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MICROBIAL QUALITY OF SOUTHERN IRAQI MARSHLAND WATER AND SEDIMENTS AFTER REHABILITATION IN 2003 AND IT'S SUITABILITY FOR DIFFERENT USES

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ABSTRACT

Microbial quality for water and sediments of Southern Iraqi Marshlands have been investigated after rehabilitation during 2003. The study was conducted during the period 2003-2004 in which both bacteria and fungi were detected. The study revealed that for bacteria detection it was found that some studied locations were polluted with presumptive *Salmonella and Shigella* while the presence of presumptive *Staphylococcus* indicated an evidence of possible food poisoning. Different fungal species including imperfect fungi, few species of Ascomycetes, and some species of the family Saprolegniaceae have been isolated from certain sites in marshes especially in Spring, while dermatophytes were not detected in all sites. It is concluded that water is unsuitable for drinking or agricultural purposes.

INTODUCTION

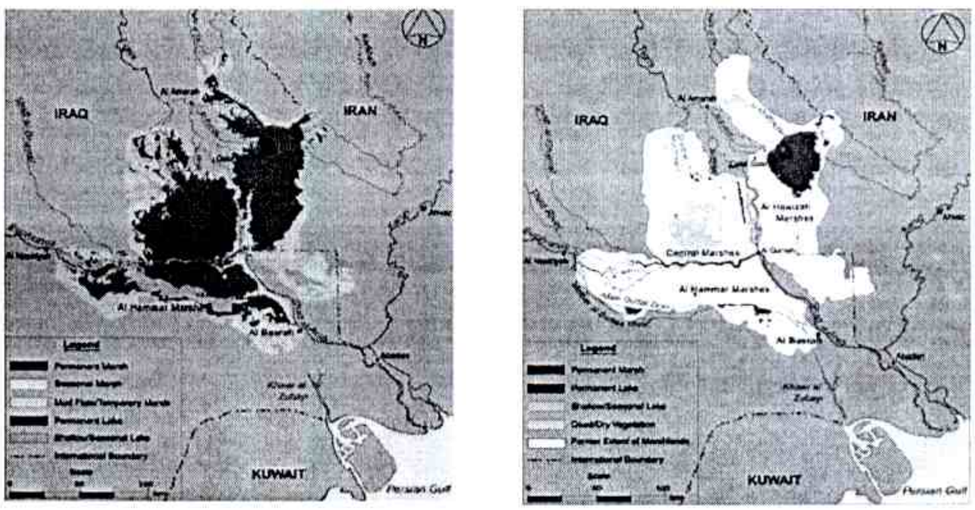
Lower Mesopotamian marshlands are situated mainly in southern Iraq (29° 55' –32° 45' N) and (45° 25' - 48° 30' E) and covered an estimated area ranging about 15000-20000Km^2 [Fig.1(A)].The formation of lower Mesopotamian marshlands have been affected by water management projects for Tigris – Euphrates Rivers System following the topography of their lower part (UNEP, 2001).

The Mesopotamian marshlands comprise the largest wetland ecosystem in the middle east and western Eurasia. it represented as home to ancient communities rooted in the dawn of human history. Inhabitants are commonly known as the Maadan or "Marsh Arab" whose population is estimated to range from 350.000 to 500.000

belongs to Sumerians and Babylonian. They have been recognize to constitute one of the world most significant wetlands on the earth. They provide habitat for important population of wild life including endemic and endangered species. (UNEP,2001).

Marshlands played as a key role in the inter – continental flyway of migratory birds and in supporting coastal fishers.According to the nature of bottom sediment in the basin of the marshland, they covered by natural wetland vegetation as common reed *Pharagmites communis* in the deepcore and reed mace *Typha angustata* in the ephemeral seasonal zone . (Al-Zubaidy, 1985).

Following the end of the second Gulf war in Feb. 1991, a massive hydro – engineering program was launched to drain the marshlands partly constructing saddam river on 7 Dec. 1992 as a part of drainge from irrigated land as shown in Fig.1(B).Intensive work to drain the central marshes was simultaneously underway in 1992. Earth embankments, ranging from six to 18 km in length,were subsequently created on the banks of the main Tigris distributors, which feeding the marshes, to prevent overtopping.



(A) (B)

Fig.1:Mesopotamian Marshlands: (A)- Land cover 1973-1976
(B)- Land cover 2000

Comparable to deforestation of Amazonian and desiccation of Aral Sea, the cumulative impacts of engineering construction and intensive drainage schemes in and around Mesopotamian marshlands have been devastating and summarized as follow (UNEP, 2001):

1.In less than a decade, one of the worlds largest and most significant wetland ecosystems has completely collapsed and leaving behind vast stretches of salt crusts.

2.According to land sate imagery from 1973 and 2000 it is concluded that an Arial changes in marshland habitat has achieved as environmental changes in the area of water and vegetation. Primary wetland disappeared between 1991 and 1995 3% of the wetland remained in 2000 of the central marshes while Al – Hammar marshes has been reduced to 6%.

3.Reduction in the discharge and changes in Tigris – Euphrates flow pattern and quality have an important impact not only on in land freshwater ecosystem, but also on the marine environment in the north-western Arabian Gulf, affecting the sea water salinity and regional fish resources.

4.As the marshlands began to rabidly dry out in the early 1995, the marsh Arabs were forced to flee.

5.Marsh water was also reported to have been poisoned with chemicals.

6.The social and economic livelihood of the Marsh Arabs(which essentially was refugee population) has fallen aspart.

7.Catastrophic impact on wildlife and biodiversity which go beyond Iraq's borders and were of regional and international importance.

8.Of major commercial importance is the seasonal migration of penaid shrimp between the Arabian Gulf and nursery grounds in the marshlands. The drying of the marshlands had an important impact on coastal fisheries in the northern Gulf.

9.Rapid desiccation of large areas of wetland and lakes is bound to have significant ramifications on the regional micro – climate. among these impacts are **:**

a-as the moderating role of the wetlands is eliminated, evapotranspiration and humidity rates will sharply decrease

b- Rainfall patterns will be modified.

c- Temperature will invariably rise particularly during Summer.

d - With salt crusts and dry marshlands soils exposed, wind – blown dust laced with various impurities will increase

e -Ecosystem degradation at seal many have serious drawbacks on human health.

f -Adjacent areas to the dried marshlands are suffer from degradation and desertification, caused by wined erosion and sand encroachment from the dried marsh bed and surrounding deserts.

Microorganisms (Bacteria and fungi) play main roles in decomposition processes in natural habitats (Gessner, 1980; Buchan *et al.,* 2003). The study of microbial quality of Southern Iraqi Marshlands water after reflooding is very important, because the people who lived in this regions use marsh water for many purposes: i. g. for human and animal drinking and agricultural purpose, so there is a need to know more about the microbial species found in this water to determine the serious microbes which can cause several diseases for those people. The main goal of this study is to determine the microbial genera which may be found in southern Iraqi marshland water after rehabilitation 2003 and its effect on the quality of the water used by the Arab marshlands.

MATERIALS AND METHODS

1- Sites of the study and sample collection

Sub-surface water and sediments were collected from the selected sites in Southern Iraqi Marshlands including: 1-El-Terabah village, and 2-Umm El-Warid Village in Al-Hawizeh marshes; 3-El-Herashieen Village, 4-Al-Fartos, and 5-El-Sadah in the Central marshes; and 6-El-Duboon, 7-El-Nagarah, and 8-El-Barghah in Al-Hammar marshes [Fig.2], during the period from Winter 2003 to Autumn 2004.Water samples were collected in sterile Nalgene polycarbonate flasks of 250 ml from the nearest point of the middle of the water flow, and sediment samples were collected by grab sampler and put in clean and sterilized plastic bags. Samples were kept in cool box and transferred to the laboratory for microbial analyses processes.

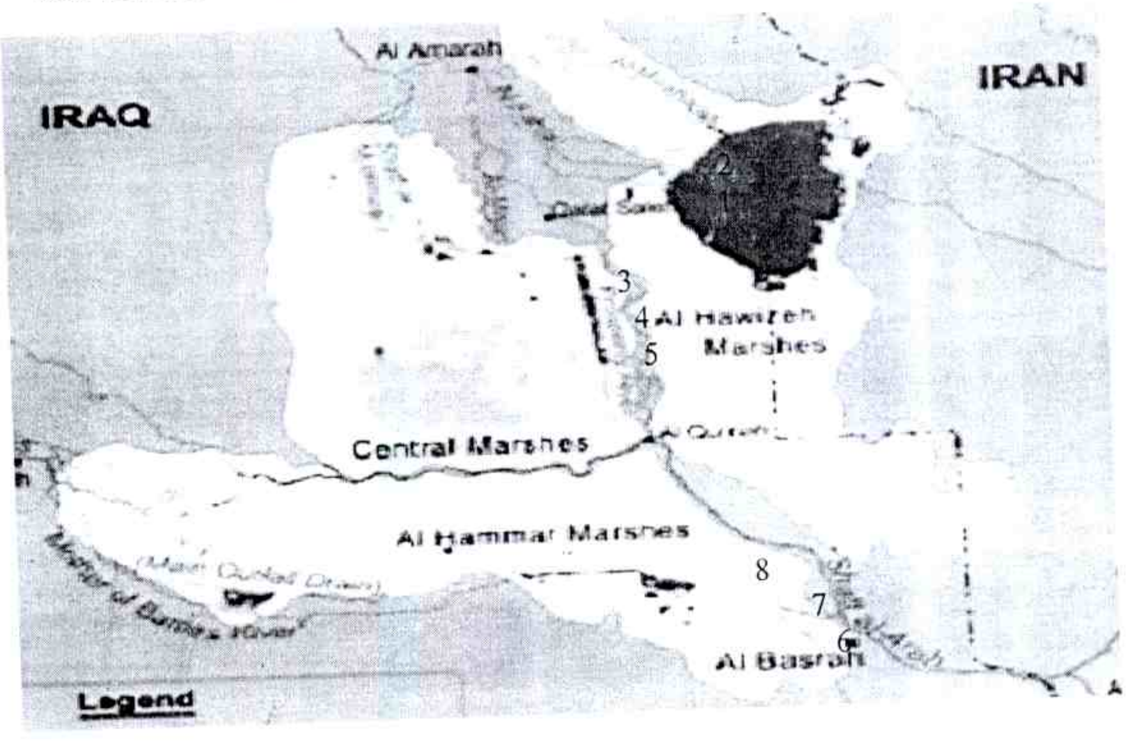


Fig.2: Location map of the sampling stations

2-Microbial analyses

Bacterial isolation: from each water sample 10 ml were taken and filtered through 0.45µm Millipore filter paper (WCN, Japan),from each sediment sample 1gm was diluted with D.W. to get the dilution of 10^{-3} cfu/ml, from this dilution 10 ml were filtered as mentioned above, the filtered samples were incubated on nutrient agar to determine the total plate count (TPC), and MacConkey agar to determine both total coliform (TC), and faecal coliform (FC), as well as *Salmonella-Shigella* agar to determine the two genera *Salmonella* ,*Shigella* and manitol salt agar for the determination of the genus *Staphylococcus* (*S*). The incubation period was 18-24 hours at 37 °C except for fecal coliform count which required a temperature of 44.5°C in a water bath then the numbers of growing colonies counted and the results were tabulated. Methods were preceded according to Partram &Weller (1997) and APHA (1995).

Fungal isolation: for the isolation of aquatic fungi, each water sample was shaken and poured in 9*9 cm Petri dishes, few previously boiled and spilt sesame seeds were placed in each Petri dish as bait. The Petri dishes were incubated at 22 °C and the sesame seeds were examined after every 24 hours for 5-6 days for any fungal growth that might have appeared. The colonized baits were then washed with sterilized distilled water and transferred to Petri dishes containing sterilized distilled water to which antibiotic Chloramphenicol (250 mg/L.) was added. These colonized baits were incubated at 22 °C and the developed colonies were examined regularly and identified, this method was preceded according to Muhsin (1977). For the isolation of fungi other than the aquatic fungi, one ml of each water sample were mixed with 25 ml of unsolidified Potato Dextrose Agar (PDA) medium (at 45 °C) to which Chloramphenicol (250 mg/L.) was added in 30 ml vials, shacked gently for mixing then poured in 9*9 cm Petri dishes and left to solidify and incubated at 25 °C for 5-7 days, at the same time, 0.1 ml of each water sample were spread on the surface of PDA with Chloramphenicol plates by L-shaped glass rod spreader and incubated at 25 °C for 5-7 days and the all developed colonies were examined and identified using the following literatures : Ellis (1976) ; Frey *et al.* (1979) ; Domash *et al.*, (1980) and de Hoog and Guaro (1995).

RESULTS AND DISCUSSION

Table (1): Number of presumptive bacteria isolated from water (CFU/100 ml) and sediments (CFU/1 gm) from selected sites in Southern Iraqi marshlands in Winter 2003.

Stations	Winter 2003									
	FC		TC		TPC		S-S		St	
	W'	S	W	S	W	S	W'	S	W	S
1.El-tarabah	Nil	Nil	Nil	Nil	UC	UC	Nil	Nil	ND	Nil
2. Umm El-Ward	Nil	Nil	Nil	2	UC	UC	Nil	Nil	ND	Nil
3. Al-Herasheen	Nil	Nil	Nil	5	UC	UC	Nil	Nil	ND	Nil
4. Al-Fartos	Nil	Nil	Nil	Nil	UC	UC	1	Nil	ND	13
5. El-Saddah	4	Nil	3	Nil	UC	UC	12	Nil	ND	45
6. Al-Doboon	9	Nil	Nil	7	UC	UC	Nil	Nil	ND	12
7.Al-Nagharah	Nil	Nil	Nil	35	UC	UC	Nil	Nil	ND	Nil
8.Al-Barghah	Nil	Nil	Nil	42	UC	UC	Nil	Nil	ND	Nil

W=Water; S= Sediment; FC= Fecal Coliform; TC= Total Coliform; TPC=Total Plate Count;
SS= Salmonella-Shigella; *St= Staphylococcus;* UC=Uncountable; ND=None Detectable

Table (2):Number of presumptive bacteria isolated from water (CFU/100 ml) and sediments (CFU/1 gm) from selected sites in Southern Iraqi marshlands in Spring 2004.

Stations	Spring 2004									
	FC		TC		TPC		S-S		St	
	W'	S	W	S	W	S	W'	S	W	S
1.El-tarabah	Nil	Nil	Nil	Nil	UC	UC	Nil	Nil	ND	Nil
2. Umm El-Ward	4	Nil	3	2	UC	UC	12	Nil	ND	Nil
3. Al-Herasheen	19	Nil	1	5	UC	UC	12	Nil	ND	Nil
4. Al-Fartos	-	-	-	-	-	-	-	-	-	-
5. El-Saddah	-	-	-	-	-	-	-	-	-	-
6. Al-Doboon	Nil	Nil	Nil	Nil	411	-	1	-	8	-
7.Al-Nagharah	Nil	Nil	4	-	276	-	Nil	-	Nil	-

W=Water; S= Sediment; FC= Fecal Coliform; TC= Total Coliform; TPC=Total Plate Count;
SS= Salmonella-Shigella; *St= Staphylococcus;* UC=Uncountable; ND=None Detectable

Table (3):Number of presumptive bacteria isolated from water (CFU/100 ml) and sediments (CFU/1 gm) from selected sites in Southern Iraqi marshlands in Summer 2004.

Stations	Summer 2004									
	FC		TC		TPC		S-S		St	
	W	S	W	S	W	S	W	S	W	S
1.El-tarabah	1300		3100		UC		Nil		UC	Nil
2. Umm El-Ward	200		Nil		UC		Nil		UC	Nil
3. Al-Herasheen	Nil		Nil		UC		Nil		UC	Nil
4. Al-Fartos	-		-		-		-		-	-
5. El-Saddah	Nil		Nil		UC		Nil		UC	Nil
6. Al-Doboon	Nil		Nil		UC		Nil		UC	Nil
7.Al-Nagharah	100		Nil		UC		Nil		UC	Nil
8.Al-Barghah	Nil		Nil		UC		Nil		UC	Nil

W=Water; S= Sediment; FC= Fecal Coliform; TC= Total Coliform; TPC=Total Plate Count;
SS= Salmonella-Shigella; *St= Staphylococcus;* UC=Uncountable; ND=None Detectable

Table (4): Number of presumptive bacteria isolated from water (CFU/100 ml) and sediments (CFU/1 gm) from selected sites in Southern Iraqi marshlands in Autumn 2004.

Stations	Autumn 2004									
	FC		TC		TPC		S-S		St	
	W	S	W	S	W	S	W	S	W	S
1.El-tarabah	65	Nil	Nil	15	UC	UC	UC	Nil	UC	UC
2. Umm El-Ward	UC	1	150	16	UC	UC	UC	Nil	UC	123
3. Al-Herasheen	Nil	3	Nil	38	UC	UC	UC	Nil	120	Nil
4. Al-Fartos	Nil	2	3	9	UC	UC	Nil	Nil	61	UC
5. El-Saddah	-	-	-	-	-	-	-	-	-	-
6. Al-Doboon	12	139	7	3	UC	UC	11	Nil	Nil	UC
7.Al-Nagharah	2	Nil	25	27	UC	UC	Nil	Nil	Nil	UC
8.Al-Barghah	1	17	2	3	UC	UC	Nil	Nil	UC	UC

W=Water; S= Sediment; FC= Fecal Coliform; TC= Total Coliform; TPC=Total Plate Count;
SS= Salmonella-Shigella; *St= Staphylococcus;* UC=Uncountable; ND=None Detectable

Table (1) showed the bacterial counts in Winter 2003. All sediment samples and the majority of water samples from Southern Iraqi Marshlands were free of FC which gives evidence that there is no recent fecal pollution, this may be because the new reflooding of this region with water . For TC there are 5 sites which undergo old fecal pollution and there is a possibility for the presence of pathogenic bacteria. These results are corporated with the appearance of presumptive *Salmonella* which causes typhoid fever and presumptive *Shigella* which can cause bacillary dysentery, as well as appearance of *Staphylococcus* which causes acute food poisoning.

Results of bacterial counts in Spring 2004 were tabulated in Table (2). For FC in water samples most of the studied stations were free from FC but in two stations, whereas in all sediments samples there were no FC recorded. For TC there were 3 water samples as well as two sediment samples which showed the presence of TC. There were 2 stations showed the presence of presumptive *Salmonella-Shigella* but all sediment samples were free. Presumptive *Staphylococcus* sp. appeared in one station and no sediment sample showed the presence of these bacteria.

In Table (3) the results of bacterial counts in Summer 2004 were recorded, 3 stations showed the presence of FC while only one station in which TC were recorded neither SS nor *Staphylococcus* were appeared.

Table (4) showed the results of bacterial counts in Autumn 2004, 5 stations showed pollution of water and sediment samples with FC.TC were appeared in 5 water samples and 7 sediment samples. Presumptive SS appeared in 2 stations in water samples but no sediment sample showed these bacteria. Presumptive *Staphylococcus* were recorded in 4 stations for both water and sediment samples.

The presence of bacteria and pathogenic (disease-causing) organisms is a concern when considering the safety of drinking water. Coliform bacteria may not cause disease, but can be indicators of pathogenic organisms that cause diseases (Oram, 2006). Water pollution caused by fecal contamination is a serious problem due to the potential for contracting diseases from pathogens (disease causing organisms). Frequently, concentrations of pathogens from fecal contamination are small, and the number of different possible pathogens is large (New York State Department of Health, 2005). The US EPA Maximum Contaminant Level (MCL) for coliform bacteria in drinking water is zero (or no) total coliform per 100 ml of water (EPA, 2006). When this standard level is compared with our findings it seems clearly that the water is unsuitable for any human and agricultural purposes.

For the fungal species isolated from Southern Iraqi marshlands, it is apparent that the most dominant species among the identified fungi are

Aspergillus terreus followed by *A. flavus* , *Penicillium* sp., many species of imperfect fungi and few Ascomycetes have been isolated from water during this study (Table 5). These fungi are widely spread in different environments and have a wide range to resist temperature, acidity dryness and increase of water salinity of this water (Abdul-Kadir, 1985). Some species of the Family Saprolegniaceae have been isolated from many studied sites especially in Spring, members of this family are important in decomposition of plant residues (Newton, 1971), but from water samples of the other sites, aquatic fungi have not been detected. These results are agreement with the results of Muhsin (1977) and Abdul-Kadir (1985). Fungal species have been isolated from water samples in high densities and this is may due to the polluted water of Iraqi Marshlands after rehabilitation 2003. Dermatophytes have not been isolated during this study duo to the lack of cyclohexamide which is necessary for the isolation of dermatophytic fungi.

Table (5): Fungal species isolated from water samples from selected sites in Southern Iraqi Marshlands at Spring- Summer 2004.

NO	Stations	Fungal species
1	El-tarabah	*Absidia* sp.; *Acremonium* sp.; *Aspergillus candidus; A. flavus; A. niger; A. terreus; Chrysosporum tropicum; Cladosporium* sp.; *Fusarium* sp.; *Paecilomyces variotii; Penicillium* sp.; *Saprolegnia* sp.; *Trichoderma viride.*
2	Umm El-Ward	*Absidia* sp.; *Achlya* sp.; *Alternaria altrnata; A. chlamydospora; Aspergillus candidus; A. flavus; A. terreus; Cladosporium herbarum; Fusarium* sp.; *Penicillium* sp.; *Saprolegnia* sp.; *Trichoderma viride;* Yellow Sterile Mycelia.
3	Al-Herasheen	*Achlya* sp.; *Alternaria altrnata; Aspergillus candidus; A. flavus; A. terreus; Geotrichum candidum ; Penicillium* sp.; *Rhizopus* sp.; Yeasts.
4	Al-Fartos	*Absidia* sp.; *Alternaria* sp.;*Aspergillus flavus; A. niger; A. terreus; Penicillium* sp.; Yeasts; Yellow Sterile Mycelia.
5	Al-Doboon	*Aspergillus flavus; A. fumigatus; A. niger; Chrysosporum tropicum; Fusarium* sp.; *Paecilomyces variotii; Phoma cava; Saprolegnia* sp.; *Trichoderma viride.*
6	Al-Nagharah	*Aspergillus flavus; A. terreus; Fusarium* sp.; *Geotrichum candidum; Penicillium* sp.;*Phoma cava; Rhizopus* sp.; *Saprolegnia* sp.; *Trichoderma viride; Ulocladium* sp.; Yeasts; White Sterile Mycelia.
7	Al-Barghah	*Absidia* sp.; *Acremonium* sp.; *Alternaria altrnata; Aspergillus candidus; A. flavus; A. niger;Cladosporium herbarum;Phoma* sp.; *Rhizopus* sp.; *Saccaromyces* sp.; White Sterile Mycelia; Yellow Sterile Mycelia.

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النوعية الميكروبية لمياه وترسبات أهوار جنوب العراق بعد أعادة التأهيل 2003 وصلاحيتها للاستخدامات المختلفة

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الخلاصــة

أجريت الدراسة الحالية لتحديد النوعية الميكروبية (البكتريا والفطريات) في مياه وترسبات أهوار جنوب العراق بعد أعادة التأهيل عام 2003 خلال الفترة مــن شتاء 2003 ولغاية خريف 2004.فيما يخص البكتريا فقد بينت الدراسة تلوث مياه الأهوار في المناطق المدروسة ببكتيريــا *Salmonella* و *Shigella* ، كما أظهرت النتائج وجود بكتيريا *Staphylococcus* التي مــن الممكــن أن تسبب التسمم الغذائي. وأظهرت الدراسة الحالية وجود أنــواع مختلفــة مــن الفطريات شملت فطريات ناقصة Deuteromycetes وأنواع قليلة تعود إلى مجموعة الفطريات الكيسية Ascomycetes وبعض الأنواع التي تعــود إلـــى عائلة Saprolegniaceae والتي عزلت من بعض المواقــع فـــي الأهــوار وخاصة في فصل الربيع، ولم تعزل في الدراسة الحاليــة أنــواع تعــود إلـــى مجموعة الفطريات الجلدية Dermatophytes في المواقع جميعها. وتوصلت الدراسة إلى عدم صلاحية مياه الأهــوار لأغــراض الــشرب أو الزراعـــة.