocal of resistance). Electrical conductivity is a function of quantity and specific types of cations and anions in the water.

Residual chlorine - Amount of residual chlorine was determined by Delagua test kit (From Oxfam production) .

Spectrophotometer method[11] was based on a measurement of the amount of light absorbed by a sample at a specific wavelength of light .the amount of light absorbed is directly proportional to the concentration of the absorbing chemical species and therefore can be used to measure concentrations.

Nitrate – Quantity of Nitrate measured by diffusion-conductivity method based on the gaseous diffusing of ammonia (NH₃) across a gas permeable membrane in the presence of excess base (KOH) and subsequent conductivity detection. Samples can be stored for up to three weeks at low temperature (<4°C).

Sulphate - Amount of sulphate sulphur present in H₂O by ICP-AES. This method quantitatively measures the concentration of sulphur in the water sample. The result is based on the determination of sulphur using an Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-AES) and assumes that all sulphur present is in the sulphate form.

Phosphate-Quantitative determination by ascorbic acid reduction of phosphomolybdate complex and quantitative measurement by flow injection analysis. This method quantitatively determines the amount of soluble phosphorus (P) in water. Phosphorus concentration in water is determined spectrophotometrically by reacting with ammonium molybdate and antimony potassium titrate under acidic conditions to form a complex. This complex is reduced with ascorbic acid to form a blue complex which absorbs light at 880 nm.

Total Dissolved Solids(TDS)and Total Suspended Solids(TSS) –

Quantitation of solids by oven drying and gravimetric analysis. This method quantifies solids in water or wastewater samples using gravimetric analysis following oven drying. Solids refer to matter suspended or dissolved in the water or wastewater and may affect water or effluent quality in adverse ways.

2- Bacteriological examination of water :-

Multiple tubes fermentation method was used in present paper, included Measurement of Total plate count ,Most probable number of coliform and Most Probable Number of *E.coli* , summarize by Transfer 1 ml of positive tubes from presumptive test of coliform of single strength MacConkey broth by loop full and incubation under 44 C ° , the temperature needed

to growth of *E.coli* , results record when acid and gas liberate in Durham tube with change of colour to yellow and compare results with Probability table .

Results

As shown in table 1 ,chemical and biological parameters exceeded international standard specifications . Table 2 shows high morbidity cases specially water borne diseases among marsh community in one representative areas of marsh land (Abo-Khasaf village).Whereas table 3 shows the results of water test taken from water facilities in targeted marsh areas after new construction of water compact units, water seems to be with acceptable quality due to chlorination technique of new water project which increase residual chlorine from zero to 0.5. . Table 4 illustrated health case of water borne diseases in Abo-Khasaf village after providing the villagers with safe drinking water and appeared low rate of diarrhoeal cases from 139 to 49 during 3 months. Table 5 shows a high pollution of waste water which discharged to the river, whereas chemical and biological parameters changed via improvement of water quality due to rehabilitation of sewage treatment plant .Table 6 shows morbidity cases rates in marshy area which appears with high rate of watery diarrhoea cases(688) before rehabilitation sewage facility .Table 7 reflex a good quality of discharged waste water from sewage treatment plant after rehabilitation process and Table 8 shows decreasing of morbidity cases among marsh children from 688 to 250 cases.

Table (1)

Chemical and bacteriological test of river water in marsh areas of Iraq during October 2003.

Localities	Ph	Turbidity	MPN of <i>E.coli</i>	TDS	Residual chlorine
Al-Refae village	7.8	30	5.1	780	0
Abo-Khasaf village	7.7	40	5.1	800	0
Al-Diben village	7.8	25	5.1	800	0
Aum Sa`ah village	7.7	40	5.1	790	0
Al-Mutbig village	7.7	40	5.1	800-	0

Table (2)

Water borne diseases among children under five years of age in Abo-Khasaf village during 3 months of 2003 using untreated raw water.

Total population = 2000 residents.

Number of children = 440

Month	Diarrhoea	Watery diarrhoea	Bloody diarrhoea
Oct.2003	50	45	5
Nov.	45	42	3
Dec.	44	40	4
Total	139	127	12

Table (3)

Chemical and bacteriological test of water taken from a new constructed compact unit in marsh areas of Iraq during October 2004.

Location	Ph	Turbidity	MPN of <i>E.coli</i>	TDS	Residual chlorine
Al-Refae village	7.7	< 5	0	780	0.5
Abo-Khasaf village	7.7	<5	0	800	0.5
Al-Diben village	7.8	5	0	800	0.5
Aum Sa`ah village	7.7	<5	0	790	0.5
Al-Mutbig village	7.7	5	0	800-	0.5

Table (4)

Water borne diseases among children under five years of age in Abo-Khasaf village during 3 months of 2004 using treated safe drinking water .

Total population = 2010 residents.

Number of children = 450

Month	Diarrhea	Watery diarrhea	Bloody diarrhea
Oct.2003	20	18	2
Nov.	15	13	2
Dec.	14	13	1
Total	49	44	5

Table (5)

Test of effluent water (waste water drewed to the river) of Amara Sewage treatment plant before rehabilitation .

NO.	Specification	International Standard limits	Present status
1-	PH	6 -9.5	8.5
2-	TDS(total dissolved solids)	< 1500 ppm	3000
3-	T.S.S(total suspended solids)	<60 ppm	120
4-	BOD (biological oxygen demands)	<40 ppm	80
5-	COD (chemical oxygen demands)	100 PPM	130
6-	So4(sulfate ions)	400 PPM	800
7-	CL (chloride ion)	600ppm	600
8-	PO4 (phosphate ions)	3 ppm	10
9-	NO3(nitrate ions)	50 ppm	70
10-	CL2 (Free chlorine)	Trace	0
11-	E.coli	< 10 per 100 ml.	> 10

Table (6)

Water borne diseases in Al-Kahlaa district among children under five years of age .

Month	Watery diarrhoea	Bloody diarrhoea
Oct..2003	180	42
Nov.	120	45
Dec.	190	37
Jan.2004	198	40
Total	688	164

Table(7)

Test of effluent water (waste water drewed to the river) of Amara Sewage treatment plant after rehabilitation.

NO.	Specification	International Standard limits	Present status
1-	PH	6 -9.5	8.5
2-	TDS(total dissolved solids)	< 1500 ppm	1200
3-	T.S.S(total suspended solids)	<60 ppm	70
4-	BOD (biological oxygen demands)	<40 ppm	40
5-	COD (chemical oxygen demands)	100 PPM	110
6-	So4(sulfate ions)	400 PPM	500
7-	CL (chloride ion)	600ppm	600
8-	PO4 (phosphate ions)	3 ppm	4
9-	NO3(nitrate ions)	50 ppm	45
10-	CL2 (Free chlorine)	Trace	Trace
11-	E.coli	< 10 per 100 ml.	< 10

Table (8)

Water borne diseases in Al-Kahlaa district among children under five years of age .

Month	Watery diarrhoea	Bloody diarrhoea
Feb..2005	53	12
Mar.	67	10
Ap..	60	17
May.	70	23
Total	250	62

Appendix -1- International Standards for drinking water

Parameters	WHO Recommended permissible limits
Water Temperature (c)	No value
PH	6,5----8,5
Turbidity (NTU)	<5,0
Conductivity (Us/cm)	<450
TDS (mg/1)	<248
Salinity (ppt)	0.4
Residual chlorine mg/1)	0.3—0.5 after 30 min disinfection
<i>E.coli</i>	0

Discussion

As shows in Table 1 most chemical parameters exceeds international standard specifications , whereas the bacteriological parameter refers to presence of contamination with sewage disposal pathogens , present result confirmed during the same table regarding to absence of residual chlorine in the tested water ,which means absence of water and sanitation facilities in targeted marsh area and spreading of *E.coli* in water samples (5.1) which raise the rates of water borne diseases such as diarrhoea cases to 139 (Table 2) especially among children under five years of age . Because it is relatively specific for faecal contamination, the faecal coliform measurement is preferred for monitoring raw water quality and for indicating the potential presence of pathogens at source.

It is also of value in testing untreated drinking water supplies. Any untreated supply that contains faecal coliforms should receive disinfection.

Table 3 shows that residual chlorine raised to 0.5 and inhibit growth of *E.coli* in water samples (zero *E.coli*)and improved water quality as a result of construction new water facilities in targeted villages of marsh area and led to decreasing rate of water borne diseases from 139 to 49 case as shown in Table 4 .so The presence of any type of coliform organism in treated water suggests either inadequate treatment or contamination and therefore should not be tolerated.

Table 5 shows chemical parameters exceeds international standard specification due to stop of running of sewage treatment plant in Amarah city and discharge waste water and sewage disposals under untreated case directly to the rivers ,which raise the rate of diarrheal cases to 688among children under five years of age in Al-Kahla`a district area (locates down stream Amarah sewage treatment plant) as shown in table 6.

During rehabilitation process of sewage treatment plant in Amarah city water quality of waste water and sewage influent were improved, thus contributed in decrease morbidity cases from 688 to 250 diarrhea cases among children under five years of age in Al-Kahla`a district as show in table 8.

It is also of value in testing untreated drinking water supplies. Any untreated supply that contains faecal coliforms should receive disinfection. The total coliform test, on the other hand, is less reliable as an indicator of faecal pollution. However, because of its superior survival characteristics, the total coliform group is preferred as an indicator of treatment adequacy in drinking water supply systems and the presence of any type of coliform organism in treated water suggests either inadequate treatment or contamination and therefore should not be tolerated.

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